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Integrated Water Resources Management – The Orange-Senqu River Basin in South Africa

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ABSTRACT

Water is essential to all forms of life. It is the key driver of social and economic development and is essential in maintaining the integrity of the natural environment. In spite of this, water resources are unequally distributed. Furthermore, population growth, rising water pollution and the impacts of climate change will result in increasing competition between different water users over water resources. As the traditional sectoral and fragmented management approach often results in the unsustainable management and use of water resources, Integrated Water Resources Management has become internationally accepted as the most promising approach for achieving efficient and equitable management of water resources and sustainable development.

This Master thesis explores the concept of IWRM in the Orange-Senqu river basin in South Africa. The basin is located in a semi-arid region and is characterised by naturally high climate variability. As the basin is already facing physical water scarcity, an increasing water demand for agricultural, economic and household purposes, and declining water quality due to pollution; water demands are likely to exceed the water supply in the basin. Furthermore, climate change is likely to increase natural climate variability that already affects people's livelihoods and is therefore excepted to impact both the society and ecosystem of the basin.

Although the South African water governance provides the legal framework basis for sustainable social, economic and environmental development, concerns over water quantity and quality are becoming stronger. Therefore, an integrated approach of water management is becoming more important. Building upon this theoretical framework, this thesis seeks to identify challenges to the implementation of IWRM within the basin. Therefore, 14 in-depth interviews with relevant experts in South Africa have been conducted. During the research process, three main hypotheses were generated. They discuss the disparity between South Africa's legal framework for IWRM and it's actual implementation in the basin, the involvement of users in participatory decision-making in water development and management and the importance to integrate climate change into water management strategies to achieve sustainable development.

The study concludes, that several aspects such as lacking horizontal and vertical cooperation between sectors and levels, a general lack of capacities and lacking participation of certain stakeholders, highly affects successful implementation of IWRM. However, a summary of promising recommendations made by the experts has been compiled that would contribute to improved water management within the basin.

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LIST OF ACRONYMS AND ABBREVIATIONS

AMCOW: African Ministerial Council on Water

AWIRU: African Water Issues Research Unit/University of Pretoria

CMA: Catchment Management Agency

CBO: Community-based Organisation

DWAF: Department of Water Affairs and Forestry, South Africa

GIZ: Gesellschaft für Internationale Zusammenarbeit

GWT - Global Water Partnership

IPCC - Intergovernmental Panel on Climate Change

IUCN: International Union for Conservation of Nature and Natural Resources

IWMI: International Water Management Institute

IWRM – Integrated Water Resources Management

MDGs: Millennium Development Goals

NEPAD: New Partnerships for Africa's Development

NGO: Non-govermental organisation

NWA: National Water Act

NWRS: National Water Resource Strategy

ORASECOM: Orange-Senqu River Commission

SADC: Southern Africa Development Community

UN: United Nations

UNDP: United Nations Development Programme

WISA: Water Institute of Southern Africa

WHO: World Health Organisation

WRC: Water Research Commission

1 Introduction

The United Nations General Assembly has recognized safe freshwater and sanitation as both a fundamental need and universal human right (UN 2010).

Water is necessary to all forms of human, animal and plant life. It is essential for overall human well-being and supports all aspects of human livelihoods. Furthermore, water plays an essential role in supporting productive human activities such as agricultural, energy and industrial production, sanitation, transportation services, fishing and tourism (UNEP 2009, KUNDZEWICZ ET AL. 2007, XIE 2006). According to GLOBAL WATER PARTNERSHIP (2009:6) "[…] water issues touch all segments of society and all economic sectors". But water resources are not only for social and economic benefits, they must also be recognized as fragile and limited natural resources that are an integral component of ecosystems, thus providing essential ecosystem services[1] for the human beings. The access to water is often used as a key indicator for development (ORASECOM 2012).

According to the UN-Water Global Annual Assessment of Sanitation and Drinking Water (GLAAS) implemented by the World Health Organisation (WHO) in 2010, around 900 million people[2] of the 7.1 billion people on our earth do not have access to safe water[3] and 2,6 billion do not have access to basic sanitation[4] or live without improved sanitation facilities. A lack of access to safe and sufficient drinking water is widely recognized as a poverty[5] indicator (KOPPEN ET AL. 2002). Due to a lack of access to safe drinking water and basic sanitation, water-borne diseases are estimated to kill approximately 1.6 million people a year, with the majority of deaths being children under 5 years (90 %) in developing countries (WHO 2013). Target 7a of the

1 *The Millennium Ecosystem Assessment (2005: 27) defines ecosystem services as (2005: 27): "[...] the benefits people obtain from ecosystems. These include provisioning services such as food and water; regulating services such as regulation of floods, drought, land degradation, and disease; supporting services such as soil formation and nutrient cycling; and cultural services such as recreational, spiritual, religious and other non-material benefits".*

2 *According to the author's literature review, the number of people without access to safe water differs among authors by between 900 million and up to 1.3 billion.*

3 *Acording to the Who, "[a]ccess to safe drinking water is defined as the proportion of people using improved drinking water sources: household connections; public standpipes; boreholes; protected dug wells; protected springs; and rainwater. Access to drinking water means that the source is less than 1 kilometer away from its place of use and that it is possible to reliably obtain at least 20 litres per member of a household per day, while safe drinking water is water with microbial, chemical and physical characteristics that meet WHO standards" (see Who 2013).*

4 *The WHO (2013) defines basic sanitation as following: "Basic sanitation is the lowest-cost technology ensuring hygienic excreta and sullage disposal and a clean and healthful living environment both at home and in the neighborhood of users. Access to basic sanitation includes safety and privacy in the use of these services. Coverage is the proportion of people using improved sanitation facilities: public sewer connection; septic system connection; pour-flush latrine; simple pit latrine; ventilated improved pit latrine".*

5 *The World Bank defines poverty as a state and process of multi-dimensional deprivation, affecting economic, health- related, psychological, socio-cultural, legal and political facets of wellbeing (Koppen et al. 2002).*

Millennium Development Goals[6] (MDGs) pursue the objective to "half the proportion of the population without sustainable access to safe drinking water and sanitation by 2015" (UN 2012). Although two billion people gained access to improved water sources between 1990 and 2010 (almost half of them live in China and India) and an estimated 89 % of the global population currently use improved drinking water sources[7], in 2012 over 780 million people still remain without access to improved drinking water sources. There exist large regional disparities; while 90 % or more of Latin America, the Caribbean, Northern Africa and large parts of Asia are covered by improved water supply, in Sub-Sahara Africa this figure is only 61 %. Further disparities are found between the rich and poor, and between people living in rural and in urban areas (UNICEF & WHO 2012).

In the coming decades, the global water demand will primarily grow due to population and economic growth, rapid urbanisation and the increasing demand for food and energy (GWP 2009). While the global demand for water resources continues to increase, in many parts of the world the quantity and quality of water resources are diminishing (VÖRÖSMARTY ET AL. 2005). Competition for water use and conflicts are likely to increase as societies face a number of social, economic and political challenges on how to govern water wisely, especially in respect to climate change (TAYLOR 2001).

However, the global water crisis is considered to be more a crisis of water governance than a crisis of physical water scarcity (XIE 2006). The water crisis is "[…] the widespread and well-articulated concern that the planet's freshwater resources are coming under increasingly unsustainable pressure from rising populations, growing demands for water and increasing pollution" (MORIARTY ET AL. 2004:1). In combination, water scarcity and poor governance impede the achievement of water security. Today, more than two billion people in 40 countries live in river basins that are considered to be water stressed (see XIE 2006). According to predictions of the Stockholm Environment Institute (SIWI), the world's population living in areas of significant water stress will increase from around 34 % in 1995 to 63 % in 2025 (see MORIARTY ET AL. 2004). But asides from physical water scarcity, a lack of access to safe water can be traced back to technical issues such inefficient water use or a lack of adequate involvement of local

6 *The MDGs were established by the United Nations in 2000 and contain eight international development goals addressing hunger and poverty, universal education, gender equality, child and maternal health, HIV/AIDS, environmental sustainability and global partnerships. All 193 member states have agreed to achieve the goals by 2015 (Un 2012).*

7 *According to Vörösmarty et al. (2005: 197) "Improved water supply includes household connections, public standpipes, boreholes, protected dug wells, protected springs, and rainwater harvesting systems [...] Improved sanitation technologies include connections to a public sewer, connections to a septic system, pour-flush latrines, simple pit latrines, and ventilated improved pit latrines. Excreta disposal systems are considered adequate if they are private or shared (but not public) and if they hygienically separate human excreta from human contact. "Not improved" sanitation systems are service or bucket latrines (where excreta are manually removed), public latrines, or open pit latrines"*

communities, which is estimated to account for 50 % of projects failure (Blue Planet Network 2013). Inadequate governance structures, uneven power relations, poverty, inequality within societies and isolated, fragmented planning without cooperation between different water user sectors and stakeholders lead to inefficient use of water resources. Apart from population and economic growth which often leads to excessive water extraction, erosion of river catchments, increased industrial pollution and and municipal waste is considered to further degrade water quality and hence reduce the quantity of usable waters (BIGAS 2012, XIE 2006). Furthermore, climate change is thought to have overall negative impacts on water resources such as changes in the hydrological cycle, creating increased rainfall variability, more frequent and intense floods and droughts and further degradation of water bodies (GWP 2012). Alongside other human activities, it is presumed to be one of the major factors that puts pressures on the world's freshwater resources, thus increasing the vulnerability of human beings and ecosystems (KUNDZEWICZ ET AL. 2007). As climate change is expected to increase global water stress in terms of surface and groundwater supplies, many countries will face new challenges in the water sector (ALAVIAN ET AL. 2009). In spite of this, current water management practices are estimated to be inadequate to meet the demands of the growing population, or to reduce the negative impacts of climate change (KUNDZEWICZ ET. AL 2007).

Therefore, sustainable management of freshwater resources is a key development priority to meet the growing demand of the world's population for water and to achieve a secure and sustainable water future (GWP 2012, WHO 2010, UNEP 2008). Water security forms the foundation of food and energy production and of overall long-term social and economic development (BIGAS 2012).

The concept of Integrated Water Resource Management has emerged in response to the global `water crisis´ and is nowadays the most accepted approach in achieving sustainable water management and therefore, water security (IPCC 2007, KUNDZEWICZ ET AL. 2007, GWP 2009). It is widely recognized, that improved water resource management is a major step toward achieving a more equitable, prosperous world (BMU 2001). Cooperation across sectors represents one of the most important issues for successful Integrated Water Resource Management (IWRM) implementation (BIGAS 2012). Also, investments in research and development in water technologies, systems, treatment, use and productivity, all support sustainable water management. Sustainable management of water resources[8] requires the participation of all members of society and requires important changes to policy, legal and institutional structures

8 *The term "sustainable use of water resoures" is explained in Chapter 2.4*

(TAYLOR 2001). It is recognised that connecting different water users promotes the wiser uses of water resources so as to achieve long-term sustainability by promoting fairer water sharing among competing users (GWP 2012). According to IPCC (2007:196), "[…] [s]uccessful integrated water management strategies include, among others [...] [the] consideration of climate change".

Successful IWRM implementation results in economic efficiency and social equity without compromising ecological sustainability. Its takes climate change into account, and considers the (competing) interests of different sectors and water users to achieve overall water security und sustainable development (GWP 2013, UNDP 2006).

1.1 Problem Diagnosis

According to UN standards, South Africa is officially classified as water-scarce country (MULLER ET. AL 2009, BIGGS ET AL. 2004). Due to it's geographical location in a semi-arid area as well as it's growing population, increasing water demand, inadequate water use or management practices and increasing pollution issues, South Africa is facing many challenges in the water sector to achieve water security (DWAF 2012). Furthermore, South Africa is not only a contributor to climate change because of it's high greenhouse gas emissions, the country is also highly vulnerable to the impacts of climate change. Increasing temperatures and changes in precipitation patterns and intensities will affect the hydrological cycle, the ecosystems and peoples' livelihoods. The South African Department of Water Affairs and Forestry (DWAF 2012) acknowledges, that the country faces serious challenges in the water management area despite adequate water management policies. The highly variable climate, associated flood and droughts risks, the potential impacts of climate change and the further depletion of water quality raise the need for adequate approaches to provide water security and sustainable development.

This thesis focuses on the Orange-Senqu river basin in South Africa. Although the basin is shared by four countries, namely South Africa, Lesotho, Namibia and Botswana, the focal point of this Master thesis is on basin area in South Africa. The water resources of the basin are mainly used for economic activities such as agriculture, industries such as mining and energy production and for household consumption. According to the Orange-Senqu River Commission (ORASECOM, 2013), the Orange-Senqu river basin is highly affected by water scarcity and thus in need of strong governance for the effective and equitable use and allocation of water resources, in a way that considers user needs. ORASECOM (2013) indicates, that the expansion of agricultural and industrial activities, the population growth and the current trends of socio-economic development in South Africa make it impossible to sustain current water consumption levels. If water use continues to be inefficient and without integrated approaches to manage the

scarce resource wisely, it is predicted that fresh water supply will no longer meet the demands of the growing population and industry by 2030. In spite of this, water consumption levels of the main water consumers (agriculture, industry, mining and domestic use) keeps on growing (ORASECOM 2013). Water supply is becoming further stressed by increasing levels of pollution, especially in densely populated areas such as Johannesburg, Pretoria and the Vaal Triangle and the water resources of the basin are thought to have already reached a critical stage.

The supply and demand for water resources in the basin have to be addressed soon, or else water scarcity will become a constraint for sustainable development in the Orange-Senqu river basin of South Africa (ORASECOM 2013). As IWRM is considered to be the adequate response in order to achieve water security in the Orange-Senqu river basin (ORASECOM 2013), it's implementation therefore forms the focus of analysis in this master thesis.

1.2 Objectives and Research Questions

The objectives of this master thesis are three-fold: the first and foremost objective is to analyse the difference between the water governance framework in South Africa (based upon literature review) and the factors that constrain successful IWRM implementation in the Orange-Senqu river basin (based upon conducted interviews). Secondly, it examines participatory decision-making opportunities of water development and management between different water users in the basin. Thirdly, it wishes to identify factors that would support the successful implementation of IWRM in the basin.

In order to address these objectives, the following research questions have been devised:

- Which factors contribute to the disparities between South Africa´s water governance framework and the actual implementation on ground level which hinder sustainable water development and management in the basin?
- Are all water users equally involved in decision-making of water development and management?
- Which factors would support the successful implementation of IWRM in the basin?

The analytical framework builds upon the sustainability context, as well as on the IWRM concept itself and the political framework for water management in South Africa. The goal of the methodology is to attain information on the factors that constrain IWRM implementation in the basin as well as factors that contribute to successful implementation. As climate change impacts

the hydrological cycle and therefore the socio-economic and environmental development in the basin, the interlinkages to water management will also be pointed out.

Therefore, the sub-questions can be summarized as follows:

- What does sustainability mean in the context of IWRM?
- What are the core ideas, the principles and the goals of Integrated Water Resource Management and why is IWRM important?
- Which legislation and Acts define the legal framework for (sustainable) water development and management in South Africa? Which differences do the interview partners identify as a ´reality´ that constrains successful IWRM implementation in the basin?
- What are the impacts of climate variability and change in the basin and what does this mean for water management in the basin?
- What are stakeholder's recommendations for sustainable water management in the Orange-Senqu river basin?

1.3 Structure of Work

This chapter has provided a brief overview of the global water crisis, the demand for an integrated water management approach and has also presented the objectives and research questions of this thesis. The next and second chapter provides the theoretical framework of this thesis, based on the current state of research and with the help of a relevant literature review. It presents the sustainability framework in context with the water sector, the IWRM concept in terms of its definition, history, its principles and main objectives. The chapter will continue with looking at the role of the political framework of IWRM and present South Africa's most important legislations with regards to water management. Afterwards it summarizes the most important aspects for the essential need of an integrated water management approach. The third chapter gives an overview of geographical and socio-economic aspects as well as climate changes and variability in the Orange-Senqu river basin. The fourth chapter discusses the methodology used in the thesis. The fifth chapter presents the results of the empirical work. Then, the sixth chapter analyses and discusses the previous results according to the three hypotheses that were developed during the research process. Furthermore, it presents stakeholders recommendations for the successful implementation of IWRM in the basin. Finally, the last chapter concludes the findings of this thesis, discusses the limitations of this work and provides an outlook by giving recommendation for future areas of research.

2 Literature Review and Theoretical Framework

This chapter gives an overview of the current state of research and provides the relevant theoretical framework for this Master thesis.

As previously discussed, the aim of this work is to analyse the disparity between the water governance framework in South Africa and the actual implementation on the ground, secondly to identify participatory decision-making opportunities for water development and management between different water users in the basin and thirdly, to identify factors that would support the successful implementation of IWRM in the basin.

2.1 The Sustainability Framework in the context of Water

Sustainable development is defined as "[...] development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (UN 1987). Since the Earth Summit in 1992, the concept of sustainable development has been the leading paradigma by which to alleviate hunger and poverty and is one of the most frequently cited concepts (YOHE ET AL. 2007, MEDEMA & JEFFREY 2005). The concept of sustainable development integrates three dimensions: the economic, the ecological and the human/social dimension (YOHE ET AL. 2007). In 2000, eight international development goals were established to achieve sustainable development and all 189 United Nations member states have agreed to achieve these goals by 2015. The eight international development goals are as follows (UN 2013):

1. Eradicating extreme poverty and hunger,
2. Achieving universal primary education,
3. Promoting gender equality and empowering women,
4. Reducing child mortality rates,
5. Improving maternal health,
6. Combating HIV/AIDS, malaria, and other diseases,
7. Ensuring environmental sustainability, and
8. Developing a global partnership for development

Water is a key factor in achieving the Millennium Development Goals. Water plays a key role for food security, poverty reduction, economic growth, energy production and the human well-being, thus highlighting the multiple linkages between water, poverty and development. A lack of access to safe and sufficient drinking water is widely recognized as a dimension of poverty. The World Bank defined poverty as a state and process of multidimensional deprivation, affecting economic, health-related, psychological, socio-cultural, legal, and political facets of well-being (KOPPEN ET AL. 2002). Although the UN declared the access to safe and sufficient water as a human right, certain groups often lack access to water that could considerably increase their

enterprise productivity and reduce their vulnerability to droughts and climatic changes (see KOPPEN ET AL. 2002). OECD (2013) defines vulnerability as "[…] a measure of the extent to which a community, structure, service or geographical area is likely to be damaged or disrupted, on account of it's nature or location, by the impact of a particular disaster[9] hazard". Hazards in this context, might include climate change impacts such extreme weather events like droughts or floods. The UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE (UNFCCC) defines climate change as: "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods" (UNFCCC 2013). With regards vulnerability to climate change, this is "[…] the degree to which geophysical, biological and socio-economic systems are susceptible to, and unable to cope with, adverse impacts of climate change" (YOHE ET AL. 2007). Without adequate adaptation measures, climate change is considered to severely affect economic, social objectives and ecological aspects (YOHE ET AL. 2007). Furthermore, as climate change affects human security, the impacts and increasing frequencies and magnitudes may well overwhelm the adaptive capacities of societies (see SCHEFFRAN ET AL. 2009). Adaptation, which is the "[...] capacity of a social, natural, physical system to tolerate disturbance and external shocks without collapsing into a qualitatively different, usually undesired, state" aims at reducing vulnerability and enhancing resilience to climate variability and change (DESSAI, S. & J.VAN DER SLUIJS 2007:39). Systems with high adaptive capacities are able to structure and re-organise themselves after disturbances which makes resilience a key component in enhancing adaptive capacity (RESILIENCE ALLIANCE 2013). Sustainable development is dependent of the adaptive capacities of people and ecosystems to sustain stress and shocks, such as the impacts of climate change. Adaptive capacities can be built not only through adequate governance frameworks and planning strategies, but also through education, health and well constructed infrastructure. Adequate climate change policies should reduce vulnerabilities and enhance the resilience and adaptive capacities of economies and communities, thus resulting in the achievement of sustainability goals.

Both are strongly interlinked: reduced resilience (e.g. through inadequate involvement in water management) generally increases the vulnerability of a system (e.g. a community) to smaller disturbances or shocks that it could previously cope with (RESILIENCE ALLIANCE 2013). Resilient social systems enhance peoples' capacity to plan for the future, and to adapt to unanticipated conditions, while adaptation increases the resilience of social-ecological systems.

9 The UN/ISDR (United Nations International Strategy for Disaster Reduction) defines a disaster as "A serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources" (UN/ISDR 2004)

Sustainability and IWRM

Sustainable water management aims to reduce vulnerability and enhance resilience so to achieve its overall goal: water security and therefore sustainable development for people and ecosystems. IWRM aims at achieving sustainable water management through economic efficiency, social equity and environmental sustainability (GWP 2013). One of the major principles that drives IWRM is the involvement of *all* stakeholders in water management, especially women who are traditionally often disadvantaged. The involvement of local communities is considered to enhance their resilience, for example to deal with the impacts of climate change. To promote participation, decentralisation and capacity building play a vital role in order to adequately involve local communities (CAP-NET 2009, GWP 2012). Local community involvement is a key component to achieving sustainable development and the implementation of IWRM.

According to UFZ (2011), capacity building is a process which improves existing skills, strengthens problem solving abilities and creates knowledge. Capacity, is the sum of skills, abilities and qualifications of people. There is an urgent need for additional skills in the management of water resources, institutional reforms, conflict resolution, social and communication skills in the existing and new water managers. Thus, the implementation of capacity building is becoming more important, as it highly contributes to sustainability in the water sector. Inadequate capacity has been identified as a recurring issue preventing the achievement of many national and international sustainability goals, such as poverty reduction or improved access to safe water supply and sanitation.

In order to meet the demands of population growth, changes in consumer behavior, increasing pollution of water bodies and the impacts and prediction uncertainties of climate change, sustainable water management is key to achieving sustainable development in the 21st Century. According to GWP (2013), sustainable development can only be achieved with a water secure world. A water secure world reduces poverty and increases living standards, especially for the most vulnerable. The GWP (2012) defines water security as:

> "[…] a world where every person has enough safe, affordable water to lead a clean, healthy and productive life [...] [It] reduces poverty, advances education, and increases living standards. It is a world where there is an improved quality of life for all, especially for the most vulnerable [...] who benefit most from good water governance".

To achieve water security, an ´integrated´ approach is important. The idea of ´Integration´ was developed to replace the traditional, fragmented and uncoordinated use, development and management of water resources (GWP 2013). There is a general consensus that competition for

water resources will increase. Hence, the consideration of the needs and demands of all stakeholders is essential to avoid conflicts and to ensure equitable decision-making over water resources (GWP 2012, CAP-NET 2009, TAYLOR 2001). ´Integration´ implies horizontal and vertical cooperation. ´Horizontal´ refers to cooperation between different sectors within a country (agriculture, energy, industry, finance, education and health), while ´vertical´ refers to cooperation between levels (international, national, regional and local) (VARIS ET AL. 2008). Beside the biophysical dimensions of water management, IWRM highlights the human dimension to achieve sustainability. It considers the interdependency (Nexus) between different water users, sectors and groups, and recognizes that the unsustainable and unregulated use of water resources of one sector might have impacts on another sector (GWP 2012). As a lack of cross-sectoral cooperation results in unsustainable management and use of water resources, IWRM means a shift from the traditional ´top-down´ to the more sustainable ´bottom-up´ approach (GWP 2012). While the top-down management approach is characterized by decision-making at high levels and without adequate consultancy of local needs and interests, the ´bottom-up´ approach is characterized by participatory decision-making on lower levels.

However, it is important to consider that IWRM represents a ´process´ with no fixed beginning or end, but rather as a long-term approach that seeks to shift unsustainable forms towards sustainable water management systems (GWP 2009). According to Cap-Net (2008:7), IWRM promotes the following aspects to achieve sustainable development and water security:

- A shift from a sectoral to a more cross-sectoral approach to integrate ecological, economic and social goals to achieve multiple and cross-cutting benefits;
- The coordinated management of water, land and related resources;
- Integration of the technical, social and political aspects, including conflict resolutions in demand, use and perception be it in the economic, environmental or geopolitical sense;
- Integration across sectors, integration of use, integration of demand, integration with the environment as well as integration with the people;
- Stakeholder participation to empower stakeholders
- Active involvement of all affected and interested groups in resolving conflict and promoting general sustainability to bring more resource efficient and socially responsible water management that benefits all sections of society

According to UNEP (2012), improved water management leads to positive environmental impacts, resulting in improved water quality (e.g. due to improved waste-water treatment). Sustainable water management looks at the hydrological cycle in the basin, takes the needs and conflicting interests of multiple water users into account, and “address[es] the role of water within the context of social and economic development and environmental sustainability” (CAP-NET

2008:7).

2.2 The concept of Integrated Water Resources Management (IWRM)

The following two sub-chapters aim at providing a general overview of Integrated Water Resources Management. Starting with the definition and the history of the concept, it continues to discuss the four principles that drive IWRM.

2.2.1 Definition and History

The most common and cited definition of Integrated Water Resources Management (IWRM) is given by the Global Water Partnership (GWP), which was founded in 1996 by the World Bank, the United Nations Development Programme (UNDP) and the Swedish International Development Cooperation Agency (SIDA) with the aim to foster IWRM (see GWP 2013):

> "Integrated Water Resources Management is a process which promotes the coordinated development and management of water, land and related resources in order to maximize economic and social welfare in an equitable manner without compromising the sustainability of vital eco-systems and the environment" (GWP 2009:18).

Especially when addressing increased water scarcity, the principle of ´economic efficiency´ emphasizes the finite and vulnerable nature of water resources. Therefore it is critical to use water with the highest possible level of efficiency (CAP-NET 2008), at the same time as allocating the resource strategically to all different economic sectors and users (see MULLER ET AL. 2009).

´Social equity´ refers to the basic right of people to have equitable access to safe and sufficient water (CAP-NET 2008), "[…] between women and men, rich and poor, across different social and economic groups both within and across countries, which involves issues of entitlement, access and control" (MULLER ET AL. 2009:17).

The third component of the definitions refers to ´environmental sustainability´, which aims at protecting and managing the water resources and ecosystems "[…] in a way that does not undermine the life-support system thereby compromising use by future generations of the same resource" (Cap-Net 2008:9). BIGAS (2012) describes the environment as ´silent stakeholders in water use´. Water security can only be achieved, when humans find a way to satisfy their growing needs without compromising the ecosystem services (BIGAS 2012).

Historically, initial integration efforts between different water users were undertaken in the 1980s, which would eventually lead to the concept of IWRM. However, there was no definition of

an integrated approach towards water management at this time. There seems to be general agreement, that the concept of IWRM came to prominence following the ´International Conference on Water and Environment´ in Dublin (February 1992) and the ´UN Conference on Environment and Development´, also known as the Earth Summit in Rio de Janeiro (June 1992) (UN WVLC 2012, MUKHATOROV 2007, CAP-NET 2009). Although both conferences did result in the four Dublin Principles (see next chapter), an official definition and or guidelines on how to implement IWRM was still lacking. Eight years later, the Global Water Partnership (GWP) released it's interpretation and definition of the IWRM concept, with the aim to promote and support the implementation of the Dublin Principles (UN WVLC 2012).

Held in Den Hague in March 2000, the second ´World Water Forum´ was the first assembly that brought together not only governmental participants and experts, but also different stakeholders related to water management from developing countries, to discuss IWRM. The forum was held in order to address different challenges related to IWRM, such as rights of access to water and land, poverty alleviation, transparent water governance and participation of all water user stakeholders (VARIS ET AL. 2008).

In 2001, the ´International Conference on Freshwater´ was held in Bonn, Germany. The conference acknowledged a dispartiy between water resources policies and their implementation and hence tried to develop practical ideas and ways in which these policies could be put into practice (VARIS ET AL. 2008). The conference concluded, to meet water security by addressing the needs of the poor, to promote decentralization and new partnerships, to address gender equity and to manage water at the lowest possible level. IWRM was declared as the most prominent approach for sustainable development (see VARIS ET AL. 2008).

One year later, in 2002, the ´World Summit on Sustainable Development´ was held in Johannesburg. Now recognised as one of the key components to achieving sustainable development, focus was placed on creating targets and guidelines for the implementation of IWRM. It was decided to develop water efficiency plans for all major river basin around the world before 2005, to improve water efficiency and to promote the development of gender sensitive policies. IWRM became internationally known as the most acceptable approach for sustainable water management (UNEP 2012, VARIS ET AL. 2008).

In 2003, the third ´World Water Forum´ was held in Kyoto, where IWRM was confirmed to be the "[...] recommendable way to achieve sustainable water resources management" (Varis et. al 2008:176). IWRM was furthermore acknowledged to support the eight UN Millennium Development Goals (UNDP 2011). At present, many countries have already adopted plans for

IWRM. However, past experiences have shown, that implementation of IWRM is a slow process that could take several decades to be fully effective (UNEP 2012, XIE 2006). Therefore, XIE (2006:14) demands for persistent, patient progress on multiple fronts so as to achieve the ultimate goal of water security.

2.2.2 Principles

The IWRM concept is founded upon four guiding principles, that were formulated during the ´International Conference on Water and Environment´ in Dublin in 1992 (GWP 2012):

Principle 1: Fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment.

Principle 2: Water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels.

Principle 3: Women play a central part in the provision, management and safeguarding of water.

Principle 4: Water is a public good and has a social and economic value in all its competing uses.

Principle 1: *Fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment.*

The first principle links social and economic development with ecological preservation. As the hydrological cycle provides a fixed annual quantity of water that cannot be regulated by human actions, freshwater needs to be acknowledged as finite and scarce resource. Water is fundamental for all forms of life on earth, providing several ecosystem services for different human purposes, services and functions. Therefore, the maintenance and sustainable management of water resources is essential so as to sustain life, development and the environment (CAP-NET 2009).

Principle 2: *Water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels.*

Water is a resource that concerns and affects everyone. Multiple stakeholders such as water users, planners and policy-makers at all levels and of all social structures must be involved and be part of the participatory decision-making process (GWP 2013). Water not only brings economic benefits, but also social ones regarding equity, poverty alleviation, the safeguarding of human well-being and environmental protection and security (GWP 2012, UNESCO 2009).

Participation refers to the involvement of all stakeholders in decision making processes, from local users to water planners and policy makers. It can take place both in direct forms, for example through stakeholder meetings, or indirectly, through representatives who argue for the interests of certain stakeholder groups. The participatory approach aims to reach long-term consensus by giving people responsibility in the water sector, in order to assure the effective and sustainable use and development of water resources. Governments should ensure full participation of all stakeholders, with particular attention to vulnerable groups within the population, such as local communities.

According to XIE (2006:13), all stakeholders must have a strong belief in the value of IWRM and all reforms that are brought by it. Only with total conviction can IWRM be supported and implemented.

Principle 3: *Women play a central part in the provision, management and safeguarding of water.*

Despite being widely accepted that women play a key role in the collection and safeguarding of water resources, particularly for domestic and agricultural purposes, the role of women in water management is usually very small. This disadvantaged role of women is usually linked to cultural and social traditions of societies. Therefore, IWRM demands recognition of the important role that women play in the provision, management and safeguarding of water. Public agencies should involve women and men in social, economic and cultural issues to ensure gender equality and full and effective participation of woman at all levels of water management decision-making. There is strong evidence that gender equality contributes to sustainable use and management of water resources, while on the other hand, integrated and sustainable management of water resources contributes to gender and *social equity.* Giving woman and men the same access to information, water related services and equal opportunities for participatory decision-making, represents a key component of IWRM (CAP-NET 2009, GWP 2012).

Principle 4: *Water is a public good and has a social and economic value in all its competing uses.*

In the past, the economic value of water resources was not adequately recognised, resulting in inefficient water use. As IWRM emphasises economic and financial sustainability, water resources should be managed as an economic good so as to achieve efficient and equitable use, while also conserving and protecting water resources at the same time (XIE 2006). Although it is important to recognise access to clean and sufficient water and sanitation at affordable

prices as a human right, the scarcity of water resources demands that economic perspectives should not be ignored (XIE 2006). Furthermore, the management of water resources as an economic good through water pricing, greatly contributes to achieving financial sustainability of water service provision, that ensures full cost recovery. Additionally, water charging contributes to efficient use and water savings, providing incentives to manage demand (CAP-NET 2009, GWP 2012). The economic value of water is generally more appreciated in water scarce countries rather than water abundant countries, because the need to manage the scarce resource is more urgent.

Access to water and sanitation is declared a universal human right by the United Nations and while some aspects of these principles might be applicable irrespective of the economic, social and environmental context, other aspects differ greatly between countries and regions (UNEP 2009). Differences in the physical environment and natural conditions, character and intensity of water problems, institutional capacities and human resources, the characteristics of the public and private sectors, the cultural setting and many more aspects, all require different ways of how water should be managed. Hence, there can be no universal design on how to implement IWRM but rather, the implementation of IWRM must involve consideration of different regional aspects (UNEP 2009).

2.3 Political Framework for IWRM

As the global water crisis is rarely viewed as a problem of physical water scarcity alone, but rather as a problem of governance, the successful implementation of IWRM is highly dependent upon a country's water resources governance framework. The following section explores the role of water governance and then focuses on the particular case of water governance in South Africa.

2.3.1 The Role of Water Governance – An Overview

The following quote highlights the interconnectedness of water governance[10] and IWRM: "The governance dimension is strongly associated with the IWRM concept. It can be assumed that the specific design of a governance system affects the decision-making and implementation of IWRM" (UFZ 2011:14).

10 *While ´government´ itself refers to "the governing body of a nation, state, or community" (Oxford Dictionary 2013), the term ´governance´ refers to the "process of decision-making and the process by which decisions are implemented (or not implemented)" (UN ESCAP 2013).*

Water governance is defined as "[…] the political, social, economic and administrative systems that are in place, and which directly or indirectly affect the use, development and management of water resources and the delivery of water services at different levels of society" (UNDP 2013). According to UNDP (2013), water governance has social, economic, political and environmental dimensions.

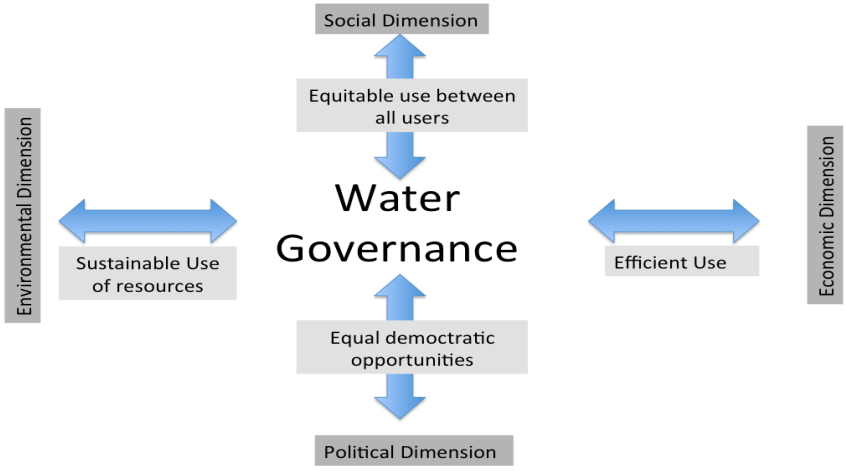

Figure 1: Dimension of water use
(Source: own representation, based on UNDP 2013)

The social dimension of water governance refers to the equitable use of water resources, because it is often unevenly distributed in time and space, between rich and poor or rural and urban settlements. Water related services and water allocation have direct impacts on people's livelihood opportunities and their health. The economic dimension draws attention to the role of water in economic growth and the efficient use of water resources within economic activities. Economic growth highly depends on water and other natural resources and effective governance can contribute to positive effects on per capita income in many countries around the world. The political dimension of water governance refers to water stakeholders at international, national and local levels, including marginalised citizens such as indigenous people, women or slum dwellers, and their ability to influence and monitor political processes and outcomes and to be active participants in decision-making. The environmental dimension indicates the sustainable use of water resources and ecosystem integrity, resulting from improved water governance. It includes parameters such as quality and quantity of water resources and acknowledges it's importance for maintaining ecosystem services. As water quality is declining in many parts of the world due to intensive agricultural use, poor people's livelihood opportunities often depend directly upon sustained access to natural resources such as water, particularly those in areas

prone to pollution, droughts and floods (UNDP 2013). As water governance provides the legal framework for all actions in the water sector, it determines the (sustainable) development of water resources and thus has profound impacts on people's livelihoods[11].

The key role of governance is to create an institutional and administrative framework, where people with different interests can peacefully cooperate and coordinate their actions (GWP 2003).

The ability of local governments to successfully apply IWRM principles depends highly upon the water governance framework and the awareness of existing governance structures to plan and implement IWRM. Local governments are usually not involved in the development of legislations and national policies. Rather they have the role of carrying out mandates in water management. Furthermore they are responsible for involving *all* members of its community and particularly for promoting participatory decision-making and involvement of disadvantaged groups, thus contributing to sustainable bottom up approaches (PHILIPP ET AL. 2008).

2.3.2 South Africa's Water Governance – A framework for IWRM?

The Republic of South Africa is a constitutional democracy and consists of three structures of government, namely: national, provincial and local governments (see figure 2).

Figure 2: The Structure of Government in the Republic of South Africa
(Source: KwaZulu-Natal Legislation South Africa 2006)

11 *The most common definition of ´Livelihood´ is given by Chambers & Conway 1988: "A livelihood comprises the capabilities, assets and activities required for a means of living" whereby the terms ´Sustainable livelihood´ means: " A livelihood is sustainable when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets both now and in the future, without undermining the natural resource base"*

The country is divided into nine provinces, which are governed by provincial governments. The local government consists of various local municipalities, which are divided into metropolitan and district municipalities. While each province has its own provincial legislature, they derive their powers and functions from the national ´Constitution´ (KWAZULU-NATAL SOUTH AFRICA 2006). The national laws define the role of municipal and local governments and provide the legal scope of actions. The DEPARTMENT OF WATER AFFAIRS AND FORESTRY (DWAF 2013) entitles itself as "[…] the custodian of South Africa's water resources [who] is primarily responsible for the formulation and implementation of policy governing in this sector". However, the implementation of IWRM itself must be conducted on municipal, basin and local level (PHILIPP ET AL. 2008). Hence, successful IWRM implementation in the Orange-Senqu river basin, goes hand-in-hand with national governance structures in the formal water sector (UNESCO 2009). In the following, the main legislations and acts, which provide the framework for South Africa's water governance, are presented.

The **Constitution** represents the supreme law of South Africa and forms the basis for any water governance there. South Africa's constitution ensures human rights and is internationally considered to be one of the most progressive constitutions in the world (DWAF 2009).

Act 106 confirms that everyone has the right to have access to sufficient food and water and to an environment that is not harmful to their health or well-being. The Act claims that the environment must be protected for the benefit of all people living now and in future, by preventing pollution and ecological degradation, promoting conservation and securing ecologically sustainable development and through use of natural resources which promotes justifiable economic and social development. It declares the national government as the custodian of all ground and surface water resources and puts local government in charge of municipal water services (Bill of Rights, Section 24, DWAF 2008). The Constitution furthermore separates the powers between the national, provincial and local government and emphasizes the cooperation between all levels. According to the Act, the overall management of water resources is allocated to the national government, while the management of water and sanitation services for all citizens is allocated to the municipalities.

South Africa's **National Water Act** of 1998, provides the legal national framework for the effective and sustainable management of South Africa's ground and surface water resources; in terms of their protection, use, development, conservation and control, in an integrated manner (DWAF 2004, DWAF 2008). As historically, water resources were unequally distributed during the apartheid in South Africa, the policy of the new government tried to address those inequalities by

ensuring the unprejudiced water allocation throughout the Republic, to satisfy the basic needs for all inhabitants (FAO 2001, KOPPEN ET AL. 2002). The new National Water Act was formulated during and immediately after the apartheid era and completely replaced the previous Water Act from 1956. The Act brought about a major shift in water resources management in South Africa, by recognising that water is a natural resource that belongs equally to all people in South Africa. Therefore, it highlights the important role of stakeholder participation in water management by promoting the equal involvement, participation and decision-making of all stakeholders at different levels. It fosters water management at the lowest possible level through decentralised decision-making by established catchment management agencies (CMAs) to reach previously disadvantaged communities and to address race and gender inequities (DWAF 2008, KOPPEN ET AL. 2002). The National Water Act highlights the essential role that water plays for social and environmental justice and promotes the overall goal to achieve sustainable economic, social and environmental development through integrated water management approaches (FAO 2001, KOPPEN ET AL. 2002).

In order to put the National Water Act into practice and to ensure efficient and sustainable water management, the first **National Water Resource Strategy** (NWRS) was published in 2004. According to MUNNIK (2011), the National Water Act requires the Minister to establish a NWRS, which must provide information about how water resources will be managed and about the establishment, function and power of the institutions that will manage water resources within the country. It presents the instruments by which to plan, develop and manage water resources in an integrated and sustainable manner, across all sectors, so as to achieve national development objectives (DWAF 2012, FAO 2001). Hence, the NWRS is about putting the policy and laws of the national water governance of the DWAF into practice, by addressing social equity and economic growth, without compromising environmental sustainability (see DWAF 2012).

To control water use and pollution in the country, the NWRS includes the economic tool of **Water Licensing**, which covers all aspects of licensing and permits related to water abstraction in South Africa. It is a legal tool to control water abstraction between different water users: from low water users with a minimal risk to impacting water resources, to middle water users until high-volume water users such as in agriculture and industry which have a very high risk of impacting water resources. It aims to obviate water over use, which may have negative impacts on catchments and other water users (table 3). Water licensing aims to create fairer water allocation between different users, thus promoting more efficient water use and hence, ensuring the sustainable management of water resources (DWAF 2008). It is compulsory for every new water user that is not listed in Schedule 1 (small water users such as subsistence farmers) or

covered by a general authorization, to apply for a license. Priority areas represent stressed catchments, where water demand exceeds water supply, such as the Orange-Senqu river basin (DWAF 2008).

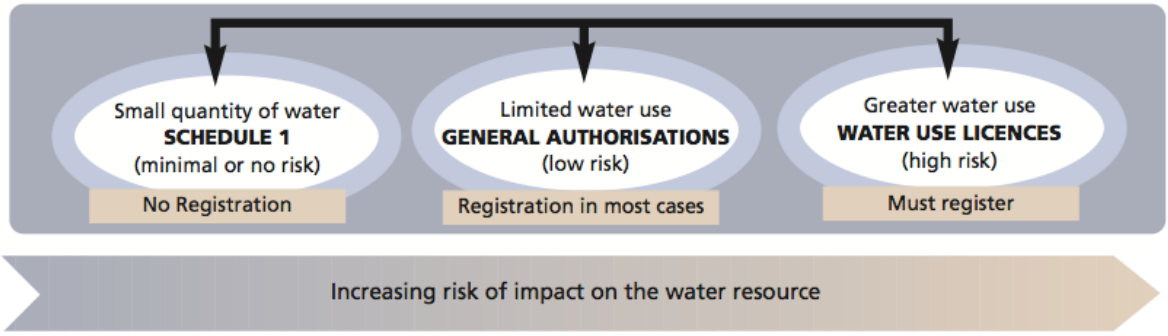

Figure 3: The three types of water use authorization
(Source: Dwaf 2008: 30)

These permissions are given by responsible authorities such as the DWAF or Catchment Management Agencies and refer only to a specific river or catchment. They can be granted for a maximum of 40 years and are revised every five years (DWAF 2008, KOPPEN 2002). A license includes certain conditions, such as the water amount that can be stored in a dam, the quantity of water that can be extracted from certain rivers or boreholes, or the period of time for which the license applies. In case of failure to comply, the authority may withdraw the water license and can prosecute the water user (DWAF 2008).

The National Water Act also includes the **Free Basic Water Policy**, which was introduced in 2000. This social tool addresses the basic human water needs of poor people in South Africa, who cannot afford to pay for water. It aims to contribute towards the government's fight to eradicate poverty. The government guarantees 25 litres per person, per day of domestic water provision, or respectively 6000 litres per month of free water per household. Water use exceeding 6000 litres per household, are then charged according to stepped tariffs. This policy formally ensures that everyone can have access to sufficient and clean water, but the implementation is the responsibility of the local governments. Besides providing a basis amount of free water per household, the government has committed itself to provide appropriate infrastructure to bring water to an adequate distance from poor peoples homes, so as to achieve a minimum state of welfare (KOPPEN ET AL. 2002). Only with adequate infrastructure can the implementation of the NWA be guaranteed (FAO 2001).

Another compliance of the National Water Act includes the establishment of **Catchment Management Agencies** (CMAs) to support public participation in water management through **decentralised decision-making** within a catchment area. A CMA manages water resources

within its defined water management area according to its catchment management strategy. It symbolises the change from a "centralized management approach based on command and control from the nation's capital, to a decentralized participatory model based on cooperative governance and coordination through CMAs" (KOPPEN ET AL. 2022: 12). The establishment of CMAs was to promote effective water management, greater responsiveness to the needs of poor and marginalised communities, participation of small scale users and disadvantaged communities, and to address equity as priority. The primary aim of CMAs are "to involve local communities in water resource management. This is in line with the international trend to give effect to principles of participation to achieve integrated water resource management" (DWAF 2008:37). The CMAs are ultimately responsible for carrying out functions such as water resources planning within the catchment, registration, water charge collection, water authorization, (compulsory) water licensing and furthermore represent the interests of all stakeholders within a basin (see KOPPEN ET AL. 2002, DWAF 2008). In the first edition of the NWRS, the DWAF established 19 CMAs in the 19 water management areas of South Africa, in order to decentralise decision-making. The second editions of the NWRS from 2012, reduced the 19 CMAs to 9 CMAs in order to reduce bureaucracy (DWAF 2012).

The **Water Services Act** of 1997, provides the regulatory framework and rights for the provision of basic water and sanitation services by the municipalities, water service authorities and providers to households and other municipal water users at local level (DWAF 2012, UNESCO 2010). The Act also contains rules for municipalities, about how they should provide water supply and sanitation services and provides norms and standards for tariffs (DWAF 2008).

Both, the National Water Act from the national level and the Water Services Act from the local level provide legal instruments and the legal framework with which to manage water resources and water services sustainably (DWAF 2012).

The **Climate Change Response Strategy**, which is part of the NWRS, is the national response to climate change for the water sector. The White Paper on the National Climate Change Response provides an integrated framework to minimise the impact of climate change and to maximise any beneficial impact. According to DWAF (2012), South Africa is both a contributor to, and potential victim of global climate change and is highly vulnerable to climate variability and change. Therefore, coping strategies will not only require mitigation measures, but also adaptations to current and future climate change impacts. The Climate Change Strategy considers the vulnerability of people, the ecosystems and the economy and integrates them into both short- and medium-term water sector planning approaches (DWAF 2012). The three key objectives of the climate change strategy are therefore: to address climate change in short-,

medium- and long-term water planning processes, to implement IWRM so as to maximise water security and resource protection under changing climatic conditions, and to reduce the vulnerability and enhance resilience to water-related impacts of climate change amongst communities and sectors at greatest risk (see DWAF 2012).

As shortages in capacities and skills pose a threat to sustainable management of water resources in South Africa, in 2004 the DWAF developed a **´Water Sector Capacity Building Strategy´.** This forms part of the National Water Resource Strategy to achieve sustainable development and management of South Africa's limited water resources. It is a cross-cutting strategy which addresses all strategic goals of the NWRS and aims at: building capacities in crucial technical and management areas, the training of water professionals and water management institutions, expanding capacities to respond to dynamic socio-economic and natural environments, and to support water resource management for growth, development, sustainable livelihoods and human security. It establishes skills for planning coordination, water quality assurance and knowledge management. Furthermore it creates public awareness through campaigns to increase public awareness of the value of water (Dwaf 2012). Another objective of the water sector capacity building strategy is, that all water sector institutions have a highly skilled workforce with the capacity to implement all the provisions of the National Water Act of 1998 and Water Services Act of 1997 (see DWAF 2012).

The **National Environmental Management Act** (NEMA) provides South Africa's environmental governance framework, that secures the protection of the environment, e.g. though addressing environmental pollution. The Act "acknowledges that all elements of the environment are linked and interrelated, and [...] take[s] into account the effects of decisions on all aspects of the environment and all people in the environment by pursuing the selection of the best practicable environmental option" (DWAF 1999:12).

Table 1: Acts of Water Governance in South Africa.
(Source: own representation based on DWAF 2012 and DWAF 2008)

Policy and legislation	Description
Constitution of South Africa (1996)	- Supreme law of South Africa - The Constitution guarantees everyone the right to have access to sufficient water and food and also a right to an environment that is not harmful to ones health or well-being
Water Services Act (1997)	- Focus: Water Services - Local responsibility - Water Services Act provides the regulatory framework for the provision of water services by Water Services Authorities and Water Services Providers
National Water Act (1998)	- The purpose of the National Water Act is to ensure that the nations water resources are protected, used, developed, conserved, managed and controlled - Focus: Water Resources - National responsibility - It defines the content of the National Water Resources Strategy 2004: First NWRS published in order to implement NWA NWRS includes: - Water licensing to control water use - Free Basic Water Policy - Decentralisation strategies through Catchment Management Agencies - Climate Change Response Strategy - Disaster National Act - Water Sector Capacity Building Strategy
National Environmental Management Act (NEMA) (1998)	The National Environmental Management Act makes provision for cooperative environmental governance by establishing principles for decision-making on matters affecting the environment, institutions that promote cooperative governance and procedures for coordinating environmental functions exercised by organs of the state

2.4 The Importance of IWRM for Sustainability

The following section focuses on key aspects of Integrated Water Resources Management which contribute to sustainable development and that support the achievement of water security.

Tackling the Global Water Crisis

According to BIGAS (2012), water scarcity is becoming a major global challenge, thus reslting in increasing competition for water between different water users. Additionally, the world is facing challenges created by population growth such as climate change, or the destruction of biodiversity which are threatening ecosystem services (BIGAS 2012: xi). In many regions, water resources are allocated inefficiently and unevenly between sectors. This leads to unregulated pollution which affects the water quality, while at the same time, social and environmental concerns are left ignored.

The global water crisis is considered to be more a governance crisis and not necessarily a crisis of physical water scarcity (XIE 2006). Therefore, a failure of governance in terms of adequate water management (such as slow institutional adjustments to water scarcity), "[...] is often a failure to integrate water management at different levels and to take local and regional

approaches into consideration“ (BIGAS 2012: xi). How states deal with increasing water scarcities, plays an essential role in either preventing or triggering conflicts, for example, between upstream and downstream populations. According to XIE (2006:4), “[...] without a significant shift in the way water resources are managed and [...] are provided, the current water crisis will only worsen”. Integrated Water Resources Management has globally emerged as a means of addressing the global water crisis by promoting sustainable water management (XIE 2006).

Tackling the Impacts of Climate Change

There is general consensus, that climate variability and change will have significant negative impacts on the global hydrological cycle and is likely to intensify in the coming decades and will affect both ecological and human well-being. Potential changes of the hydrological cycle are linked with many uncertainties. The MILLENNIUM ECOSYSTEM ASSESSMENT (2005:5) considers that “[a]lthough many of the potential effects of climate change on ecosystem service provision to date have not been clearly distinguishable from short-term variations, climate change over the next century is projected to affect, directly and indirectly, all aspects of ecosystem service provision”.

Impacts include an increased frequency and magnitude of hydro-climatic events (BIGAS 2012). Changes in water supply may also affect food security or energy supply when not enough water is available, as water dependent sectors such as agriculture (e.g. for irrigation) or the energy sector (e.g. for cooling water) are highly vulnerable to climate change. Although computer model predictions can produce relatively confident predictions of changes in temperature and precipitation patterns, predictions in changes to hydrological cycles remain very uncertain. According to DESER ET AL. (2012: 527), “[u]ncertainty in future climate change derives from three main sources: forcing, model response and internal variability“. `Forced changes` refers to uncertainties that arise from a lack of knowledge regarding external factors that influence the climate system. This include for example the development of future anthropogenic greenhouse gases emissions, land use change or uncertainties regarding stratospheric ozone concentrations. `Model response` refers to uncertainties that arise because different models may project different responses to the same external `forcing` because of different physical and numerical formulations and calculations. The third main uncertainty arises due to internal atmospheric variability, respectively natural climate variability of the climate system, which arises from non-linear thermodynamic interaction and processes and occurs in the absence of external forcing factors. This includes processes in the atmosphere, the ocean and interlinkages in the ocean-

atmosphere system. In general the forced changes can be detected earlier than atmospheric circulation and precipitation (DESER ET AL. 2012).

Impacts on the hydrological cycle are accompanied by changes in the quantity and quality of water resources, thus likely to intensify with progressing climate change. Hence, there is a strong need to improve our understanding of climate change impacts on hydrological cycles and the availability of water resources (UNESCO 2009, UNEP 2009). Dealing with uncertainty is one of the major challenges of adaptation measures in water management (UNESCO 2009). According to UNESCO (2009), appropriate adaptation measures are important so as to ensure sustainable water security for social, economic and environmental needs. Adequate adaptation measures prevent negative impacts of climate change on economic development and ensure food security. Enhanced resilience and reduced vulnerability through cross-sectoral cooperation and decision-making approaches, between sectors and users makes IWRM very adaptable to climate change (UNESCO 2009).

Conflict Prevention

Conflicts can be prevented through the cooperation, participation and equal decision-making of users, planners and policy makers. To achieve sustainable management of water resources, *all* water users must be involved in decision-making processes and management. Different and competing interests of water users and sectors must be brought together to ensure the sustainable use of water resources and to protect ecosystems from threats such as pollution (GWP 2010). Without proper involvement, competing interests between water users creates conflict. The Netherlands Organisation for Social Research defined conflict in 2007 as following: "Conflicis a process that begins when an individual or group perceives differences and opposition between oneself and another individual or group about interests and resources, beliefs, values or practices that matter to them. This process view can be applied to all kinds of parties – nations, organizations, groups, or individuals – and to all kinds of conflict – from latent tensions to manifest violence (CAP-NET 2008:ii).

The scarcity of water resources, its distribution to different stakeholders and a lack of clean freshwater resources are often named as factors that lead to tensions, political instabilities or even conflicts (CAP-NET 2009). Conflicts mainly arise between competing sectors and users that depend on the same river basin, such as urban and rural water users, between agriculture or industrial demand, between upstream and downstream areas or in trans-boundary basins where over extraction and pollution causes impacts on the neighbouring countries. As environmental aspects are often undervalued in water management, a lack a water allocation for the proper function of ecosystem services may impact the population that depend on them *(XIE 2006).* To

prevent or to resolve conflicts, cooperation between the main water users (agriculture, industry and domestic) as well as involvement of local communities is highly recommended to achieve better and sustainable management. “IWRM has become the internationally accepted approach for achieving sustainable water resources management“ (UNEP: 21). As IWRM promotes a shift from sectoral to a more cross-sectoral approach and the integration across sec tors, integration of water use and demand and integration with the environment and people, it highly contributes for conflict resolution (CAP-NET 2009).

While there are different types of conflicts, such as relation conflicts, value conflicts, structural conflicts and interest conflicts (CAP-NET 2008), this thesis only focus on the fourth type: conflicts due to different interests that may arise thorugh increasing competition over water resources. As

Meet Population Growth & Food Security

According to United Nations Secretary-General’s High-Level Panel on Global Sustainability (2012), the population will grow by 30 % between 2000 and 2025 and up to 50 % between 2000 and 2050 (9.5 billion by 2050). Food production will need to have doubled to meet the needs of population growth. Worldwide, agriculture is the biggest consumer of freshwater resources and accounts for 70-90 % of freshwater withdrawal (GWP 2010). Due to growing water demand for agricultural purposes, the pressure on existing water supplies will increase, while the need for water for natural ecosystem processes is often not adequately addressed. The adequate allocation of water for the environment is critical in supporting biodiversity and the production of ecosystem services. A failure of adequate water supply for environmental services might result in a decline in the environmental capacity to provide food and to support modern agricultural practices (BIGAS 2012).

Population growth, changes in consumer behaviour and the negative impacts of climate change on our water resources will thus require more efficient water use by the agricultural sector so that it can increase food production, while using less water (GWP 2010).

2.5 Implications for this thesis

The previous chapters have provided the theoretical framework for this thesis.

Operating within the concept of the sustainable water management context, IWRM implementation is only possible with an adequate political framework on a national, municipal and local level, which can provide the institutional framework for IWRM. Not only physical water scarcity, but also inadequate water management practices (e.g. unequal decision-making between different water users), the impacts of climate change on the hydrological cycle

(uncertainties) and population growth (including the increasing water demand for higher agricultural production & changes in consumer behaviour) will add pressure on freshwater resources and raise competition between users in the Orange-Senqu river basin.

Therefore, the national water governance must provide the framework for regional and local governments to implement IWRM. Only when the IWRM principles are adopted by all levels, sectors and users, IWRM can be fully implemented, thus resulting in social equity, economic efficiency and environmental sustainability. Adequate involvement in water management practices enhances people resilience and thereby increases their adaptive capacities to climate variability and change. Thus, through IWRM, the overall aim goal of water security and sustainable development can be achieved. Figure 5 summarises the conceptual framework of this thesis.

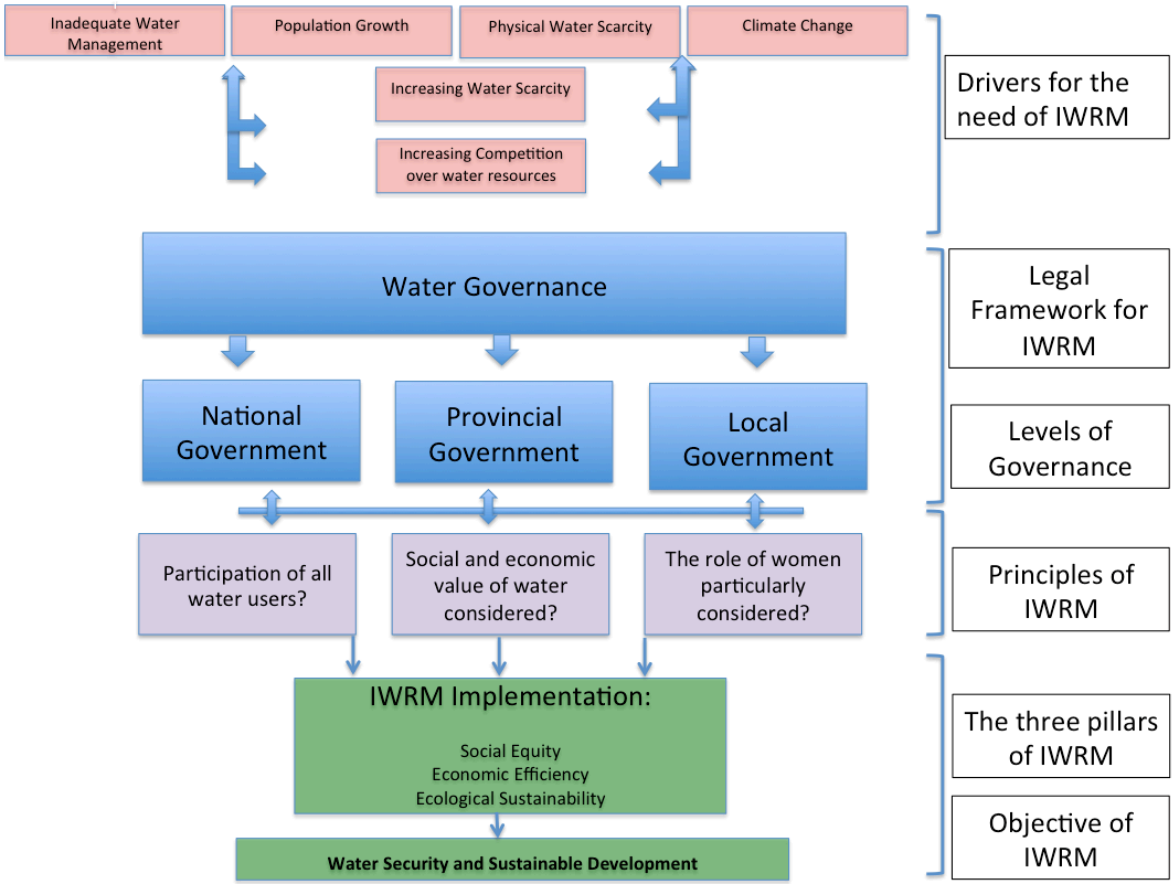

Figure 4: Conceptual Framework for this thesis.
(Source: Own representation)

This overview has presented the theoretical framework that will be used in this study, together with the relevant and supportive literature. In the next chapter, a brief overview of the geographical and socio-economic situation in the Orange-Senqu river basin in South Africa will be discussed.

3 Description of the Study Area - The Orange-Senqu River Basin

3.1 Geographical Overview

The transboundary Orange-Senqu river basin[12] is after the Congo and the Zambezi river basin, the third largest river catchment in Africa. The whole basin area covers approximately 100.000.000 km^2 and stretches over four countries. It covers 64.2 % (almost 600.000 km^2) of South Africa, 24.5 % of the southern regions of Namibia, 7.9 % of the Republic of Botswana, while the entire country of Lesotho falls within the Orange River basin (3.4 %) (ORASECOM 2013). The following maps show the different river basins in southern Africa (SADC Water Division 2011).

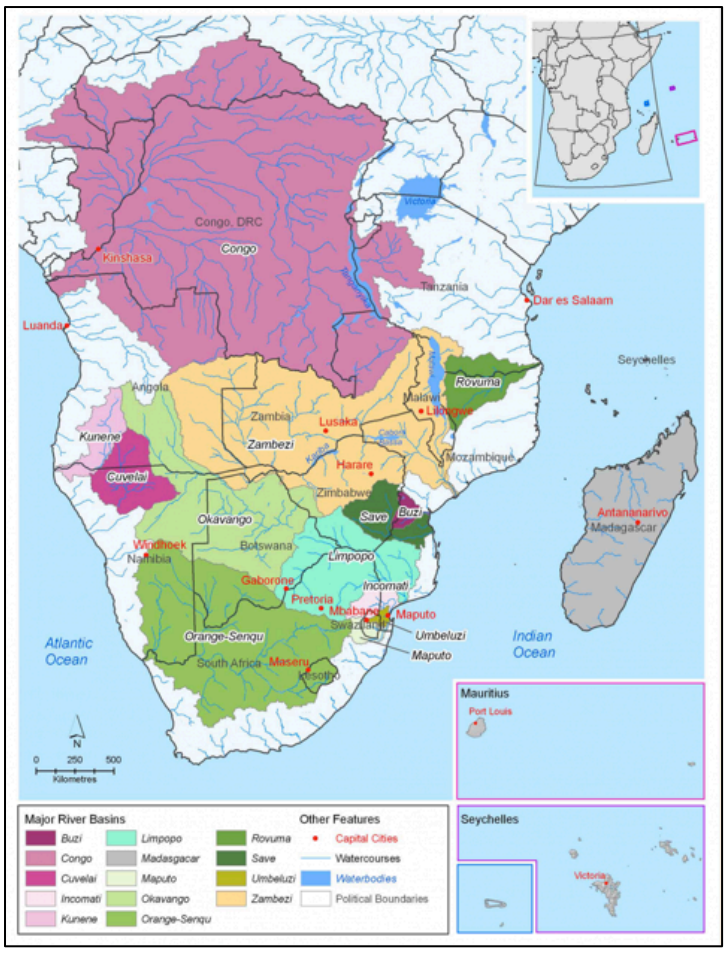

Figure 5: SADC Political Boundaries and Major River Basins.
(Source: SADC 2011)

12 *A basin area is bordered by the watersheds of rivers and streams that flow towards the same outlet and is generally recognised as a hydrological system and unit for water resource management (Gwp 2009).*

The ´Senqu river´ originates in the Lesotho *Maluti Mountains,* close to the Lesotho's highest peak, “Thabana Ntlenyana” at 3.482 m above sea level. As soon as Senqu river crosses the Lesotho border to South Africa, it becomes the ´Orange river´. The river crosses central and western South Africa and flows near Alexander Bay into the Atlantic Ocean. The major tributary of the Orange-Senqu river within South Africa is the Vaal River, that originates in the Highveld escarpment in the north-east. South Africa has nine river catchment areas. The Orange-Senqu river basin contains two different water management areas: the Orange-Senqu catchment management area (6), including the Upper and the Lower Orange as well as the Vaal Catchment Management Area (5), including the Lower, Middle and Upper Vaal catchments.

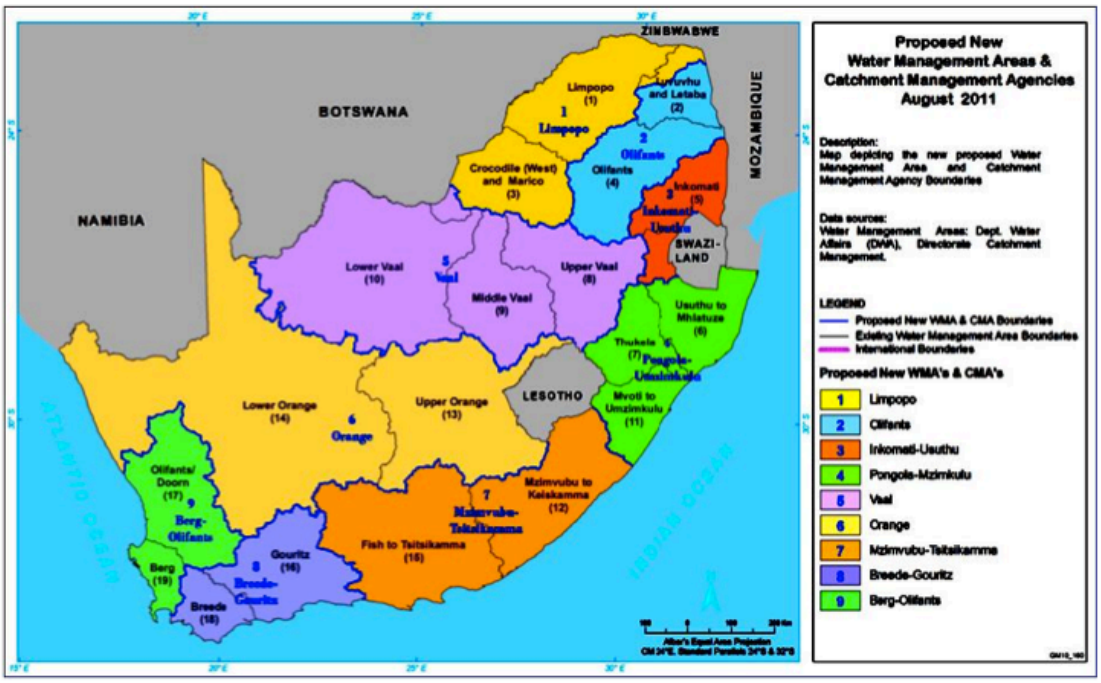

Figure 6: The nine water management areas since 2012.
(Source: DWAF 2012)

The four primary land cover types in the Orange-Senqu basin include grasslands (64 %), bushes (18 %), bare ground (10 %) and cultivated area (7 %). Other land types include urban, wetlands, trees and mining areas. In terms of it's topography, the upper part of the river in the Lesotho Highlands is mainly dominated by a very steep topography, becoming less steep and more hilly from the Lesotho border. In the downstream areas, the river channel is partially incised while the lower part of the river is flat and characterized by wide flood plains (ORASECOM 2013). According to Köppen-Geiger Climate Classification, the basin is located in a dry and semi-arid climate (KOTTEK ET AL. 2006).

In terms of it's climate, South Africa is located between the Atlantic Ocean and Indian Ocean, with high pressure zones on the west and east. These two oceans play an important role for South Africa's climate. Extreme temperatures up to 50°C can be possible along the lower Orange River (ORASECOM 2013).

The mean annual precipitation in the Orange-Senqu basin is 400 mm, varying immensely in time and space. While the average rainfall in the Lesotho Mountains (where the Senqu-River originates), is about 1600-1800 mm, the average rainfall in the Orange River Mouth on the border to Namibia is just 45 mm (ORASECOM 2013).

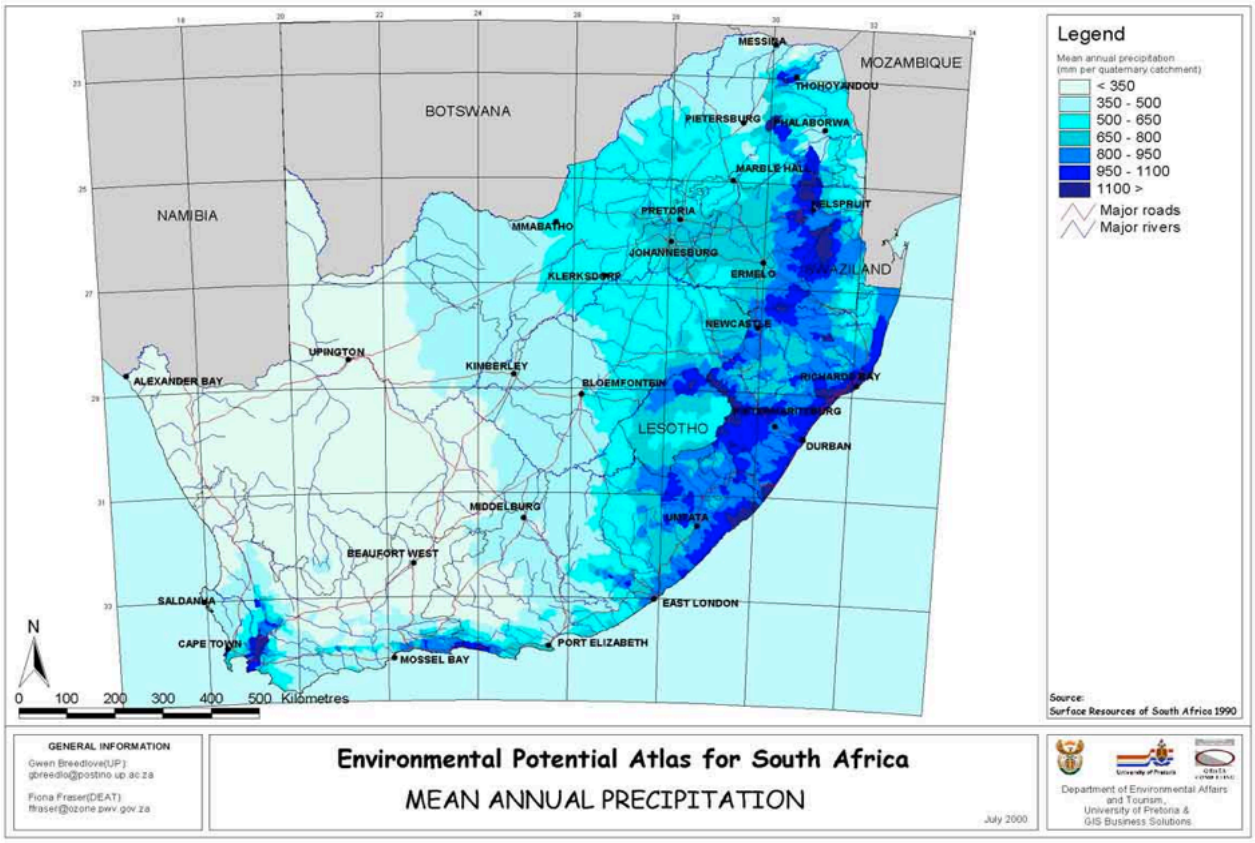

Figure 7: Mean annual precipitation in South Africa.
(Source: Dwaf 1990)

3.2 Socio-Economics of the Orange-Senqu Basin

The scarcity and unequal distribution of freshwater resources in the Orange River basin is considered one of the fundamental threats to the economic and social development of the southern African region. The water resources of the Orange River basin are used for various purposes, such as irrigation for agriculture (the main water user, particularly in the lower reaches of the Orange sub-basin), mining and industries (mainly in the upper reaches of the Vaal basins)

with power generation and domestic consumption being the main user groups (AWIRU 2005).

The entire Orange-Senqu river basin is considered to be the most developed transboundary river basin in the Southern African Development Community (SADC 2012). The Vaal river, which forms part of the Orange-Senqu river basin and is the largest tributary of the Orange river, is by far the most important river because it supplies water to the economic heartland of the country (MCCARTY 2011, AWIRU 2005). The region around Johannesburg (Province Gauteng) is the industrial heart of the country. It is densely populated and home to almost half of South Africa's population. Johannesburg a population of around 3.8 millionen people which is expected to increase to 4.1 million people in 2015. In comparism, the Lower Orange river basin is much less populated due to climatic, physio-graphic and socio-economic factors. Around 60 % of the population lives in rural areas.

South Africa is by far the largest water user of the Orange-Senqu basin and accounts for 97 % of total water withdrawal. Although Lesotho contributes to over 40 % of the stream flow, they only use 1 % of the water resources, Namibia accounts for 2 %, and Botswana less than 1 % (AWIRU 2005). Agriculture accounts for 61 % of water demand from the Orange-Senqu basin (LANGE ET AL. 2006). Nowadays, more than half of the basin's population are employed in agriculture. Agriculture mostly takes place in the fertile strips which border the river, but most of the commercial agriculture is artificially irrigated, using both water from the river and from groundwater due to the region's aridity. Large parts of the basin are used for commercial rain-fed agriculture (e.g. for maize and wheat production). The middle and lower reaches of the orange river are dominated by irrigated farming practices and in the west of the basin, many extensive rangeland-based livestock systems are managed (ORASECOM 2008).

The Orange Senqu Basin is also rich in mineral resources such as gold, diamonds, uranium, coal, base metals, semi-precious stones and industrial minerals. Gold mining has funded much of the development of South Africa, accounting for around 7 % of the countries GDP (ORASECOM 2013). However, mining (extraction and processing) is recognised to have negative impacts on the environment, particularly upon water resources. The most frequently mentioned impact is acid mine drainage, which arises when the mineral pyrite[13] comes in contact with oxygenated water. As the rock mass becomes extensively fragmented during mining, the surface area is greatly increased and thus increases the rate of acid production (MCCARTY 2011:1). The truly detrimental impacts of mining arises when large quantities of acidic water are released into the

13 *Pyrite is "[...] a common minor constituent in many mineral deposits and is associated with [...] coal, the source of acid mine drainage" (McCarty 2011:1)*

environment, polluting surface and groundwater resources with heavy metals. Nowadays, the Vaal catchment is considered to be highly polluted, affecting water resource availability for other economic sectors within the basin and the population (ORASECOM 2008). To ensure sustainable economic, social and environmental development in the basin, the DWAF (2012) highlights the importance of addressing industrial pollution.

In social terms, according to Orasecom (2008), the majority of those living in the basin's rural areas can be described as poor. The highest levels of human development can be found in the urban centre of Gauteng, where indices such as adult literacy and access to improved access to water sources has increased in line with the growing economic patterns, while the arid western area of the basin is characterized by the lowest levels of human development. In this region, traditional, small-scale rain fed land-uses are most typical. In order to meet the water demands from agriculture, industry and domestic water use, many dams and large reservoirs have been built in South Africa. The major dams within the Orange-Senqu basin include the Gariep and Vanderkloof dam in the Upper Orange, and the Vaal and Bloemhof dams in the Vaal sub-basin. The dams provide water and hydro-electricity for the population and for the industrial and mining activities of South Africa (ORASECOM 2012).

3.3 Climate Variability and Change & Impacts

South Africa's hydrological system is highly variable. According to ORASECOM (2008), in the absence climate change, the current average climatic conditions in southern Africa already present high risks for the population and the hydro climatic environment. In general, the country has low levels of rainfall compared with to global averages, high rainfall variability and high evaporation rates due to the hot climate. South Africa is characterized by high intra-annual variability of hydrological responses, which are by global standards, very high (ORASECOM 2008). Precipitation and evaporation are the main drivers of the hydrological cycle, while temperature is the main driver for evaporation.

According to ORASECOM (2008), increasing temperature of about 1°C has been identified during the 20th Century over many parts of southern Africa as a consequence of the increasing CO^2 level in the atmosphere due to human activities. Accordingly, evaporation rates have increased in recent decades. The lower Orange sub-basin in particular, is facing increasing temperatures. Furthermore, a less severe frost season in the Vaal sub-basin and the middle Orange sub-basin has also been identified (ORASECOM 2008). To give an overview of temperature changes in

South Africa, the following graph presents the mean temperature anomalies for 21 selected South African climate stations from 1961 to 2012.

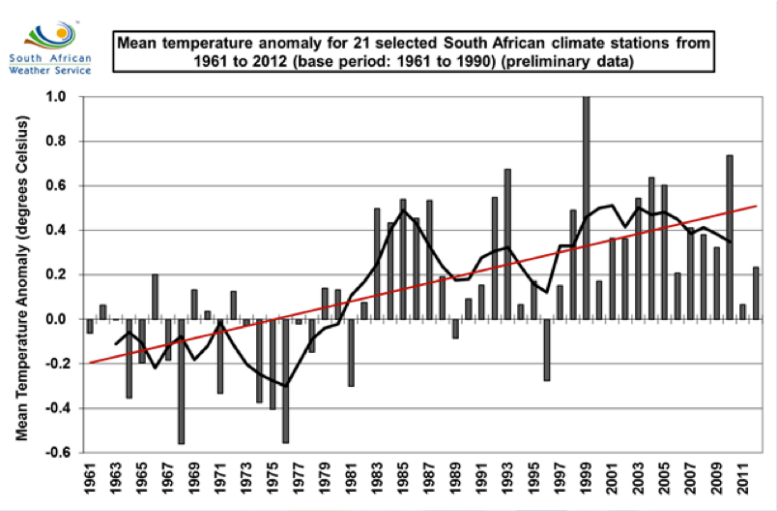

Figure 8: Temperature development in South Africa
(Source: South African Weather Service 2012)

As a consequenses of higher temperatures, changes in precipitation will increase (ORASECOM 2008). In terms of precipitation change, rainfall variability appears to have increased in South Africa. During the 1961-1990 period, significant increases in extreme rainfall events were recorded compared to during the 1931-1960 period. In the Upper Orange-Senqu sub-basins, mid-summer rainfall has slightly decreased between 1996-1990, whereas in the lower Orange sub-basin winter rainfall has increased as the basin experienced more winter rainfall in the late 1980-1999 period compared to the earlier 1950-1969 period. In the lower reaches and the west of the Vaal sub-basin, rainfall has decreased.

The mean annual precipitation ranges from less than 50 mm to over 1200 mm. Rainfall regimes are highly seasonal and differ strongly between summer and winter and also from region to region. An already high inter-annual rainfall variability (short wet seasons and long dry seasons), will likely affect the natural hydrological system.

In terms of stream flow, changes in flow variability are indicated. Stream flow has increased in the lower Orange and middle Orange, but decreased in the Vaal sub-basin. Additionally, there seems to have been a shift in the arrival times of the high summer flows. The highest summer flows tend to arrive 1-2 months later in the middle Orange, Orange-Senqu and Vaal sub-basins.

Regarding future climate change predictions until 2050, in South Africa temperature rises of between 1°C and 3°C are projected. The highest temperature increase of up to 4°C has been predicted for the middle and lower Orange-Senqu basin and the Vaal sub-basin. Increasing

temperature will lead to higher evaporation rates of between 10-20%, thus resulting in increased dam evaporation losses and higher demands for irrigation. Furthermore, a slight increase in precipitation intensity is also predicted, while summer rainfall levels are projected to decrease by 15 % over most of South Africa (except the lower Orange sub-basin), while winter rainfall is projected to decrease by more than 25%. Extreme weather events such as heat waves, droughts and floods will also increase. Changes in precipitation patterns and increasing temperatures are likely to affect the hydrological cycle. But predictions of how the hydrological cycle will respond are very uncertain, as the hydrological cycle itself is already very complex. Predictions for future climate change within the next 50 years are also linked with many uncertainties. Nevertheless, water resources management should consider these trends. Uncertainties about climate change prediction models arise from natural climatic variability, uncertainty of future greenhouse gas emissions, lacking scientific knowledge and empirical downscaling (ORASECOM 2008).

The next chapter will discuss the methodology used in this study.

4 Methodology

The aim of this chapter is to discuss the methodology used in this study to analyse the disparity between the water governance framework in South Africa building on the second chapter and the factors that constrain successful IWRM implementation in the Orange-Senqu river basin according to the interview partners, secondly to examine participatory decision-making opportunities of water development and management between different water users in the basin and thirdly, to identify factors that would support the successful implementation of IWRM in the basin.

In this thesis, a qualitative research method has been chosen to gain valuable insights and into different stakeholder's viewpoints of IWRM. The qualitative research approach produces findings that cannot be determined in advance (MACK ET AL. 2005). The goal of qualitative research is description, that focuses on it's subjectivity through it's interpretation. At the same time, description includes problems such as the pace of data collection, the volume of data, the procedure of data analysis and the generalization of findings. Therefore, it has to be considered and accepted, that whatever methodology is chosen for the scientific research in terms of data collection and the type of analysis, will include implicit and explicit problems and affect the research product to a certain extent (GLASER 2004).

4.1 Introduction

To achieve the aims of this master thesis, the study methodology consists of a range of qualitative methods. The methodological procedure of this thesis can be roughly subdivided into three phases:

The **first phase** involved a literature review and Internet based research to obtain theoretical background information on the concept of sustainable water management, namely IWRM in South Africa and to collect information about the linkages between climate change and water management. The Internet based research was particularly important in order to detect potential interview partners who are involved in water-related issues and climate change within the Orange-Senqu river basin. Sources of information included official government reports, particularly reports by the South African Department of Water Affairs and Forestry (DWAF), reports from international organisations such as the United Nations (UN), Food and Agricultural Organisation (FAO), World Bank Reports, the official website for the Orange-Senqu River Commission (ORASECOM) in South Africa and other relevant documents from international, national and regional organisations, institutions and non-governmental organisations (NGO).

The **second phase** of research consisted of a field-trip to South Africa in order to understand all factors that support or constrain IWRM implementation and to understand the role of climate change upon South Africa's water management. The research field-trip for this master thesis was undertaken from August 18th to September 28th 2012, in order to conduct stakeholder interviews. Primary research included the collection of qualitative data through 14 semi-structured face-to-face interviews, mainly conducted in the country's capital Pretoria, but also in Johannesburg, one interview in Stellenbosch and another interview in Cape Town. The interviews lasted between 20 minutes up to around one hour.

In the **third phase**, all interviews were first transliterated, encoded and analysed, thus resulting in the generation of three hypotheses.

The next sub-chapter highlights, how interview partners were selected and is followed with a description of the participants.

4.2 Sampling and Description of Participants

The literature review has illustrated that while the theoretical framework of IWRM has been well studied and discussed, literature regarding practical recommendations for successful implementation of IWRM appears to be lacking. The lack of guidelines for successful IWRM implementation can mainly be traced back to two reasons: IWRM is highly dependent on the specific geographical and socio-economic contexts, which differ immensely between countries and regions, thus aggravating the development of a ´universal´ guideline. And secondly, IWRM is a very slow process, which makes it hard to identify ´successful´ implementation. Rather, success in one area may be accompanied by positive changes in other areas. IWRM is about changing current practices and cultures, which usually takes a long time to achieve (XIE 2006).

Nevertheless, this thesis is an attempt to identify the constraints of successful IWRM implementation in the region-specific Orange-Senqu river basin in South Africa.

As relevant information could not be fully obtained from literature review, interviews have provided important supplementing information to the available written sources. While a local community-based assessment was not possible due to the resource constraints of this thesis (which would have been exemplary for a participatory ´bottom-up´ approach), a partial analysis was conducted with available interview partners. In accordance with MACK ET AL. (2005), reasons for interviews include a) to understand a given research problem from the perspectives of involved stakeholders regarding their opinions and experiences, b) to seek answers to research questions, to produce findings that were not determined in advance and c) that are also

applicable beyond the immediate boundaries of the study (which might include other river basins in South Africa). This thesis uses qualitative expert interviews. According to FLICK (2009) an ´expert´ is a person with specific capacities, experiences and knowledges in a certain field who represents a certain group. Expert interviews are furthermore considered to support the generation of theories about a certain issue, by reconstructing the knowledge of several experts (FLICK 2009).

The interview partners were chosen according to their working area and expertise in the areas of water management and climate change prior to the field-trip via internet based research. As soon as a potential interview partner was identified, contact with the interview request was made up via email, including a letter of introduction about the topic of interest and research. A guideline of the interview questions was also attached to the email to enable the person to prepare for the interview. As the feedback received from the emails was very limited, it was not possible to arrange any meetings prior the field-trip, thus forcing me to remain fairly open to allow the highest level of flexibility during the fieldwork. Although attempts were made to include a wide range of important stakeholders during the fieldwork, contacted representatives of international NGOs as well as representatives of CBOs were found to be unavailable for interview. This may affect the findings of this thesis and should be kept in mind.

The interview partners came from research institutions, such as the Department of Geography, Environmental Management and Energy Studies at the University of Johannesburg, the Department of Geography, Geoinformatics and Meteorology at the University of Pretoria and the Department of Geography and Environmental Studies at the University of Stellenbosch. The group of international organisations is represented by the River basin Organisation ORASECOM, Cap-Net and ACCORD. In the following, information about the institutions and organisations (with exception of the universities) are briefly presented using information from their website homepage.

The Orange-Senqu River Commission (ORASECOM) is the river basin organisation of the Orange-Senqu river basin. It promotes the sustainable development of water resources in the basin and fulfils the task to promote coordination between the four riparian countries: South Africa, Lesotho, Namibia and Botswana. It promotes IWRM through capacity building on national, provincial and local levels (see ORASECOM 2012). Cap-Net is an international network for capacity building in IWRM and a partnership of autonomous international, regional and national institutions and networks committed to capacity building in the water sector (see CAP-NET 2012). The International Water Management Institute (IWMI) is a non-profit, scientific research organization focusing on the sustainable use of water and land resources in developing

countries (see IWMI 2013). The African Centre for the Constructive Resolution of Disputes (ACCORD) is a South African-based civil society organisation working throughout Africa to bring creative African solutions to the challenges posed by conflict on the continent. They focus on conflict management, conflict analysis and conflict prevention through mediation, negotiation, training, research and conflict analysis (see ACCORD 2013). The national NGOs is represented by MVUALA Trust. They are South Africa's largest water and sanitation NGO, working to improve the health of rural and peri-urban communities, by increasing access to clean water and sanitation mainly by capacity building within the water services sector. They were established to provide the necessary institutional and technical support with the implementation of IWRM (see MVUALA TRUST 2013, KOPPEN ET AL. 2002). Government related bodies included the Ministry of Water Affairs and Forestry (DWAF) and the South African Water Research Commission (WRC). The Ministry of Water Affairs is the custodian of South Africa's water resources and is responsible for the formulation of water governance in the country (see MINISTRY OF WATER AFFAIRS 2012). The Water Research Commission was established in terms of the Water Research Act, following a period of serious water shortage. It was deemed to promote the country's water research purposefully, in order to tackle the lack of research co-ordination and furthermore to provide meaningful contribution to the development of the capacity of the water sector (see WRC 2012). WRP Consulting is a private company for water resource planning and implementation, water demand management and conservation in Pretoria. They are working with the municipal sector and the Department of Water Affairs, assisting and supporting in water conservation and demand management. WRP focuses on awareness and education in water conservation (see WRP 2013).

Table 2: Organizations represented by the interview partners.

	International	National/Regional
River-Basin Organisation	ORASECOM	
Research Institutions	International Water Management Institute (IWMI)	University of Johannesburg University of Pretoria University of Stellenbosch Water Research Commission (WRC)
Government related bodies	Cap-Net	Ministry of Water Affairs
NGOs		MVUALA Trust
Others	ACCORD	Water Resource Planning (WRP)

In some cases, more than one expert from the same institution was interviewed, because the interviewee specialised in different topics. From the Ministry of Water Affairs for example, the

Director of the Department of Water Affairs itself and the Director of the Climate Change Unit were both interviewed.

By interviewing a range of different stakeholders, every effort has been made to understand and analyse South Africa's concept of IWRM, the problems and constrains of water resources management, the role of government, the impacts of and peoples vulnerability to climate change and the role of capacity building for IWRM. This has been done so as to build a comprehensive picture of the demands and expectations of the stakeholders towards policy-making, with regards water resources management in South Africa.

4.3 Interview procedure

In total, 14 semi-standardised interviews with a common outline were carried out, thus allowing for small changes during the interview. For the greater part, mostly open-ended questions were used during the interview to allow the interview partner to answer using what she or he considered to be most important. Leading questions were avoided as much as possible during the interviews. To assure that the most important issues for this master thesis were definitely addressed and to provide a reference framework, a catalogue of questions has been developed (Annex 2). The questions catalogue has been arranged into a hierarchical structure and is subdivided into 1) an introductory section, 2) a main section, and 3) a closing section. The introductory section included easy-to answer, descriptive questions about the interviewee's field of work and experience and the aims of the organisation in which she or he works. The main section continued with more abstract issues addressing, amongst others, water use and pollution issues in the basin, the role of government, disadvantaged peoples, reasons for vulnerability, trends of climate change and the expected impacts for society, economy and the environment or the role of capacity building. The closing section gave room for additional remarks (that were not addressed during the interview), to clarify questions and to ask questions in return. While the introductory and the closing-sections were part of all interviews, the questions in the main section were chosen in accordance with the specialisation area of the interviewee.

All interviews were audio-recorded with a dictation machine. In addition, notes were taken down immediately after the interview that included the interview location and atmosphere, as well as the key points addressed during the interview. After the first three interviews, the interview outline was reviewed and some questions were omitted, revised or reworded, usually due to new informations and experiences obtained during a previous interview.

4.4 Data Analysis

After the field-trip, every single interview was transcribed by the author with the help of F5, a standard program for scientific transcription. After importing the audio files of the interviews, it was simultaneously listened to and manually written down. Nuances of accents as well as non-verbal communication were not written down as a verbatim transcript was not considered relevant for the research questions of this thesis. The transcription of the interviews prepared for the coding and enabled for further analysis of the interviews. The specific methodological qualitative research approach of this thesis is the Grounded Theory methodology (GT).

The Grounded Theory is a particular inductive research style for qualitative research that aims to understand and explore social reality. The aim of this theory-based methodology is to generate hypothesis and theories. The importance of certain aspects of the study area emerges during the research process and are not implicitly defined nor postulated in advance by a commitment of a hypothesis. Thus, instead of verifying or falsifying a given theory, it rather aims at developing hypotheses and subsequently a theory, which is ´grounded´ in the data. So the hypothesis and theory generation only gains shape and emerges *during* the research process. The theory undergoes constant changes and is continually modified during the research process (DILGER 2000).

As MAXQDA is considered to be one of the most popular ´computer assisted qualitative data analysis´ (CAQDAS) packages for scientific research, it was chosen to analyse the content of the interviews (BERGER 2008, SAILLARD 2011). Furthermore, according to grounded theory, MAXQDA also supports the analysis of qualitative. The written transcripts were categorised during the coding process in terms of research questions and subdivided topics. The coding process was utilized to organise and reduce the collected data of the interview transcripts and additionally enabled the development of an analytical structure. According to GLASER (2004), the conceptualisation of data through coding, represents the foundations of grounded theory. The typical process of coding includes fracturing the data, then grouping certain patterns of empirical indicators into codes so as to develop theories from the data (GLASER 2004). The following figure illustrates the coding process with MAXQDA.

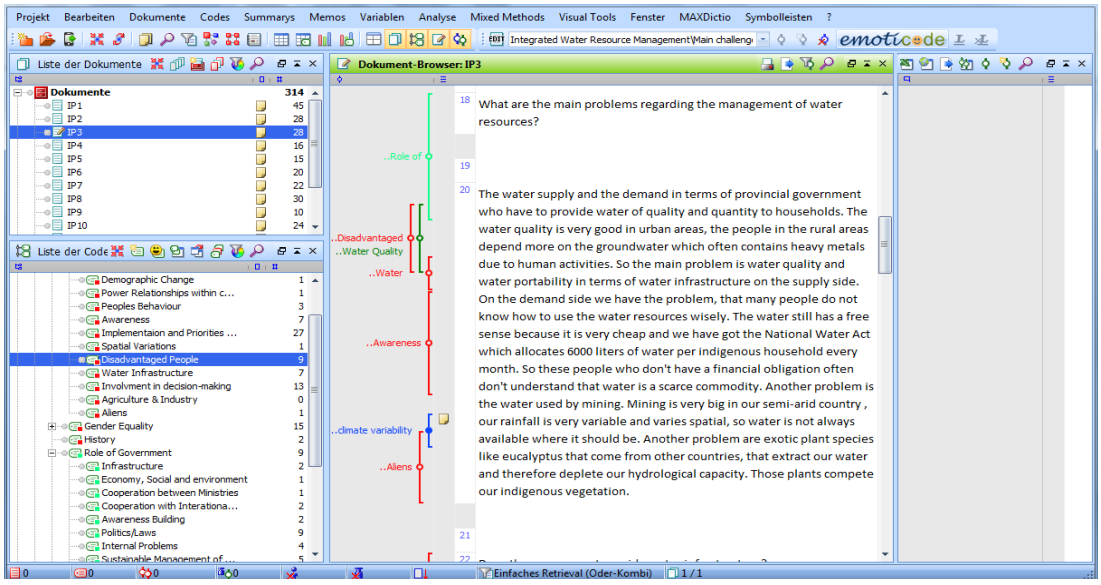

Figure 9: Screenshot of Coding Process with MAXQDA.
(Source: Own picture)

Although the computer-based software MAXQDA was used to reduce the complexity of the qualitative material, to support the organisation of text-based material and to identify trends from the transcripts, the coding process itself was done manually. The process included the development of categories, which were then subdivided into further subcategories. Furthermore, ´memos´ were taken down, thus allowing for reconstruction and understanding of the formation of categories and subcategories and, helping to generate hypotheses (GLASER 2004). The codes were reviewed several times, then revised and further developed in a circular analytical process. As the coding was tentative, some initial codes were extended, sub-categorised or also merged into new categories and finally into certain themes (e.g. ´Role of Government´). The sorting is important to ensure internal integration among categories and to provide theoretical completeness. Only then, is theory building is possible (Glaser 2004).

Afterwards, the coded sections were exported as text documents to facilitate further analysis. Interview sections, which were not relevant for further analysis in this study were not coded and thus left out (selective coding) in further analysis (GLASER 2004). To represent specific developed themes, tables were developed to allow a visualisation of the content. ´IP´ refer to the stakeholder who was interviewed (IP1 – IP14), while 'paraphrase' refers to a quote of the interview partner. The ´generalisation´ summarized the most important issues.

Table 3: Table Structure using the example of access to water.
(Source: Own representation)

IP	Paraphrase	Generalisation
IP10	-The official figure is that 94 % of the people have access to clean water. -So we believe that about 74 % do have access, but 95 % should be, but just if they operate properly.	-Official statistics: 94%, but 74% estimated

While chapter 5 presents the experts' statements along 12 themes, chapter 6 also refers to the interviews during the discussion of the interviews: “I think the major one in terms of quality is the mining, because we have a big problems in South Africa with acid mine drainage” (IP8Q2). All used quotes are listed in full in Annex 3.

Beside the construction of categories and themes that allow a proper overview for the research questions, three hypotheses were generated during the research process. These are based in the data of the interviews and are discussed with regards to the current state of research. However, this thesis did not develope an own theoretical framework, it rather discussed certain aspects of IWRM alongside the hypotheses and provides the background for future research that might generate a proper theory. Interesting future areas of research that might build upon this thesis are presented in chapter 7.3.

4.5 Ethical consideration

Prior to the interviews, interview partners were always asked for permission to audio-record the interview. However, none of the interview partners declined the recording. As the statements of all interview partners are represented in a numbering system in the following chapter, they cannot be traced back to the individual interview partners. Additionally, this master thesis will be sent after completion via email to all interview partners who requested them.

5 Empirical Results

In this chapter, the results of the stakeholder interviews are presented descriptively, according to the methodology explained in the fourth chapter. The results are presented in a number of tables arranged into three sub-chapters from 5.1 to 5.3. In some interviews, themes arose that were not directly asked for during the interview, so a classification and analysis of the answers following the questionnaire outline would pass over important statements and themes considered important by the interview partners. Therefore a coding system has been developed with the help of the computer programme MAXQDA (as described in the fourth chapter), which groups statements alongside different topics. The tables are thus oriented according to this method of analysis. Before the tables are presented, a short summary of the main statements of the interview partners is given in order to provide an overview of the table contents. The questionnaire is outlined in Annex 2.

Based on the interview guidelines and the information provided by the interview partners, the main themes were identified and further subdivided into the following areas:

Subchapter 5.1: The Orange-Senqu River Basin

- Ecosystem services, user groups, water quality and access to clean water and sanitation.

Subchapter 5.2: IWRM and Climate Change

- The role of government, Participation in decision-making; disadvantaged groups in the basin, the role of women, trends and impacts of climate change, climate variability and uncertainties, vulnerable groups to climate change, capacity building, awareness, water infrastructure, conflicts and general perceptions of IWRM implementation in the basin.

Subchapter 5.3: Recommendations

- Recommendations to improve IWRM implementation, to reduce vulnerability but enhance resilience to climate change.

The following section presents key statements made by the interview partners, subdivided into the topics as outlined above.

5.1 Orange-Senqu River Basin

The ecosystem services provided by the Orange-Senqu river basin supports agricultural, industrial and domestic water supply services. Hence, the main water user groups within the basin identified by the interview partners included: farmers (commercial and subsistence), as they use water for irrigation; industry, as they use water e.g. for mining or power generation, as well as; the population, as they require water for all household-related activities.

Various stakeholders raised concerns about the water quality of the Orange-Senqu river basin. This can mainly be attributed to human activities such as agriculture (use of fertilizer and pesticides leading to eutrophication), industry (acid mine drainage of gold and coal mining), informal settlements (ecological contamination of surface and groundwater resources due to the dumping of toxic waste-water and a lack of access to sanitation facilities) and waste dumping (e.g. plastic).

Although the interview partners agreed that the majority of the basin's population has access to clean water, (although those living in more rural areas often have less access than those in urban areas), access to sanitation remains a major challenge.

Table 4: Summary of comments on ecosystem services, user groups, water quality and access to clean water and sanitation within the Orange-Senqu River Basin

IP	Paraphrase	Generalisation
	Ecosystem Services	
IP1	It is huge, because it is our biggest river. Of course we have agriculture particularly for irrigation purposes and also industry, especially when you look up the Upper Orange and the tributary rivers. The Vaal for example flows through heavily industrialized area. It starts in Mpumalanga so a lot of that water is drawn for the coal mines, the power stations and the industry in this region. Then the water flows through Gauteng, which is also a heavily industrialized area. So you see the water of the Orange River and the tributaries are heavily used for industry, but obviously also for urban water supply. Gauteng is our smallest province but it is our most densely populated area with more than 10 million people and although not all of them rely on the tributary Vaal for domestic water supply, the majority of the population does. Furthermore most of our power stations need water to work. But a lot of them are very old, so they are not very water efficient anymore. So you will find these power stations along the river that has been damned for these purposes of the power generation.	-Agriculture -Industry -Urban Water Supply -Power Generation
IP3	I can think of agriculture, fishing, ecosystem integrity, water supply and energy but also ecological processes.	-Agriculture -Fishing -Ecosystem Integrity -Water Supply -Energy -Ecological Processes
IP4	Agriculture is a big thing, followed by industry. Hydropower is not a big thing in the Orange, because there are not so many opportunities. These are more in the Lesotho highlands. And there are two large dams on the middle Orange river, the Gariep and the Vanderkloof dam, generate hydropower.	-Agriculture -Industry (-Hydropower)
IP8	There is also water for strategic use like generation of energy and electricity. So of the amount, which is left, most of the water is used by agriculture maybe in average around 75 %.	-Energy Generation -Agriculture

	User Groups	
IP1	I would say the two biggest one in the Orange-Senqu basin are the farmer as they are taking water out of the river for agriculture and also the municipalities for their domestic water supply. But if you take the entire basin with the tributaries it is going to be the power stations and industry.	-Farmers -Municipalities -Industry
IP3	In the guideline of water quality of the Department of Water Affairs they identified close to 7 different types of users. You have the water for household consumption, water for agriculture, water for recreation, water for industry and others as well but these are the most important ones.	-Domestic consumer -Farmer -Population (recreation) -Industry
IP4	Beside agriculture and industry, but when it comes to water supply for urban and industrial use, it is large utilities that are in charge of, so here in this region where we are now, it is rand water.	-Agriculture -Industry -Domestic consumer
	Water Quality	
IP1	Poor management and sewage are the biggest problems. So we need a new technology in this area. Obviously not everybody has access to flushing toilets, so the informal disposal of human waste is also a significant problem. We have a major problem in our rivers with ecola bacteria. Another problem is gold mining, so the river contains radioactive material from the uranium. Furthermore, acid mine drainage is a significant problem in the Orange river due to the coal and gold mines. And then pollution from agriculture I must admit, especially where we have very high densities of cows in small areas, and the pollution flowing out of that is absolutely horrendous. Also nitrates and phosphates are a serious problem. Probably less from our industry, because they are slowly improving their methods although they are not innocent of course, but certainly the pollution incidence from our industry has reduced. And then there is a general plastic pollution problem, people are dumping illegally.	-Poor Management -Sewage especially of informal disposal (Bacterial pollution) & Plastic -Industry (Radioactive material through gold mining & acid mine drainage of coal and gold mines) -Agriculture (Salts)
IP3	Pollution by human activities. We are talking about industry, we are talking about mining, we are talking about agriculture and their contamination but we are also talking about informal settlements. These people are taking land without permission, they occupy the land, there is no infrastructure, no toilet facilities and no water and they waste a lot which affects the catchment, the environments in general and the water as well. -The water quality is very good in urban areas, the people in the rural areas depend more on the groundwater, which often contains heavy metals due to human activities.	-Industry (Mining) -Agriculture -Informal settlements -General better in urban than in rural areas, where groundwater is often contaminated
IP4	It is agriculture and everything that relates to agriculture and industry such as heavy metals from the mining industry. These are the major issues. Urban pollution is an issue in terms of biological terms and it is probably getting worse.	- Agriculture -Industry (Heavy metals from mining industry) -Bacterial pollution
IP7	The two typical problems in water quality illustrate the power relationship. The one is ironic because the polluting wastewater works along to the local government, so the government is the polluter in this case. It is difficult to force them not to pollute. In the catchment forum the other participants are not really strong enough to force local government. The other big problems in the country is acid mine drainage from the gold and coalmines. The gold mines are up to 120 years old and some coal mines are just starting up today.	-Wastewater from municipalities -Industry (Acid mine drainage from gold and coal mines)
IP8	I think the major one in terms of quality is the mining, because we have a big problems in South Africa with acid mine drainage. -But it always depends where you are. If you are at an area where there are a lot of industrial activities like in Gauteng, water quality is a big problem. In the rural areas but also in the urban area they had issues of onside sanitation and practices that are not proper, for example people that are putting on toilets in areas that are vulnerable to impacts of groundwater. -Land use practices in general are also a big thread. […] We have some of our dams with a lot of algae not necessarily as the result of climate change at this junction but also because of the water use upstream regarding the return flows from agriculture and the municipalities. So their salts are accumulating in the dam triggering eutrophication. So there are number of problems but always depending on where you are.	-Industry (Acid mine drainage) -Informal disposal and untreated wastewater -Agriculture (Eutrophication due to fertilizer)
IP10	Domestic pollution is a problem of bacteriological pollution and domestic waste. Certain industries also pollute quite a lot and then we also have the mining pollution. Basically we have all the sectors polluting due to agricultural pesticides, fertilizers, the industry is polluting and also illegal settlements. On urban side we got backyard industries, which rains washes of and ends up in the rivers. In terms of water pollution, you don't only have the chemical side; you also have the physical side in terms of temperature for example as well.	-Domestic pollution (Bacterial problems from informal settlements) -Industry (Mining pollution) -Agricultural (Pesticides and fertilizer)
IP11	Of the biggest things has been the acid mine drainage. I think our industrial mining and power generation sector has had a lot to do with that. -Our agricultural sector is also quite big, if you look at fertilizers and pesticides, obviously they are threatening the quality of our water resources as well, if they are not managed properly. Also we also have had a lot of sanitation backlogs, so	-Industry (Acid mine drainage) -Agriculture (Pesticides and fertilizer) -Improper sanitation especially in rural areas

	providing people with proper sanitation facilities that play a huge role, particularly in our rural areas, where people would just dig up their own pits. This contaminates our groundwater resources, which particularly the people in the rural areas use, because they generally don't have a lot of access to the conventional system that we use to gain access to water.	
IP14	Water pollutions consist of a couple of problems in South Africa. The first one being the municipalities, which do not take care of the sewage treatment plants. And there are lots and lots of problems, so the bacteriological pollutions of our surface water must be the number one concern in South Africa. The second one, everyone is talking about that right now, is acid mine drainage from our mine industry and all the heavy metals that goes with it. A third concern is eutrophication. Some of the algae produce toxins, which is a big problem in South Africa. These should be the three main concerns in South Africa. The pollution in our rivers ends up in dams, which is primarily used for drinking water and irrigation.	-Untreated wastewater (Bacterial contamination) -Industry (Acid mine drainage) -Eutrophication
	Access to clean water and sanitation	
IP1	Well it is getting better, I can´t remember the exactly percentage account but it is much higher, than it has been ever in the past. So I would say overall the majority of the people do have access to clean water coming out of taps. There are few bad cases unfortunately, so some town and rural areas that don't, but the majority of the population does. -Unfortunately less in the area of sanitation, we have been less successful in removing the bucket system.	-Overall majority has access to clean water -Exceptions: some town and rural areas -Access to sanitation is still a problem
IP10	-The official figure is that 94 % of the people have access to clean water. -So we believe that about 74 % do have access, but 95 % should be, but just if they operate properly.	-Official statistics: 94%, but 74% estimated
IP11	I think at the moment the backlog is sitting at about 8 million. It is also at the website of the Department of Water Affairs, where they deal with all the backlogs. I would say we have between 60 - 70 % coverage at the moment. So around 40 % who still don't have access to proper water and sanitation.	-Around 60-70 % do have access to water
IP12	Once you give water to local authorities or to people that provide sanitation and drinking water services, often doesn't have reached the whole population yet. Access to water and sanitation should be a human right, but if you look at the statistics it is not really.	Some areas underprivileged in access to water and sanitation

5.2 IWRM and Climate Change

In order to analyse the implementation of IWRM and the influence of climate change on water management in the Orange-Senqu river basin, interview partners were asked about the role of government, participation in decision-making, disadvantaged people in water management, the role of women, trends and impacts of climate change, climate variability and uncertainties, vulnerable groups to climate change, capacity building, awareness, water infrastructure, conflicts and constraints of IWRM implementation.

5.2.1 The Role of Government

As the successful implementation of the IWRM principles is highly dependent on having an enabling environment to do so, which is subject to the water governance framework of a country (PHILIP ET AL. 2008), interview partners were asked about the role of South Africa's government in water management. The interview partners characterized the government as the custodian of South Africa's water resources, responsible for providing the political framework for IWRM. The actual implementation however, is the responsibility of the municipalities who also have to monitor compliance with laws within the municipality population and local industries. The government should raise awareness of water-related issues through campaign. Water licensing

is identified as the main political ´tool´ to control water use and pollution, especially in the industrial sector. The National Water Act (NWA) is a key part of water governance in South Africa and includes the ´Free basic water policy´ which provides a certain amount of free water so as to cover the basics needs of poor households. When asked about the role of government in climate change, the ´South African White Paper on Climate Change´ was identified to be the main tool on managing water resources under climate change. To promote decentralisation, catchment management agencies (CMAs) were founded to ensure decentralized decision-making from the basin level. Interview partners generally agreed that South Africa has a very advanced water policy. When asked to the water ministry itself, they responded that their focus lay towards providing basic water supply for rural areas, combating discrimination in urban areas, addressing bias between the rich and poor in urban areas, providing jobs and allocating water according to income, addressing gender bias and providing capacity building.

Table 5: Summary of comments on the role of government

IP	Paraphrase	Generalisation
	Role of government	
IP1	The National Water Act basically nationalized our water resources. So the state controls all surface water in this country and they have to look after it on behalf of the citizens of South Africa. So the state owns the water of this country. -So the state owns the water of this country, so one of the government jobs is to build dams. We have governmental organizations that provide the purification infrastructure and they pump the water to the municipalities. And on the local level you have the local government, who has to build the infrastructure. So they have to build the water lines and they have to run the sewage system, they pump the water to thesis taps and they will bill you for that water.	-Government is the custodian of water resources, ensured by the National Water Act -Responsible to build dams -On local level, municipalities are responsible for water infrastructure
IP6	I think there are bigger issues that the government have to deal with at the moment, like poverty. Climate is not very high on the Agenda -I think it is not a priority at the moment, there are more serious problems that government needs to look at, such as job creation and poverty and things like that.	-Relevancy of climate change to government: Not very high on the Agenda
IP8	The government should play a regulator role, because the government has to use the license as a way of ensuring how water is used. The Act is very clear, if you look at Section 3 of the National Water Act, it makes the minister to be the custodian of all the water resources. -The government has to monitor the water resources in terms if the situation is getting better or worse. The Department of Water Affairs for example is configured in a way to address these issues, but there are always challenges associated with capacity. -In the beginning of the year we have water weeks, where they go around. So government also publish on newspaper with slogans "Please save our Water" and other slogans to create a sense for using the water sparely.	-Governments is the custodian of South Africa's water resources -Water license as tool to control water use -Responsible for monitoring -Awareness building to save water
IP11	Our government in South Africa is the custodian of our water resources. Currently they are playing what you call the regulatory role, so they developed the policies and regulate how water services are managed. However there has been a lot of decentralization in terms of the powers and the responsibilities. Previously government was actually responsible for also implementing things on the ground and installing infrastructure. But that role has changed and I think, in some respects it has caused quite a lot of confusion. -And the role of the Department of Water Affairs actually being a regulator and not an implementer, sometimes I think it gets mixed up.	-Government is the custodian, providing the policies and laws -Government is not responsible for the implementation on the "ground"

	Laws and Policies	
IP1	(...) the National Water Act (...) is the key piece of legislation. -As we have the free basic water policy (...) -So {the government] took this 25 litres and they said, with an average of three people in a household and they ended up with 6000 litres of free basic water (…)	-National Water Act key water legislation -Free Basic Water Policy
IP2	-I think environmental change and human security is quite important for the government, but the "Climate Change White Paper" that came out recently focused more on mitigation, output and demands for greenhouse gas emissions. So it does not focus so much on vulnerability.	-Climate Change White Paper main tool for water governance and climate change
IP3	Yes I think we have one of the best in the world. The National Water Act has recently been regarded by the United Nations Environment Programme and they said it is one of the best legislation in water governance. -In South Africa you need a water user license to extract water, for example the industry that is polluting a lot. So the polluter must pay for the cost of rehabilitation of that catchment, lagoon or wetland.	- National Water Act -Water license as political tool to control water use and pollution
IP4	South Africa is in a process of decentralizing in terms of subbasin catchment management agencies […] these institutions are already functioning. -South Africa in particular has a very progressive environment in the water sector.	-Decentralization through CMAs -Advanced water policy
IP6	-There is a very active mitigation strategy going on in government. -In the water sector there is not a lot of talk about climate change. It is two different departments that are handling climate change. […] The water people are more concerned about the growing population and the demands for water in the future. Climate Change and the impacts on water resources is not really a big topic, they are more focused on how we will supply water to the rapidly growing population in the future.	Very active mitigation strategy -Concerns are more around population growth and increasing water demand, than climate change
IP7	-South Africa adopted pretty much 20 years ago the IWRM. -So in 1992 the whole IWRM concept was completely accepted in South Africa by the water sector. -The are some changes now, for example the 19 catchment have reduced to 9. For the Vaal river 8, 9 and 10 has been combined. So they have fewer agencies, so it is to cut down the bureaucracy. -Probably the best instrument that you have for regulation the water use is the water use licence.	-IWRM adopted in 1992 -Government divided South Africa into 19 catchments management areas -Reduced to 9 catchments in order to reduce the bureaucracy -Water Licence
IP8	The government should play a regulator role, because the government has to use the license as a way of ensuring how water is used. -They have to ensure the use, management and that this is done sustainable. The government has a huge responsibility and play a big role in terms of ensuring protection though the license. Even when the government is not directly responsible, at the end of the day, it is generally accountable to whatever happens to water.	-Water licence as instrument to control water use -Water licence to control use and ensure protection
IP10	We have a very modern Water Act. In chapter one specifies the purpose of water management. So it says, the water must be protected, controlled, managed and there are various purposes such as contribute to politics, economic interests, and social welfare and contribute environmental interest. That's a legal requirement of chapter one of our act. In the second thing in the Act, we declare water for the environment and the people basic services as a priority. We state the environment as a priority.	-National Water Act -Act 1 & 2 address political and economic interests as well as social welfare and environmental interests
IP11	Yes of course our government does play a role there are a lot of policies that are in place, I think South Africa is very advanced when it comes to our acts and our policies on water management. We have got the "National Water Resources Strategy" which is reviewed every 5 years, we have our regulations in place also in cooperate water conservation and demand management. We have got our "Water Services Act" which is very good. -[…] our law is the "National Environmental Management Act" in NEMA and it talks a lot about conserving water quality. But it places a lot of emphasis on companies taking care of water resources.	-Advanced water policy -National Water Resources Strategy -Water Services Act -National Environmental Management Act

	View of Water Minister	
IP5	So that's our number one priority and we allocate water to these areas. If you go to our urban areas we put in big schemes to ensure there is no discrimination. Everybody in an urban area is being planned for to get water. So it is up to the municipalities to make that happen. There is coverage in between poor and rich to get water of all the urban areas. And now we are busy with rural areas as well. Two other areas we are talking about, is not the water allocation as such but the benefits of the outcome. If we take water away from the industries, mining and agriculture, so the formal professional systems, there will be no jobs. -The Department of Water Affairs has a gender unit, there are targets for gender actions. Of course there should not be discrimination. -So we are doing lot of studies and we are teaching people about wastewater as well. -We want to make water central to our planning. The people from the national departments must look on their checklist, before they plan anything. The second we bring in is a whole total water footprint. That means not only how much water you use, but also what are your impacts on the water resources and how do you contribute to welfare and the benefits of the country. -We report our studies to the parliament and the cabinet. It is really a top agenda and we have finished the policy now with the "South African White Paper on Climate Change". That paper is managing departments to start working individually and to report everything to the cabinet, in terms of observed and studied impacts of climate. So it is an issue that we are taking very seriously and which is taking seriously by the government. -Yes it is definitely a big topic on our agenda now, one of the top things. We even now have an entire unit that is dedicated to demand management and water conservation. And that unit is looking exactly at that link between climate change and water management. Though we can't say now exactly what is going to happen, that doesn't mean we should stop our adaptation strategies. We need to plan, we need to include the climate projection into our planning, we need to focus on demand side management and water conservation and we need to put targets that people comply, that are the whole basket of management.	Focus of government: -Basic water supply in rural areas -No discrimination in urban areas -Address bias between rich and poor in urban areas -Benefits of outcome: provide jobs & allocate water depending on outcome -Address gender bias -Capacity building in wastewater -National departments must involve water footprint in their activities -Climate change is a top agenda -Departments have to report any observed and studied impacts of climate to the cabinet -Climate projections have to be considered within planning management strategies

5.2.2 Participation in Decision-Making

As the second IWRM principle stands for participatory decision-making in water management, involving water users, planners and policy-makers at all levels and sectors (GWP 2013), interview partners were asked about their view on participation opportunities within the basin. No single interview partner considered the decision-making between users, planners and policy-makers as equal and balanced. Rather that powerful people, namely politicians on national level and important industries, made decisions without full consideration of the viewpoints and needs of local water users. Reasons for unequal decision-making were seen to originate from a lack of cooperation and communication between national, provincial and local levels, a lack of public participation around water issues and historical reasons.

Table 6: Summary of comments on participation in decision-making

IP	Paraphrase	Generalisation
	Participation in decision-making	
IP1	I would say the decision-making over water resources is mainly dominated by politicians at the moment that is the biggest problem. -Oh yes shame, especially the user on local level, these poor people they are really not involved in the decision making. -The decision-making mainly takes place on national level but we just do not have enough people and these people often do not have the right capacity to do it. There are a few good ones, but it is just not enough. So the local people are not really involved and I don't think they have a clue what is really happening because they haven't been informed. They are not involved because our public participation process around water in this country is extremely weak.	-Dominated by politicians at national level -Local people are not involved -Problem: Public participation around water is weak

IP3	No, I would not say that it is adequate or equitable. We still are still struggling with the separate development in this country, the authorities, consulters, and engineers are planning in isolation from the general public, so it feels very much autocratic. There is just not enough cooperation between government and catchment management agencies for example. Furthermore we don't have enough public participation. We would like to have an equitable decision-making, but that is not where we are at the moment. -I think the national level has got much more expertise but local government and communities are not really involved in water management.	-No equitable decision-making -Local level is not involved adequately -Lack of cooperation -Not enough public participation
IP8	No I don't think they are all equitable involved. There are good policies, which ensure the equitability, but I don't think it is really happening at the moment. You can't only blame the government of that. People are breaking the laws every day. Perhaps the government is not doing enough itself to ensure that all stakeholders such as users, policy makers and implementers and so on come together. But the responsibility lies with all of us to ensure that it works out.	-No equitable decision-making -Problem: Lack of cooperation
IP9	No, right now they are not. There is a lack of communication. Even we, the researcher are not adequate involved and especially the small people like farmer are not really involved in the decision-making. -Other sectors such as subsistence farmers don't really have to say a lot in water management, they are just not adequate represented.	-No equitable decision-making -Especially local people such as subsistence farmers are unattended -Lack of communication
IP11	No, I wouldn't say that. We have got a law in South Africa, called PAJA, which is the Promotion of Administrative Justice. -Our users suffer a lot and I think their voices are not really being heard. -So do the people on the ground have an equal voice? No. Do they have equal participation? No, absolutely not. There is a lot that needs to be done.	-No equal decision-making -Especially local people are unattended
IP12	Woman have this role of fetching the water, but the opposite happens in terms of how the decisions are made at higher level, about how much water should be allocated per household, to agriculture and the environment. -Woman have a lot of undocumented power and influence on decision that are not formal, but in generally woman at local level have not to say as much as they should about water decision-making. -The powerful industries such as the mining industry has much more to say and the rest are less involved in water management.	-Particularly woman are not equitable involved in decision-making, especially in local level -Powerful industries have more power to take decisions
IP14	Not really. If we talk about big projects like building of new dams, new irrigation schemes and so on it is the Department of Water Affairs and Agriculture. So it is the government taking the decisions and they have their own ecologists I suppose, but the overall planning is from central government.	The central government takes decision

5.2.3 Disadvantaged groups in the basin

Although the previous table has already uncovered certain groups that are under-represented in decision-making processes, the following table makes particular reference to those less advantaged in their water use and management, decision-making and access to water. Based on the knowledge and experiences of the interview partners, the most disadvantaged groups included the poor, local communities in rural areas and women. Furthermore, the downstream population as well those living in informal settlements were also deemed to be disadvantaged.

Reasons for their disadvantage can be traced back to their high and immediately dependency on natural resources. This becomes a problem in areas with poor water infrastructure where people are heavily dependent on surface and groundwater resources, which in parts of the basin are highly polluted due industrial activities.

Table 7: Summary of comments on disadvantaged people regarding water management

IP	Paraphrase	Generalisation
	Disadvantaged People in Water Management	
IP1	-As we have the free basic water policy (...) so [the government] took this 25 litres and they said, with an average of three people in a household and they ended up with 6000 litres of free basic water, but it is certainly not enough. It is not enough for flushing the toilet, it is not enough if somebody is HIV positive because they require a lot of extra washing for example. (…) So we need to change the free basic water to 13.000 but even that is not a lot of water and especially poor and disadvantaged people who needs to use extra water, they are forced to pay for it. And what concerns me, that in future the water is becoming more and more expensive.	-Poor people that are dependent on free basic water and do not have financial resources to pay for water
IP3	-But the rural areas are struggling very very much to have water systems to deliver sufficient water. -Yes, very much. Especially in removed areas also to our historical legacy of water planning. In the past we used to have areas for blacks and areas for whites, the government is trying to address that by bringing all the infrastructure to all areas in the country. But it is still in progress and it takes a long time to make it equitable so that everybody has access to clean water. -The water quality is very good in urban areas, the people in the rural areas depend more on the groundwater, which often contains heavy metals due to human activities. -I think the national level has got much more expertise but local government and communities are not really involved in water management.	-Rural population -Lack of adequate water infrastructure + heavy dependence on groundwater, which is often polluted in rural areas -Local Government and communities
IP4	Land and water were unequally distributed in the previous South Africa. There is a legacy on that that tries to address this problem but again, it is a long process and it is gradually happening and it is also a thing of gender.	-Black population because of historical reasons -Women
IP9	That is a big problem in South Africa. Usually the women play a small role in water management from agriculture to domestic use. Other sectors such as subsistence farmers don't really have to say a lot in water management, they are just not adequate represented.	-Woman -Subsistence farmers
IP10	If the people don't treat water properly, there is an environmental impact on the pollution side. And that impact with economic impact from industry causes a social impact as the downstream population must pay for it.	-Downstream population
IP13	I think certain groups are more affected than others. What you find generally is that woman work on the fields […] The youth is often excluded, they don't have a voice.	-Woman -Youth
IP8	I also think our municipalities have also inherited a lot of problems interns of the past political dispensation. There was a limited population that was provided properly for water resources.	Black population because of historical reasons
IP14	If we talk about disadvantaged people, I immediately think of people on the local level who do not have enough access to clean water and treated water and access to enough water. -In the rural areas there is no purified water available. Those people still have to make use of boreholes or rivers to collect water. But if the river is polluted, it is all what they have. They have to use this water. To have purified water as we do have in our cities for all of our people, it is still a long way to go.	-Local level -Rural areas in general

5.2.4 The role of women

IWRM highlights the important link between gender and sustainable water management. Only if women are adequately involved in using, managing and developing water resources from the household level to higher levels, will water management succeed and be sustainable (GWP 2013, LEWIS 2006). Therefore, all interview partners were questioned specifically about the role of women. The interview partners assessed the involvement of women in managing and developing water resources as being very low, especially in traditional rural areas. In urban areas gender imbalances are much lower and certain improvements are already noticeable, as for example some women occupy key positions in ministries. Inequalities within society can be

traced back to traditional ´thinking´ and other cultural aspects, a lack of self-confidence of women towards themselves and a lack of support for each other.

Table 8: Sumamry of comments on the role of women

IP	Paraphrase	Generalisation
	Gender equality & Role of Woman	
IP1	Shame, obviously there is no gender equality, this is Africa. -So in general you will meet woman in key positions, but I would say it is still a very male dominated society and there are just a few woman that are able to give input into policy documents. And one of the biggest problems in South Africa is that woman lack self-confidence. They are afraid and they don't fight for their points.	-No gender equality -Male dominated society -Woman lack self confidence
IP3	I think in urban areas you don't see gender bias in water supply and demand but in the rural areas there is a gender imbalance, because the woman travels long distances to obtain and get access to water with containers on their heads, the woman have to prepare meals, it is the woman who need water to bath their children and the men are normally not involved. So there is a gender bias, especially in traditional societies.	-In urban areas no gender bias -In rural areas gender imbalances, especially in traditional societies
IP4	You can look at different levels. So the professionals are involved in government department and agencies, in the more engineering dominated fields it is very male dominated area, in the environmental area it is half, but in general I would say especially in governments that it is still more man dominated. Some projects on local level try to work with children, so that they reach more the woman than man.	-Depending on sector -In general and especially in government a male dominated society
IP8	Not at all. I think it is extremely inadequate. If you look at the WRC, most of the projects are run by man, you almost don't see woman doing that, although there is an improvement to an extent. But there is still a lot to be done. There are a lot of attitudes, behaviour, man who don't have a space for woman at all this at different levels. -In certain areas you find more women, but the woman themselves also have a problem. I have seen a number of women in positions and they don't help other woman to come up into the decision-making. I think woman have a huge challenge. On one hand there are the man, who are very conservative and who don't want to recognize that woman can be better than them and on the other hand, there are woman, who think, now I am here and I am the only one and I am the best. In general I am very critical, we have to do more in this area.	-No gender equality, male dominated society, although woman can be found in key positions -Woman also do not help each other properly, especially woman in higher positions
IP11	I would say it definitely has improved. If I look particularly at the sector we are working in, engineering sectors is heavily towards the male gender. That could be due to a number of factors such as socialization, so those women generally don't choose engineering as a career, although I think that is also changing quite rapidly. -And it is interesting, because I think in Sub-Saharan Africa your largest work force particularly in terms of agriculture, 80 % of your workforce is woman. But in terms of just obtaining the necessary skills, there is still a lot that need to be done in terms of gender quality. It is improving, but it is just not enough yet. -Usually the people who get harmed are the people who generally don't really have the money to be able to undertake those processes. So I don't think we have got equal voice, I think there are a lot of presumptions that are our governments have made.	-Certain improvements -Depending on the sector, but in general not enough gender equality
IP12	In theory yes, in practice gender equality is very difficult. -I think there still remains the real challenge. People are tired of hearing gender, but the problems haven't gone away. We don't have female professional in the field, at community level we don't have woman formally influencing water resources management.	-No adequate gender equality so far -Women are not adequately represented and involved
IP14	The women are mostly involved in the collecting of water and wood, they are the people on the ground. They are responsible for the gathering the water for the household.	Woman are responsible for all water-related household activities

5.2.5 Trends and Impacts of Climate Change

When questioned about observed changes in South Africa's climate, temperature increases and seasonal shifts were most frequently mentioned, which have had various impacts on the environment and the population. Seasonal shifts were explained as being caused by a shorter summer season, more intense rainfall and longer dry winter periods, although the annual

precipitation amount has stayed the same. As a consequence of seasonal shifts, impacts identified included more floods during the rainy season and longer dry periods, all of which affect the water supply. Other extreme weather events such as snow in regions where is does normally not occur and increases in the frequency and magnitude of disasters such as field fires, floods, and changes to rainfall patterns were also mentioned. When asked for expected future impacts of climate change, interview partners identified the following challenges: water scarcity, thus affecting people´s security, impacts on agriculture due to shifts in seasons and thus affecting food security, a rise in natural disasters such as field fires, droughts and floods, changes in water run-off and precipitation due to snow melt in the Lesotho highlands and higher water pollution levels in the dry season.

Table 9: Summary of comments on observed climate trends and impacts of climate change

IP	Paraphrase	Generalisation
	General observed trends and impacts	
IP2	-There seems to be changes in rainfall and warming. Some of my students have done temperature analysis and evaluated temperature data and there is a rise in temperature over the last 60 years. -Yes I would say that climate change affect food security. Especially local communities, so people that basically produce might be affected in a long run. -I think at the moment there are other things that are directly affecting the quality of water such pollution, overuse of water resources or mining. So I would say at the moment climate change does not directly affect the water quality it just compound with these factors. So climate change is just worsening the existing problems	-Changes in rainfall and warming -Impacts on agriculture, thus affecting food security -Climate change worsens the existing problems
IP5	-Yes, we do have some observed trends. Snow for example is one extreme event that has been really unusual in South Africa. Normally it is just common in the Drakensberg and the Lesotho Highlands, but a few weeks ago we had snow in Johannesburg and Pretoria right in the middle of the day, which is very unusual. It hasn't been like that since 1984 I think. I can tell you about a work where we looked at natural disasters, so certain natural hazards, that are showing us trends. We do have observed trends that we cannot deny in terms of increase more than in the number of hazards but also in shifting of rainfall patterns. If we look at the dates of the South African weather services, there seems to be a trend to more field fires. So it is about floods, snow, hail, tornados, wind, fires where has been observed an increase in the number of disasters. We have seen floods in the last two years that we have never seen before in South Africa. Floods like in Thailand, so very large-scale kind of floods. And not only in the number of disaster-frequency, but the magnitude also has increased to such an extent that societies can't no longer cope in respect in between the process of coping, there is always another disaster than even reverses it even more that the disaster before. -So we are really not expecting uniform impacts, each river catchment will respond in a certain way. [...] So we need to study these impacts and shouldn't generalize. -But we still haven't really seen what the impacts are in the system themselves, what we are trying to figure out at the moment. Because it will be hard to draft adaptation strategies without knowing how the systems are responding.	-More extreme weather -Shift and increase of disaster frequency and magnitude of disasters such as field fires, floods, and shifts in rainfall patterns -The biggest issue is the uncertainty regarding climate change impacts which makes to harder to draft adaptation strategies
IP6	So if you look at climate change there are two aspects. The first one is to look at changes that occurred over the past forty years. According to the IPCC the global warming extended quite significantly consistently over the past 40 years. So if we look at observations over the last 40 years in terms of rainfall and temperatures as the two most important ones, there is definitely a warming taking place. The unusual thing is that the warming is more taking place along the coastline, but also where we have more cities and industry of course. But this is different to the IPCC projections that the central continental part will warm faster than the coastal part. So this is the first thing we observed, so we have a little bit of a conflict between the observations and the IPCC. My feeling is that the slower warming over the interior might be because of urbanisation and industrialization, where a lot of particles are released into the atmosphere, which might even contribute to a cooling. -But beside of that there is a clear signal that South Africa is warming, there are some studies over the last forty years. If we look at observations of rainfall over South	-Differences between IPCC projections and observations -Changes over the last 40 years: temperature increase, shifts in the seasons -Annual rainfall stays the same - Summer season gets shorter with more intense rainfall, while the dry winter period gets longer -Impacts: more floods and longer dry periods, affecting the water supply -Challenge for water management

	Africa, you know South Africa has a wetter east during summer month and during the winter in June, July and August we have wetter area over the western area such in Cape Town and the coastline. If we look at the annual rainfall, we couldn't detect any changes in rainfall over the last 40 years. So in South African the average annual rainfall is still the same. So the average annual rainfall won't change according to our own observations and according to IPCC, but this is contradictory to what some people are telling us that Africa is going through severe droughts or wet conditions. -The problems in South Africa is actually what is happening in the year, because the average annual rainfall is not changing, but in the year there are indications that the summer seasons are becoming a little bit shorter and if the annual rainfall stays the same but the season gets shorter, we are getting more intense rain. And this might have significant impacts, because we have a shorter period with more floods and a very long dry period, although the same amount of water will fall over the year. -As far as water management is concerned is that if we can capture the water that is falling about this short period in reservoirs for the longer dry periods, we might sustain this. But this is a big problem, how we are going to do this and catch the water of this short rain period. So you have to distinguish between the winter and the summer rainfall and the projections and observations, that sometimes totally opposite. - The effect of climate change and climate variability on smaller farmers is actually a problem.	
IP8	We know that South Africa's climate is highly variable, but in a long term climate change is going to exacerbate the situation in terms of eutrophication problems. We have some of our dams with a lot of algae not necessarily as the result of climate change at this junction but also because of the water use upstream regarding the return flows from agriculture and the municipalities. So their salts are accumulating in the dam triggering eutrophication.	-In long term, aggravation of already existing eutrophication problems
IP12	What is happening now is that we have a growing population change, a movement of the people from rural areas into cities and then climate change. If you combine the issues of demographics and the issue of climate change, it creates many other problems, for example how we are going to achieve the food security in different places?	-Problem: Combination of population growth &climate change might affect food security
	Expected Future Impacts	
IP2	- Maybe it is a little bit too early to know whether if climate change is affecting agriculture, but […] I think potentially it could affect agriculture quite severely in a long term. I would say water shortage is one of the biggest and possibly impacts on agriculture, due to changing seasonality effects. -I think water is becoming one of the biggest problems in South Africa in the future and this will affect people's security.	-Water scarcity, affecting people´s security -Impacts on agriculture due to shifts in seasons
IP4	Obviously there are quantitative and qualitative problems regarding the water resources. At this point we are focusing on qualitative problems, but I think the future will be the quantitative problem, worsening by climate change.	Water scarcity
IP5	Definitely the water resources. Especially in terms of water quality, but we just do not have enough studies that proves what I am saying at this point. -Water scarcity is really becoming one of the major problems. The second one is food security. We have already seen disasters that have affected food security to an immense extent. Field fires and droughts we did not really have in the last 10 years, but the tendency is, if once we get hit by a drought it kind of reverses everything. Floods are also a problem, in December 2011 it was a nightmare, we had a very very wet season so that as well affects food security and prices.	-Water scarcity -Impacts on food security, due to higher frequencies of natural disasters such as field fires, droughts and floods
IP6	-So in general we are heading more into a dry scenario in future. -If we look at water supply, the annual rainfall will not change so much, but due to the spatial changes we will have to make provisions. The other thing is that South Africa is getting a lot of its water from Lesotho, where you have very high mountains with snow on it. So if the warming is continuing we are having now, the snow which is a reservoir of water, might start melting in Lesotho and rainfall might start to reduce over the Lesotho mountains. We have the risk of losing snow in Lesotho, which has effects on the run-off and the water falling down. In terms of water quality and climate change you will probably have bigger problems of pollution because of a longer dry period and the pollution doesn't get washed away.	-Drier climate -Snow melt in the Lesotho highlands might affect water run-off and precipitation -Higher water pollution in dry season

5.2.6 Climate Variability and Uncertainties

Climate variability in the basin is seen as a natural phenomena, which varies in space and time. Although to a certain extent people are already used to some climate variability and the consequent impacts on livelihoods, climate change adds an extra layer of stress on top of this.

Uncertainties surrounding climate change are usually due to lacking scientific knowledge that might otherwise improve predictions future climate change and secondly, a lack of understanding of climate change processes and the impacts themselves. Interview partners find it difficult, to trace back certain phenomena (e.g. droughts or floods) to climate change, as these may also just be the result of natural climate variability, thus creating uncertainties.

Table 10: Summary of comments on climate variability and uncertainties

IP	Paraphrase	Generalisation
	Climate Variability	
IP3	Our rainfall is very variable and varies spatial, so water is not always available where it should be.	Rainfall highly variable
IP6	People are already used to fluctuations in climate, so the impact will be not that severe.	Climate fluctuations are common
IP10	We are already in a water stressed country, we have got a naturally highly variable climate in space and time. Variability is normal in South Africa. Now we put all the people on top of it, so it is stress on stress, we already build a lot of dams, we pollute and climate change will be even more stress on the stress.	-Naturally highly variable climate in space and time -Climate change will worsen the situation
IP12	Variability of climate is in itself very poor managed. Climate variability affects peoples life, agriculture etc. Before they have putting place systems to actually deal with variability, you have an extra layer of complexity now, that is been added, which is in itself climate change. I think there is a poor response to climate variability, because of poor capacity. Climate change only makes that worse (...).	-Climate change adds complexity and exerts extra stress
	Uncertainties	
IP2	I guess, capabilities that are lacking include an understanding and predictions of the impacts of climate change, so the actual science. -There is a big lack of capacity and understanding of impacts	Lack of understanding and prediction of climate change
IP5	But we still haven't really seen what the impacts are in the system themselves, what we are trying to figure out at the moment. Because it will be hard to draft adaptation strategies without knowing how the systems are responding. Though we can't say now exactly what is going to happen, that doesn't mean we should stop our adaptation strategies.	Impacts of climate change unclear which makes adaptation strategies difficult
IP 6	The capacity of the people, who know something about climate change, is very limited in South Africa […] so the knowledge capacity and the people who have to enforce policy or legislation is very small.	Lack of knowledge creates uncertainties
IP12	I think at the moment we don't really understand yet, what is going on regarding climate change and these things are going to affect our position in the future. The second thing is that climate change creates too many unknowns. There are examples of dealing with variability and climate change in terms of uncertainty and so on, but there is a lot that we actually don't know. We don't know actually if the hydrological cycle has changed due to climate change. And that is a big thing. The question becomes how to deal with things, you don't know, how you deal with uncertainty. Water resources management is already poor in many places and climate change has blown the problem out of proportion. We also have to know how to deal with the growing pollution and climate change. It just makes us appreciate more that our management decisions may not be as effective for addressing the future.	-Uncertainties and many unknowns around climate change -Hard to deal with uncertainties -Water management is already poor in many places and climate change adds extra stress
IP13	Something that I have learned from this edited Volume that we have just produced is that it is extremely hard to identify specific climate impacts from natural climate variability. In localities where people are very dependent on natural resources such as water, it is very hard to say this lack of rain this year or this flood is the result of climate change. If it is so difficult to identify climate impacts how can that are negotiated? Because many people are focussing on climate change adaptation but what they are saying is, let's build capacity and resilience at a local level, so that it makes a difference even if climate change doesn't happen. So if the projected impacts don't realize lets have contributed to development, the management of natural	-Hard to identify impacts that are directly related to climate change. -It is important to manage the uncertainty around climate change properly

	resources, economic growth. This is important to me, this distinction between how do you manage the uncertainty around climate change. Also related to water in terms of climate change and climate variability.	

5.2.7 Vulnerable Groups to Climate Change

According to the interview partners, vulnerable groups that are particularly affected by the impacts of climate change are primarily the poor and rural communities (subsistence farmers).

The experts identified several reasons for people's vulnerability. For local communities, their natural resources dependent lifestyles (to water, livestock and irrigatation farming) and very low adaptive capacity were identified as key reasons making these groups more vulnerable to the impacts of climate change. Furthermore, local communities and subsistence farmers lack access to information, which might help them to develop or adapt farming strategies. A general lack of education or of alternatives, unemployment and poverty results in additional vulnerability. Also poor governance, corruption, a lack of capacity on local level and flood prone housing makes people more vulnerable to climate change. In terms of adaptation strategies, diversification of crops and a change into other forms of direct income (e.g. labour related activities) were mentioned, although the impacts of these are linked with many uncertainties, thus aggravating the possibility of adaptation measures (see table 11).

Table 11: Summary of comments on vulnerable groups, root causes of vulnerability and possible adaptation strategies

IP	Paraphrase	Generalisation
	Vulnerable Groups	
IP2	Especially the rural poor that directly rely on natural resources, especially the people conducting rain fed agriculture more than anybody else, for example in the northern provinces where it is very dry. -Yes I would say that especially local communities, so people that basically produce might be affected in a long run. -I suppose especially for people in certain areas that rely on water resources. -Furthermore there will be changes for communities that rely directly on natural resources. -I think in a lot of areas climate change is worsening poverty related problems but particularly more for rural communities. -If you look at the poor communities, they have the least adaptive capacity.	-Rural poor and local communities that directly rely on natural resources -Poor communities: climate change might worsen poverty related problems -Poor communities have the least adaptive capacity
IP5	South Africa has a high level of unemployment, but money is your source of your basic livelihood. And it makes you better able to cope with any natural disaster. Beside the unemployment, there is a very low level of skills in this area. Many people still live from subsistence farming and traditional farming methods, which doesn't come from ignorance but they just don't know what else to do. They are not well positioned for example to deal with genetically modified seeds and all this sort of things. So it is just the basic farmer who is living day to day, from hand to mouth just to survive. And these people are not in the best position for coping capacities with any natural hazards. So these people would go through a drought and they start to recover and then a flood comes. These subsistence farmers don't have anything else to rely on beside their land. So coping and adapting is not easy.	-Unemployed people -Traditional subsistence farmer
IP6	The effect of climate change and climate variability on smaller farmers is actually a problem. -These people live from year to year; they don't worry about fifty years from now, although the commercial might worry more about that. -How do the people and especially the farmer deal with the impacts of climate change? There are two types of farmers in South Africa, the subsistence farmers who are just	-Small farmers who are heavily depending on natural resources and thus vulnerable to climate variability.

	farming on their little piece of land for their own use and these people are really affected not only because of climate change but also by the variability of climate, that's the one poorer farmer. And then you have the big commercial farmer.	
	Root causes of Vulnerability	
IP2	-So poverty definitely, and a lack of alternatives. -It is also an issue of housing in urban areas, so the quality of houses is more prone to flooding.	-Poverty and a lack of alternatives -Inappropriate housing conditions
IP5	-Beside the unemployment, there is a very low level of skills in this area. Many people still live from subsistence farming and traditional farming methods, which doesn't come from ignorance but they just don't know what else to do. -And these people are not in the best position for coping capacities with any natural hazards.	-Lack of skills and knowledge to cope with any natural disaster
IP6	The commercial big farmers they are fine, they plan very well and things like that but for the subsistence farmers, there is a need of information and knowledge. These people don't really know how to farm and get the maximum out of their land. Many of them are using the same practices that they used 100 years ago. It has to do with culture sometimes as well, and some people still believe in the rain-queen and they don't worry about sciences.	-Subsistence farmers lack information and knowledge regarding appropriate farming strategies
IP13	I think the high dependence on natural resources of farmers such as water for animals, consumption and farming. A lack of adaptation options, they may not have the money to adapt in terms of building dams or to get a water tank. I guess they don't have the entitlements to address a particular problem, sometime they are not educated, and they don't have access to markets, poor governance especially on local level. On local level, there is also corruption, a lack of capacity.	-High dependence on natural resources -Lack of money to adapt -Lack of education & capacity -Lack of access to markets
	Adaptation strategies	
IP2	I think people do make certain adaptations, so it is more about the poverty impact that is worsening and that the people are coping with that but not really dealing. Other attempts are to diversify livelihoods and trying to change into other forms of direct income, so labour related activities. But I wouldn't say these are really effective coping strategies in a long term. -I think the impacts can be quite severe but I am not sure if the people necessarily need to deal with them yet.	-Diversify livelihoods -Change into labour related activities, so other forms of direct income -The impacts of climate change are not very visible yet.
IP5	Though we can't say now exactly what is going to happen, that doesn't mean we should stop our adaptation strategies.	Despite of prediction uncertainties, adaptation strategies are important
IP6	That is a very difficult and risky question to us. […] So despite of climate change we are living in an area where we already have huge fluctuation, we have natural occurring droughts, we have very wet periods, we have snow, and we have warm periods. That is why I think that South Africa or southern Africa in general is better prepared to adapt to large fluctuations. -As I already said, South Africa is a country with already big extremes in climate and people sort of have to adapt to that. At the moment people are used to adapting quickly.	Due to natural climate variability, people are used to fluctuations, so adaptation seems to be relatively easy at the moment

5.2.8 Capacity Building

"Water sector capacity building supports the process of transformation for the implementation of integrated water resources management, including water policies and legislation, institutional development and human resources development" (CAP-NET 2002:4). The two interviewed experts in capacity building for water management consider capacity building to be essential for successful IWRM implementation and to enhance resilience to climate change impacts. Capacity building aims to make expertise available, to support decentralization processes for decision-making and empowers people on the local level to develop skills. As capacity building supports the ability, to manage water resources effectively and to maintain local water infrastructure, it ultimately contributes to people's resilience at local level.

But the experts also identified several challenges for successful capacity building. Main challenges include the high costs for meetings, transport to (remote) communities and cell phone bills (as capacity building requires frequent contact with people), difficulties in working with people with a lack of (scientific) background knowledge, a lack of willingness from the community side, the slow processes of changing institutions, the slow process of changing mind-sets of people and providing incentives for them to actually change.

Table 12: Sumamry of comments on capacity building

IP	Paraphrase	Generalisation
	Capacity Building for IWRM	
IP7	-So I would say capacity building is really important for IWRM, especially to work with the existing institutions and to strengthen them, because the sustainability factor is four, five times higher if you do it that way. -Capacity building also implies making expertise available. -There are different types of trainings, there is hygiene trainings, construction training, quality control training and for different tasks. -An important issue is decision making and that decision-making should be decentralized to the community as much as possible. The second one is that people should be empowered in a sense that they need to develop portable skills that they can also use for other projects or in their own, if they develop an own business. -The are some changes now, for example the 19 catchment have reduced to 9. For the Vaal river 8, 9 and 10 has been combined. So they have fewer agencies, so it is to cut down the bureaucracy. For the community point of view it is a challenge because the agency is now farer away from the people. So it important to strengthen these forums, so that they are as powerful as possible.	-Important for IWRM -Makes expertise available -Different types of training -Aims: to decentralize decision-making and empower people and sectors, by supporting the development of skills -Aim: Strengthen the capacity sub-catchment forums, which are important for the implementation of IWRM
IP12	But what we need to see for example, that capacity development is number one, stimulating that these organizations are developed to manage water at the basin level or where they exist, that they are fully able to carry out their functions. So there are some indicators that show us that there is capacity development. We actually see the allocation of water response to the developments needs of the area in which water resource management is supposed to be embedded. -Institutionally, we break down capacity into a generic three point, that individuals need to have skills, the organization for whom it work need to have the ability to create change and to manage water resources effectively and to be adaptable according to the changing world and a changing state of water resources and thirdly, that policies and institutions need to create the incentives for better water resources management. So those would be the three levels of capacity development. What when you are doing all this as well, what then is supposed to happen? I think what then is supped to happen, is better water governance [...]	-Support of water management at basin level, helps to allocate water in response to needs -3 Aims: skills development, organisations need to manage water resources effectively and policies and institutions need to create incentives for better water management
	Problems and Constraints of Capacity Building	
IP7	The basic finances, so to get a venue, to get transport to the venue and to communicate to people, so the costs for cell phone. These are relatively small costs but then those communities they are an obstacle, so the costs of meeting, communicating, and transport that's one obstacle. In some instances in water resource management in this governance issues, the people try learning. So you may work with people who do not do had chemistry at school, and to explain all the processes going on by acid mine drainage, this takes a very long time. But in general people get it, if you are patient enough. So in some of the citizen science aspects it takes a longer time, because you have to do basic sciences as you start. -I think capacity building is mainly affected by people who do not really want to cooperate. -The crucial issue for capacity building is where the people really need and want it.	-High demand of financial resources due to transport to communities and costs for cell phone to stay in contact -Work with people with a lack of knowledge background -Lack of willingness to cooperate
IP12	So in many ways capacity development for IWRM has not achieved its goal. It has achieved some goals, there is now favourable in many places, enabling environment in terms of the law and policies that explicitly say, a state that explicit look at the resource in an integrated manner as a system, that specifically embrace the principles of IWRM, but the implementation on the ground has been a little bit slow. There are a couple of reasons for that. Firstly, things go in faces and first you have to motivate people and institutions to change. This means, a lot of the education that we are making is about preaching the gospel of IWRM. And when people open up the space for change, then you can filter in some more specific capacity development.	-Aim: implement IWRM -Problem: Not achieved yet, -Hard to motivate people and institutions to change -Change institutions is a very slow process - Decisions, where capacity development makes sense in terms of financial resources and

	-It is no longer about motivation, it is really about saying how this new framework actually tackles the problems that people face on the ground. So, changing institutions is in itself a very slow process. -What we need to do is, to not just support the development of knowledge and pushing through new knowledge, but to support the incentives that forces organization such as water utility and river basin organizations to actually show how they are responding to this knowledge, both from international and local level. -I think, the experts in capacity building need to do their homework and understand first, what is the logic of how different organization work in different places and respond then to very specific needs of these different organizations. We need to be able to provide a framework for them to improve their decisions, without dictating this package. It is about the adaptation of the concept now in terms of the geography of the place.	the outcome -Give organisations on local level incentives to change -Understand how different organisation work to provide a general framework to improve decisions

5.2.9 Awareness

It is widely recognized, that without a change in the way consumers and industries use water, sustainable water resources management is not possible. Awareness around the value and scarcity of the resource is therefore extremely important to achieve sustainable water management (SCHAAP & STEENBERGEN 2001). When questioned about their awareness of water-related issues in the basin, interview partners identified a general lack of awareness of water scarcity or the value of water and also the consequences of water pollution. According to stakeholder's experiences, a lack of knowledge (capacities) within the population was identified as a possible reason. Furthermore it seems that the government does not do enough to raise awareness about water-related issues or climate change within the country. However, experts did note some improvements of awareness within the population during the last few years.

Table 13: Summary of comments on awareness around water-related issues

IP	Paraphrase	Generalisation
	Awareness around water resources	
IP1	So the average domestic consumer is turning on his tap and they don't realize why water needs to cost money and why it becomes more expensive. They don't realize the pollution problem, they don't realize how much water we are wasting. -So these people [politicians] are supposed to our national Water Ministry is very weak with a lack of capacity, they are corrupt and there is a lot of partisanship. They should raise awareness around the importance of water management, pollution management and so on but they are not fulfilling their duties at all. It is very sad but it is true. -We need to regrow our civil society, because the average South African knows, that we have a major problem around energy. (...) But we are not aware of how big our water problem is. And it is going to hit us unfortunately much later, it is not going to hit us so much now, but in future.	-Lack of awareness within population regarding reasons of water costs and pollution problems -Lack of awareness building from political side
IP3	On the demand side we have the problem, that many people do not know how to use the water resources wisely. The water still has a free sense because it is very cheap and we have got the National Water Act, which allocates 6000 litres of water per indigenous household every month. So these people who don't have a financial obligation often don't understand that water is a scarce commodity.	-Lack of awareness regarding sustainable water use -Possible reason: Free Basic Water
IP8	If I were the municipality then I would demarcate areas that are vulnerable and should not actually being used for activities. But the current scenario is that thinking of municipalities is not developed so far yet and people maybe do not understand certain issues.	-Lack of awareness due to lack of knowledge

IP10	And certainly the people have to pay for water to become aware of the value of water resources. -The second security point is how the people treat the water, because they don't treat it properly, which is a security risk.	Lack of awareness because of ´Free Basic Water´ -Lack of awareness leads to water pollution
IP11	We are very pericentric in the way that we approach the environment. We extract form the environment, because we need the resources and services they provide and that's all it is good for. Just recently we have had to really shift our focus to what we are putting back into the environment, the waste thing, function of the environment, how much is it actually able to cope with, where are the limits and I think we already achieved some limits, because we are always extracting but putting nothing back to help sustain it.	-Awareness around water is a relatively new trend

5.2.10 Water Infrastructure

Sustainable water management is only possible with adequate water infrastructure, thus ensuring that water is available in the required amount, quality and duration (GWP 2008). The interview partners identified many challenges around water infrastructure in the basin. These include leaking pumps, problems with water quality and the portability of infrastructure, (sewage)- infrastructure backlogs in rural areas and informal settlements, the difficult physical environment in areas requiring infrastructure, poor infrastructure maintenance, a lack of awareness of and vandalism of infrastructure as well as theft of pumps.

Table 14: Summary of comments on water infrastructure within the basin

IP	Paraphrase	Generalisation
	Water Infrastructure	
IP1	We have serious leak problems. So we are cleaning the water, we are pumping it all the way up to municipalities and then a lot of water gets lost due to leaks.	-Leak problems
IP3	So the main problem is water quality and water portability in terms of water infrastructure on the supply side. -Yes, the government has very much to provide the infrastructure in urban and rural areas of this country. But the rural areas are struggling very very much to have water systems to deliver sufficient water.	-Problems around water quality & portability -Infrastructure backlogs in rural areas
IP7	Then there is a more technical critic that says that IWRM depends on having adequate infrastructure in terms of dams, pipelines and so on. So we in South Africa do have a lot of dams and water detention for the dry country, but there are big areas such as remote poor areas that were under provided and where the infrastructure now has been built, but also that at least 2 million maybe more live in places where slopes are really bad or they are so thinly distributed, that it is difficult to have infrastructure. IWRM maybe does not have the technical base in South Africa to just apply those principles.	-Infrastructure backlogs in rural areas, also because of the physical environment
IP10	Then many people especially in rural areas they vandalize and they steal the pumps. The same thing on waste, so if they don't maintain the systems, that is a problem. -We know that it is becoming more and more expensive to run water and people just invest in infrastructure, but not on the operational maintenance.	-Vandalism & stealing of pumps -No operational maintenance
IP11	So and particularly in the poorer areas as the townships for example, the infrastructure that has been in stored is actually not adequate to me regarding the population demands. And that is a huge problem, so we sit with the huge infrastructure backlogs, so infrastructure that needs to been upgraded. -And also our infrastructure asset management is just lacking at the moment. People want to see infrastructure being in stored but there is seldom a plan to actually maintain that infrastructure. So you in store something after a time it is all in ruins, because nobody maintained it. This is also a big factor in South Africa.	-Infrastructure backlogs in townships and rural areas -Lack of infrastructure asset management -Vandalism of water meters -Lack of understanding the idea of water meter

	-We have a huge shortage in our country, particularly the technical skills that are required to manage systems properly. -I have seen it, that even on the very local level, where municipalities for example install a prepaid meter, so a water measurement device. There you get a connection in stored, you get a water meter and it calculates how much water you use and the municipality can bill you for that water. But they have not consulted the community, they don't know what it is what the people are actually wanting, what their perceptions are of meters. And a 5 or 10 million Rand investment is down the drain, because people have completely smashed the meters. […] So people go there to install devices that the community and the water users don't actually understand. And they are completely vandalized those installations, we are sitting in a situation where you wasted 5 or 10 million Rand, because you haven't actually consulted. And you see this lot.	
IP12	So the service deliveries are poor and the quality of the system and the sustainability are problematic.	Poor service deliveries and maintenance of infrastructure
IP14	So there must be major upgrade of virtually all sewage systems to be safe with our surface water. This involves a lot of money and a lot of knowledge. You don't see a lot of money pumped into this problem. -Water Infrastructure, especially the sewage system, is not properly maintained. Growing population leads to further challenges.	-Backlogs in sewage systems -Lack of maintenance of infrastructure

5.2.11 Conflicts

IWRM promotes vertical and horizontal cooperation and communication in order to prevent conflicts (VARIS ET AL. 2008). Interview partners identified conflicts arising from competing interests between different water users and (unfair) water allocation. Other tensions between upstream- and downstream populations regarding water pollution by human activities (industry and agricultural contamination of water resources, ecological pollution due to untreated wastewater and dumping) were also identified.

When asked about conflicts due to climate change, interview partners were not aware of any conflicts that could be traced directly back to climate change. In spite of this, possible tensions were mentioned in terms of droughts and floods, which may affect food security and so trigger conflicts in future.

Table 15: Summary of comments on conflicts due to water resources and climate change

IP	Paraphrase	Generalisation
	Conflicts	
IP1	Well there are lots. One of the biggest conflicts is between farmers and domestic and industry. But the conflict is not really seen around water but around costs. -But what is really happening is that farmers can access a lot of water for little money, so industry and domestic consumers in particularly are actually picking up the bill. So the conflict is really about money, around costs of this resource. And because insufficient pressure has been placed on our farmers to be more efficient with the water use, so they still consume a bulk of our water. Ironically the actual amount of food that South Africa has been producing has actually declined. So they are still using a lot of water but it is not for our food security on national level, because we are now importing food.	-Not directly seen around water, but more around money and allocation between famers, domestic and industry -Agriculture is the biggest water consumer
IP2	Not directly. There are some deliveries in terms of food but it is not directly related to climate change, but in general I think climate change will raise that possibility of conflicts.	No conflicts directly related to climate change but climate change will raise the possibility of conflicts

IP3	No I am not aware of any direct conflicts there, but in a catchment like that you could expect settlements that are affected by upstream activities such as dumping. So the downstream users and also their livestock are affected, because they are consuming the water. So in that context conflicts are possible. -Pollution by human activities. We are talking about industry, we are talking about mining, we are talking about agriculture and their contamination but we are also talking about informal settlements. These people are taking land without permission, they occupy the land, there is no infrastructure, no toilet facilities and no water and they waste a lot which affects the catchment, the environments in general and the water as well.	-Not directly, but tensions between upstream and downstream settlements -Tensions around water pollution by industry, mining and agriculture and informal settlements
IP4	And there are two large dams on the middle Orange river, the Gariep and the Vanderkloof dam, generating hydropower. You also find there conflicting objectives for water resources management. The hydropower generation affects the water flow. -Obviously they are building new infrastructure but water will become more and more expensive. Water productivity is higher in any other sector than the agricultural sector, which is currently the largest user. So some of the discussion will be about reallocation between sectors, which is also a highly political issue. So this will be a major cause for conflicts.	-Conflicting objectives for water resources between sectors -Reallocation between sectors
IP6	I don't think in South Africa, I know about Central Africa such as in Uganda, they have big problems with that issue. We sometimes have droughts and floods but I don't think it's leading to conflict.	No conflicts due to climate change
IP8	Groundwater and surface water do interact, so if there is a problem here, it can causes problems downstream somewhere. Issues of improper sanitation of many people in one area could be a problem.	-Upstream-downstream constellations
IP12	-If allocated in some places it takes recognition of how much water you are actually having. There is evidence now of over depletion of rives in many places, and there is of course competition for water and so allocation in many times doesn`t respond to a wide stakeholder group. Competitions itself are not a problem, but often just not well managed and leading to conflicts maybe. -Community managing and irrigations schemes are going to have impacts downstream of the basin or outside of the basin, if they pollute the water with their agricultural practice it is going to be felt at some point.	-Water scarcity -Competition over water & allocation issues that are bad managed -Downstream impacts due to activities of the upstream population
IP13	A particular response to climate change would be tensions and conflicts. If you go the rural areas in South Africa you might find that government institutions are weak and local communities have their own systems of resolving conflicts.	Climate change might raise the chance of conflicts.

5.2.12 IWRM implementation

As discussed in the second chapter, GWP (2009) has defined IWRM as "a process which promotes the coordinated development and management of water, land and related resources in order to *maximise the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital eco-systems".* To analyse the progress of IWRM implementation, interview partners were asked about the economic, social and environmental balance and their general view on IWRM implementation in the basin. Although South Africa's water governance was generally assessed as being quite advanced in its provision of a supportive legislative framework for IWRM, the experts identified the actual implementation of IWRM as being the greatest challenge. According to the experts' knowledge and viewpoints, economic interests generally tend to dominate over social and environmental issues. Problems with implementing IWRM include: lack of cross-sectoral cooperation and communication between ministries, national and local levels and between institutions, a lack of human resources at national and municipal level to enforce legislations and a a general lack of capacities on all levels, particularly the municipal level. Some example given of this include, regarding the

maintenance of water infrastructure, there is an unclear distribution of responsibility between the national and municipal level, non-compliance of water licenses, power differentials, a lack of understanding of the IWRM concept, non-accordance between political boundaries and catchments, corruption, poor workmanship, partisanship and a lack of awareness, a lack of scientific knowledge of the hydrological situation in the basin, a lack of political willingness and financial resources as well as improper management of financial resources.

Table 16: Sumamry of comments on the sustainability concept[14] and IWRM implementation

IP	Paraphrase	Generalisation
	Problems of IWRM implementation	
IP1	No, I think the economic aspects are the most important. We do create jobs, either if they are good or bad, but they haven't really focus on social welfare, in terms of qualitative good and well-paid jobs. -And the main problem is that there are bigger interests on the political side, for example how to create jobs and business and to bring money in, but at the same time all the environmental issues just get ignored. So the main issue is about politics and a lack of capacity. So here in South Africa we do have a lot of environmental legislations, but the trouble is, we cannot enforce them because we have a lack of capacity and there is a lack of political willingness. -It is a beautiful piece of law, the National Water Act, but in some parts it just hasn't been implemented especially when the catchments don't match with the political boundaries. -But the government on the one hand does not always have the money to enforce these legislations, they do not always have the capacity and there is a lack of political will. We have serious water problems, especially around pollution. -So these people [politicians] are supposed to our national Water Ministry is very weak with a lack of capacity, they are corrupt and there is a lot of partisanship. They should raise awareness around the importance of water management, pollution management and so on but they are not fulfilling their duties at all. -So the ministries are not working together. -But there is a serious shortage of staff, so they just so not have enough people. -So to evaluate the cross-sectoral linkages I would say it is weak and weakest link is at our national government department level. The ministries kind of work more against each other than working together. -So that's the whole debacle that they just operate and extract water without a water license. -As we have the free basic water policy (...), we knew that we have to get people to pay for water, because if people do not pay for water, they don't appreciate it and they waste it. (...) Cleaning the water costs money, building the dams cost money and our water is basically an industrial product where you have to pay for. -And what really concerns me in the long run is that they have been severely limited to how much water they can have, free of charge. And obviously in a country like South Africa with regular droughts that we have, we are a water stressed country and we can't have people just wasting water, so they need to pay for it.	-Economic interest predominate over social and environmental issues -Ignorance of environmental issues -Lack of political willingness -Catchment agencies do not fit with political boundaries -Lack of money to enforce legislations -Catchment areas do not correspond with political boundaries -National level: lack of capacity, corruption, partisanship and not enough awareness building from political side -Ministries are not working together -Lack of human resources at national level -Cross-sectoral linkages weak and poor in terms of communication and cooperation between ministries -Noncompliance of water license
IP2	Another problem is a lack of capacity at local level	Lack of capacity at local level
IP3	We have got a wonderful piece of legislation with the National Water Act, but the implementation is a very big challenge. The new government often have no idea about the hydrological situation and environmental economy. -The water supply and the demand in terms of provincial government who have to provide water of quality and quantity to households.	Lack of scientific knowledge of hydrological situation and environment economy -Provincial government: gap between water supply and demand
IP4	South Africa in particular has a very progressive environment in the water sector. The problem is that the government is struggling with the implementation at various levels.	Progressive environment in water sector, but government struggles with implementation

[14] *According to the definition, the core principles of IWRM include: Social equity, economic efficiency and ecological sustainability (Philip et. al 2008)*

IP6	So the knowledge capacity and the people who have to enforce policy or legislation are very small. And therefore in many cases we have very well prepared legislations and laws on paper but when you look what is going on out there, you will see it is a different story. That's because there is not enough people to really look after it and push this and enforce the laws.	-Knowledge capacity low -Lack of human resources to monitor implementation
IP7	-And I think it is a fundamental weakness of IWRM if that power differential is not balanced out. - Some work on their old licenses and don't stop their business, but there is no legal system in place to control the water use. -Unfortunately there is a big backlog on this water use licenses. So your main instrument to control the behaviour of the water users is stuck in the bureaucracy, which is sad. -So most people really criticize IWRM on the basis on whether it works as promised. -But what is happening is that this canal in the village belongs to the Department of Agriculture. They have no idea what the other people are doing. So the rainwater-harvesting tank maybe was built by the province poverty alleviation campaign. And the tap belongs to the local government. Nobody maybe runs the river, it is supposed to run by the catchment management agency, which is one of the 9 provincial offices 200 km away. So on a village level you have multiple use for multiple sources and that is actually real Integrated Water Resource Management by the community, but on top you have three completely different bodies that have no idea of what is going on the ground, and there is no coordination between their water systems. -Problems do arise because the national and local systems don't talk to each other plus the water managers don't create a situation where it is easy for village people to use their resources together. We have a policy to do this, but it is not implemented. I suppose my last comment on IWRM is in the implementation that is a lot of critic. -It is different for the forum to hold a mining polluter to account. You can bring the facts to the forum but the water officials don't necessarily act against them. Sometimes they do, sometimes they don't. In one of the forums it was the nephew of the president who ran the mine, so people were politically scared.	-Power differentials -Noncompliance of water license -Backlog in compliance the water license because of too much bureaucracy -Lack of cooperation and communication on local level, institutions work at cross-proposes -Lack of cooperation between sectors and between national and local level -Partisanship
IP8	-I think the major problem with the management of water resources is the enforcement. Everybody who uses water, depending on the volume, needs a license. But the question is, if the people comply with the license conditions. If everybody complied with the license, I think we would have half the problems or even less. But there is no efficient and effective compliance. -We have a good number of polices but we have the challenges and this isn't necessarily resulting in sustainable water management until people don't apply. Well it will work when there is IWRM in practice. (...) So we break every law on the book, even the constitutional. So actually the major problem is the issues of compliance the end of the day, how do we ensure that people do comply, but they don't. -So in my view, the concept of IWRM is an excellent concept, but it is not being practiced. In the water sector they are talking about it for years about IWRM. -But the major thing is that a lot of things are driven by the economy, rather than working at the whole issue of sustainability and how we balance economic beneficiation with a sustainable use of the water resources. -The government has to monitor the water resources in terms if the situation is getting better or worse. The Department of Water Affairs for example is configured in a way to address these issues, but there are always challenges associated with capacity. -For example within the municipalities areas they are responsible for the management of water and those management approaches should be in form by what the government has. The government has got integrated management plans and so on but it is a matter of having the capacity such as the bodies and people who are doing it.	-Lack of compliance the water licence -Lack of human resources to monitor effective compliance -Contempt of Court Law: People do not abide the laws -Predomination of economic interest -Lack of capacity to monitor water situation on national level and municipal level -Lack of capacity in municipalities to approach integrated management plans
IP9	The implementation is a big concern in South Africa. We do have a lot of good legislations, government initiatives and good ideas, the hydrology sector is quite advanced, and the international science community is very strong. But when it comes to implementation it is a big problem. -I think there is a strong environmental interest and awareness which is very good, but when it comes to implementation, it is not very strong in terms how to conserve the environment and also maintain agricultural output and sustainable water development and conservation. -Every state and every person wants to develop, but these developments require more natural resources including water. How do you make these things happy together, the social development, environmental conservation and economy? This is the goal of IWRM but in South Africa they have so many other problems, not enough investment and not enough capacity to do this. -That is the main goal of IWRM, but the people are just starting to realize about the importance of this combination (economy, social welfare and environment). But I am looking forward very positive in South Africa.	-Good policies in water management, but main challenge remains the implementation -Lack of investments and human capacity to implement IWRM -Lack of awareness

IP10	That's a legal requirement of chapter one of our act. In the second chapter in the Act, we declare water for the environment and the people basic services as a priority. We state the environment as a priority. In practice we do have problems, because more than 60 % of our environmental areas are under thread in terms of our river systems. We have to ensure social and economic development. We have a lot of conservations studies and we try to answer with certain solutions. But the challenge is to implement and get money to do it. So there is a challenge but we also have to change the mind-set of using groundwater. From economic side I would say we have done it, agriculture is a difficult one because it is becoming very expensive for them and on the social side we put basic services and we prioritize them. But I do believe we are not effective enough. -We are going to enforce them {the laws] all to implement our national water plans, but the next hints is the communication. There are also other big issues like better discipline, awareness trainings, school capacity building.	-Priority of National Water Act: water for environment & basic services for all -Lack of financial resources to implement IWRM -Mind-set of population regarding groundwater -Lack of communication -Lack of discipline, awareness and capacity
IP11	So we have got all the policies and regulatory implements in place. But I would say, what is lacking currently is the enforcement -I think there has always been a huge emphasis on economic development, when it comes to the sustainable model. The economic component of sustainability will often win out (...). So you would find, as a classic example of South Africa, the most developed municipalities are the municipalities with the highest industrial development. So our metropolitan municipalities such as Equaleni, Johannesburg, so all the economic heads of the country are actually doing best in terms of managing the water resources. (...) Regarding the social component, I would say it is almost second in line (...) Unfortunately when it comes to environment, that component is often left unspoken for. If you look at climate change talks for example, is it's something that has really only started receiving the spotlight more recently. Because the environment has starting to show science of strain. -You have got an elite view that really knows what IWRM management is, how it should be interpreted and translated into behaviour. But then you have the rest of us, who actually need to implement IWRM. I don't really know if we completely understand what it is really about, I am talking about communities and the people who are supposed to implement this lovely wonderful concept (...). -A lot of municipalities go on and on about the fact that have got lack of funding. Well this a maybe a challenge to a limited extend, but I think the bigger problems are how those funds are generally managed themselves. So maybe it is not the availability of money so much the problem as the way in which it is used. You would find that fund that was originally for water demand management for example ends up at buying office furniture. I think the way the funds are managed is quite a challenge. -Corruption is also a big problem is our country and also poor workmen ship. -I think there is a little bit of dispersion between our national and local levels and who is responsible for what regarding the distributions of duties. -I have seen it, that even on the very local level, where municipalities for example install a prepaid meter (...). But they have not consulted the community (...) And a 5 or 10 million Rand investment is down the drain, because people have completely smashed the meters.	-Very advanced water policy, but the enforcement is lacking -Focus: economy, second: social aspects, last aspect: environment -IWRM is a good concept, but the three pillars of sustainability (economic and social welfare and environmental interests) are not considered simultaneously -Lack of understanding of the IWRM concept -Municipalities: Improper management of financial resources -Corruption & poor workmanship, -Unclear responsibilities distribution between national and municipal level. Not enough cooperation and communication between government and local level -Lack of capacity building for local level to maintain infrastructure
IP12	What is not there sometimes is an interconnection between the institutions that make these decisions. So there needs to be a better way and the challenge here is about transactions costs, because there need to be some way that there is a response from higher institutions to the lower institutions, that are closer to the resource. -The second is, there has been a lot of capture by policy makers and weak government in terms of how water is allocated to the most powerful of industries, such as agriculture and big mining business. - The second is, in the definition of IWRM from the global water partnership, is says it's about managing water and land resources. Somewhere along the line, the land resources got forgotten.	-Lack of cooperation between institutions and between higher and lower institutions -High transaction costs -Uneven water allocation between sectors -Land resources underrepresented in management strategies
IP13	On local level, there is also corruption, a lack of capacity. The municipalities don't spend the money properly. People don't talk to each other, there is a big lack of communication between government and local level, NGOs and so on.	Local level: Corruption, lack of capacity & communication -Misuse of money

5.3 Recommendations

The following table represents all suggestions and recommendations that were made by the interviewed experts on how to improve the implementation of IWRM, how to reduce vulnerabilities and how to adapt to climate change. Recommendations for IWRM include: to improve cross-sectoral linkages through cooperation and communication between government,

municipal and local level (vertical cooperation) and between sectors (horizontal integration), to build capacity on all levels and within sectors, to empower women and promote general participation in decision-making and water management particularly on local level (also to improve technical skills for water harvesting, water conservation and water recycling), to increase the number of people in divisions to ensure effective monitoring and compliance with laws, to control illegal water use and monitor the compliance of the water license (focusing the big water users such as the industry), to promote further decentralisation of decision-making on basin level, to create awareness around environmental issues starting from school (environmental education), to upgrade water infrastructure, to involve scientists in political decisions so as to ensure scientific background knowledge for political decisions, to stop racism and gender bias and to involve the private sector.

Furthermore an array of suggestions was made regarding climate change. As sectors, scales and actors were addressed for certain suggestions, generalisation was difficult. Most interviewees focused on suggestions for agriculture, government or science. Regarding agriculture, reductions in water use were suggested, as South Africa is facing water scarcity and a growing population. Further suggestions included adapting to drier farming conditions, planning for dry conditions, and diversification of crops with drought-tolerant crops. Also, increasing access to information and knowledge for subsistence farmers as well as capacity building and training were all seen as important key factors to build resilience and capacity, reduce vulnerabilities and to deal with climate change.

Suggestions for the government addressed the following issues: strengthening local governmental capacity, training and awareness building within the government and service deliveries, giving population access to information and making knowledge available regarding the impacts of climate change, especially to people involved in agriculture, as well as a long-term overall upliftment-policy. Upliftment policy is, in a sense, the idea that the government should identify vulnerable groups that rely most directly on those resources that are likely to be affected, and so ensure constant access to those. The government should especially focus this at the household level, in terms of providing employment, capacity building and trainings to create resilience within the population.

Other suggestions were related to science: firstly, improved predictions related to climate change may improve water management. Secondly, better communication between scientists and the population would provide them with increased access to information, and enable them to plan and increase resilience. Another suggestion referred to awareness building for climate

change that may help to integrate this issue into general mind-sets and improve certain climate related activities.

Table 17: Summary of comments on stakeholder´s suggestions to support IWRM implementation

IP	Paraphrase	Generalisation
	Suggestions for IWRM	
IP1	-We need to employ more people in these divisions, we need to build the capacity and choose people who are better qualified for this job. And then we need political will. -We have serious water problems, especially around pollution. So we need to strengthen our civil society, we also need to strengthen our professors to get involved. - So financially water will be a problem in future and then in terms of pollution it is going to be a disaster in future. So civil society really need to develop capacity around that topic and we need politicians that we can hold to account and we need academics to help to build capacity in our country and do research in this. -Poor management and sewage are the biggest problems. So we need a new technology in this area. Obviously not everybody has access to flushing toilets, so the informal disposal of human waste is also a significant problem. -Self-confidence trainings for woman. And particularly men in South Africa need gender training because they don't know about the extent they dominate the woman. -So we need to strengthen our civil society, we also need to strengthen our professors to get involved. -This National Water Act that was drafted by scientists, so by very educated people, those kind of people need to get back into the game and start giving input to policies and start being vocal in the media.	-Employ more qualified people in divisions -Build capacity -Strengthen society -Involve scientists -Create awareness around pollution -New technology for wastewater treatment -Empower women -Involve scientists in political decisions
IP2	And then you have the big commercial farmer. At the moment the Department of Water Affairs is looking at the big farmers because they are using about 75 % of all the water from the country. So they are using too much water, so there should be a shift in that area to farm with less water, because we are not a water right country. And with the growing population we will have to cut down our water use. -At service delivery on local level should be looked at more in detail. Another problem is a lack of capacity at local level and government and what they are able to do; so local government capacity has to be strengthened. -A lot of training and awareness building. We need to strengthen capacities within the government and the service deliveries, as there is a big lack of capacity and understanding of impacts. -It is also important to make the knowledge available in terms of what climate change impacts are. A lot of people are not aware of these facts and especially people involved in agriculture need a better accede to that information's. -I think we tend to focus on managing after extreme events, but in long term an overall upliftment policy not only in the context of climate change but in general is very important. -Definitely, there is a relationship between climate change and water management. I think predictions related to climate change would help with water management. -We can't really improve anything because we just started, so it is not just about changing things, it is more about to integrate climate change in what we are doing. There are no brand new policies or changes, but we have to enhance the way we are doing and how to do it better.	-Reduce water use -Strengthen local governmental capacity -Training and awareness building within the government and service deliveries. -Make knowledge around the impacts available especially to people involved in agriculture -Long-term overall upliftment policy -Improve predictions related to climate change to improve water management -Awareness building: Integrate climate change into mind-sets
IP3	[…] national and provincial governance's have to cooperate in a better way. The industry as a big business in general should adapt to the water principles and act more environmental-friendly. -I think decentralization, so that local government must approach more power and making decisions closer to the people (...) and better water harvesting for an improved water supply. -Also water conservation and water recycling has to be improved through environmental education. -Cooperatives at local level are important to empower woman.	-Improve vertical cooperation -Industry should adopt to water principles -Decentralisation of decision-making -Improve water harvesting, water conservation and water recycling -Environmental education -Empower woman
IP4	The decentralization process, because decisions have to take place motor on sub-basin-catchment level. But that seems to be a long process and another big issue is the reallocation between sectors.	-Decentralisation of decision-making -Improve water allocation between sectors

IP5	In terms of reducing vulnerabilities, you have to create adaptive measures to development. Adaptation strategies must been adapted to new conditions, on floods for example that we never had before. -But the government should focus more on an integrated strategy and how to support people that are more affected such as the poor. -Building resilience is very challenging in the sense that we can only do so much. Households play a key issue in building resilience. Poverty is really there, we can't deny that, so we have to provide employment, capacity building and trainings of emergencies and these sorts of things that would help people to build resilience and reduce vulnerabilities. Many books talk about building resilience, but hands on, they never talk about how to do that. That is what we are trying to find out at the moment. So there is a gap between theory and praxis.	-Create adaptive strategies to new conditions (e.g. floods) -Focus on an integrated strategy and support the poor -Important on household level: provide employment, capacity building and trainings to crease resilience -Create adaptive measures
IP6	And in terms of capacity building there has to be improved a lot. We furthermore have to control illegal use, get a better financial management, infrastructure, discipline, control, better planning, technology, effective use, these are the new areas but we don't have all the skills. So we need capacity to operate schemes. IWRM is not just about catchments, it is also about linking economic and politics and we have to influence mind-sets. - We always have to remember that South Africa is located in a dry area, so I always tell farmers that when it is dry, it is not unusual. In the first part, despite of climate change, farmer must adapt more to farming dry conditions. We are not living in a wet area and some people are forgetting this, they are using a lot of water and they don't plan for a dry region. People must start adapting more to survive in a dry region and to farm with crops that are drought-tolerant. So in general we are heading more into a dry scenario in future. -The commercial big farmers they are fine, they plan very well and things like that but for the subsistence farmers, there is a need of information and knowledge. These people don't really know how to farm and get the maximum out of their land. -More of a focus on vulnerabilities and then targeting overall upliftment, so paying attentions to problems like service delivery issues and providing access to resources. So looking at a broader level of vulnerably instead of just focusing general policy that doesn't really target vulnerable groups. So to identify those who are likely to be the most vulnerable and rely most directly on resources and looking at overall uplifting programme. But also which resources are likely to be affected and targeting those for groups, so now it is more of a macro level policy and not really focusing on individual groups.	-Capacity building -Control illegal water use -Better financial management, planning, infrastructure and technology -Adapt to dry farming dry conditions -Farm with drought-tolerant crops -Plan and farm for dry conditions and reduce water use -Access to information and knowledge for subsistence farmers -Identify the most vulnerable groups and resources that are likely to be affected -Overall uplifting programmes on macro level policy
IP7	An important issue is decision making and that decision-making should be decentralized to the community as much as possible. The second one is that people should be empowered in a sense that they need to develop portable skills that they can also use for other projects or in their own, if they develop an own business. -So I think that should come from an activist state that makes participation real in that term.	-Decentralisation of decision-making -Capacity building -Public participation
IP8	-Creating awareness is a huge issue and these issues should also find the way to curriculums at school level. The children must be taught in these things and grew up with these issues (...) and the people must apply the policy laws. People also have to learn from each other to improve their adaptive management. -People should be appointed on the basis of their knowledge and we should not judge by skin colour for example. The issue of gender is also a huge one (...). -My recommendations would be to give woman who are good in their field, the chance to do that. But woman in certain positions should also give more space for the other woman as well. - So we should woman give to opportunity to lead projects and putting them in positions of power and decision-making. - If I were the municipality then I would demarcate areas that are vulnerable and should not actually being used for activities. -People from the water sector have to work hand in hand with people working in agriculture and other sectors, this would mean an integrated way. We have to work in an integrated way to translate something, but we haven't reached that stage yet.	-Creating awareness and environmental education -People have to apply the laws -Improve adaptive management -Stop racism and gender bias -Involve woman in water management and decision-making -Provide capacity building -Demarcate vulnerable areas that are prohibited for industrial actions -Improve horizontal cooperation between different sectors
IP9	-There are not really good cross-sectoral links and different stakeholders should work more together and cooperate through sectors. -There is a lack of communication. […] we need interaction. -We have to look at the action on the ground for a better water management. -The government should work more with the local level and small farmers and other stakeholders.	-Improve cross-sectoral linkages -Improve communication between government and local level -Focus local level
IP10	-The groundwater management. Groundwater is an essential part of our solutions. And we have to reinstate its importance. (...) Furthermore we have to protect the groundwater resources because there is a lot of pollution not only from domestic areas. -We have to do better modelling of where the water is and we need experts to find the water.	-Reinstate groundwater's importance & protect resources -Improve water modelling/protection/management & technologies to improve water quality

	-The protection management should be improved, local government don't manage it. You also have to find technology to improve the water quality. -It is import to build local capacity to deal with climate change.	-Build local capacity to deal with climate change
IP11	-There is a lack of communication. We need to deliver our funding's and find the way to the policy makers, we need interaction and the policy makers (...) -I would definitely say training is required. (...) I think training ad capacity level both at national and local level, in terms of engineers and in general for all the different sectors that need to be implementing, is very important. -So much more awareness is important. (...) we even should need to start from school, so from basic education where you need to build this culture. So that people coming-out of institutions understand the importance of the water sector and how water resources should be managed. - (...) but one of the things that may help is public private partnership. You would find that the private sector often attracts most of your skills and in terms of helping municipalities at local level, forming partnerships between public institutions like municipalities and the private companies. -So greater involvement from our private sector might be a huge benefit to improving the way that things are managed.	-Improve cross-sectoral cooperation communication between sectors -Capacity building -Improve understanding of IWRM -Raise awareness, starting from school -Involve private sector
IP12	-So when we teach IWRM it shouldn't just be politicians or academics, but the interaction of appreciating water resources together. So the challenge is that they have to come together and negotiating about taking decisions. Negotiations and a forum for negotiation are very much an integral part of connecting these different groups. -What is not there sometimes is an interconnection between the institutions that make these decisions. So there needs to be a better way and the challenge here is about transactions costs, because there need to be some way that there is a response from higher institutions to the lower institutions, that are closer to the resource. -Woman have this role of fetching the water, but the opposite happens in terms of how the decisions are made (...) They should become a big part of this, either in water user associations, farmer associations and whatever structures, and they don't.	-Involve woman in decision-making -Promote participation in user/farmer associations -Communication between politicians, academics and the population needs to be improved -Improve interactions between ministries -Involve woman is decision-making
IP13	-We have people arguing that the private sector should become involved. They have huge capacities and resources for innovation and they can really make a difference in local communities for example. -Local communities, local people and especially woman need to be involved. I think IWRM needs to create a good link between local communities and marginalized groups and link them with local and national government. -People should diversify crops. NGOs can help to develop a bigger variety of crops. Woman is taught to use products that are more efficient. Furthermore it is important to give them access to different markets to sell their cheese for example. -But also the communication between scientists and the population. They should make it more understandable for them and help them to get access to this information. That would be very useful, because it enables them to plan. The opportunity for wealth creation supports other opportunities.	-Involve private sector -Involve woman -Cooperation between local and national level -Diversify crops -Give woman access to different markets to sell their products -Improve communication between scientists and population in terms of providing access to information's
IP14	-We must start at local level and we must see that there is an equitable distribution of our water to all our people in South Africa. Which means water lines, stand pipes. I think to give every household access to water will only be possible in the long term. But let's say standpipe within 200-300 meters from household is still better than nothing. -So there must be major upgrade of virtually all sewage systems to be safe with our surface water. This involves a lot of money and a lot of knowledge.	-Focus local level in terms of decision-making and water allocation, water infrastructure -Infrastructure upgrade

The structuring of 14 in-depth interviews amounting to over 80 pages of material was a highly challenging task. On the one hand, the semi-structured interview guidelines were developed to allow flexible answering, while on the other hand, several new aspects arose or others were deepened that made a uniform reporting less flexible and more difficult. Therefore in the end, no question-guided structure could be implemented, but rather a highly flexible structure, which grouped similar aspects and which sought the true meaning of the interviews. A detailed problem analysis is given in Chapter 7.2.

The following section will discuss the results presenting in this chapter.

6 Discussion and recommendations

This chapter draws on the empirical findings that resulted from the expert interviews. During the research process in South Africa and especially during the coding and analysis process of the 14 in-depth interviews afterwards, the author of this thesis developed three main hypotheses. They will be presented in the following and discussed according to the current state of research.

6.1 Hypotheses

The first hypothesis discusses the disparity between the political framework for IWRM and the actual implementation on the ground within the Orange-Senqu river basin. The second hypothesis refers to participatory decision-making opportunities in water management, which aim at preventing conflicts and to ensure sustainable water development and management, while the third hypothesis refers to the importance to integrate climate change into water management strategies. During the following discussion, key supporting quotes from interviews are also presented to help support statements and summaries of themes.

6.1.1 The disparity between South Africa´s water governance and IWRM Implementation

Hypothesis 1:

"Although South Africa's water governance provides the optimal framework for IWRM, the actual implementation on basin level is lacking*"*

One of the most common definitions of water governance is derived from GWP: "[…] water governance refers to the range of political, social, economic and administrative systems that are in place to develop and manage water resources, and the delivery of water services, at different levels of society" (GWP 2003:16).

As widely acknowledged, the successful implementation of IWRM highly depends on the enabling environment and conditions in place and depends strongly on the legal political framework of a country (PHILIP ET AL. 2008, UN WATER/GWP 2007). While water management is about achieving goals, water governance is about external legitimization. Adequate national policies, laws and strategies are therefore the basis of any changes in institutional frameworks to achieve cross-sectoral cooperation, involvement of stakeholder groups, public awareness and decentralized decision-making at basin and local level. Both water management and water governance are important and presuppose each other (TOONEN 2011).

Chapter 2.3.2 elaborately presented South Africa's main laws, acts and strategies to achieve sustainable water management and therefore, sustainable development in social, economic and environmental terms. The National Water Act represents South Africa's main piece of water legislation after the apartheid era in 1994 and is based upon IWRM principles (MORIARTY ET AL. 2004). The Act is globally recognized for it's 'best principles for integrated water management', which includes the integration of surface and groundwater management, the gradual decentralization of water management to the lowest appropriate level through catchment management agencies, public participation and community involvement and the preservation of water for ecological purposes (DWAF 2012, MULLER ET AL. 2009). The National Water Act appoints the government as custodian of the countries water resources and inserted a system of compulsory licensing to distribute water resources more equitably within the catchments. As the Water Services Act (1997) defines the legal framework for water and sanitation services, both Acts together provide a comprehensive framework for water management by acknowledging the basic human right for access to water resources and to achieve ultimate social equity, economic efficiency and environmental sustainability. In terms of the most important policies, legislations and strategies in the water sector, the interview partners identified the following: National Water Act, free basic water policy, water license, decentralisation polices, National Water Resources Strategy, Water Services Act and the National Environmental Management Act (see figure 10).

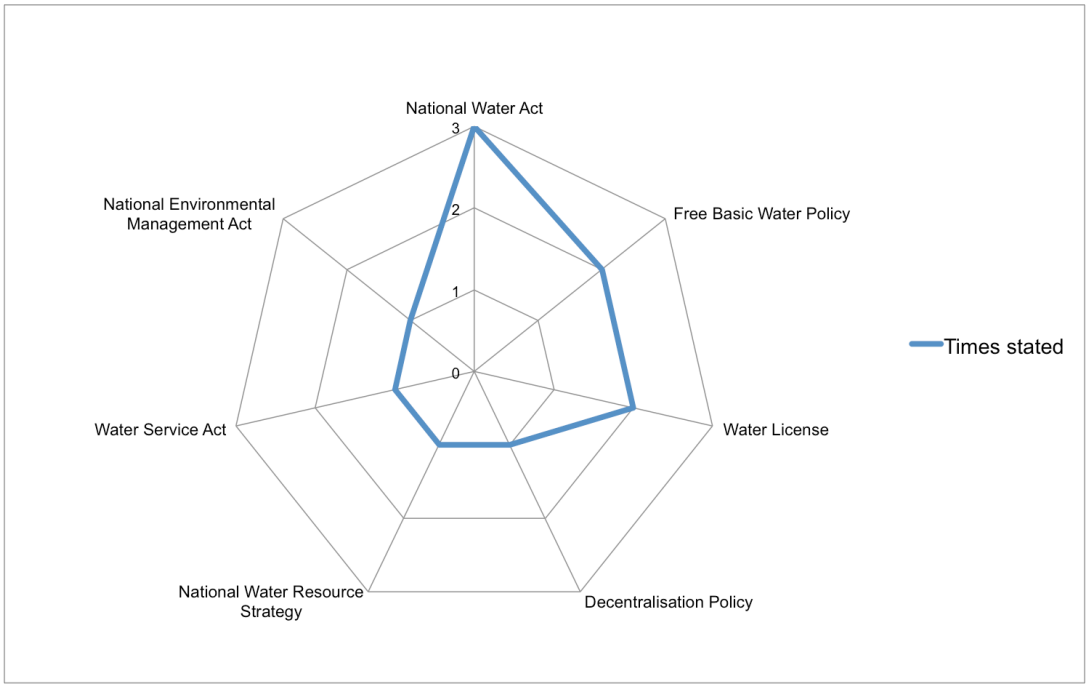

Figure 10: Identified water policies for water management through the interview partners.
(Source: Own graph)

According to the interview partners, South Africa's water governance is quite advanced and provides the optimal legal framework for IWRM, but the actual implementation remains the main challenge so far (IP1; IP3; IP 4; IP6; IP8; IP9; IP10; IP11; IP13). The following table summarizes the statements about IWRM implementation in South Africa:

Table 18: Statements of the interview partners regarding the disparity between IWRM theory and praxis

IP1Q11	It is a beautiful piece of law, the National Water Act, but in some parts it just hasn't been implemented.
IP3Q8	We have got a wonderful piece of legislation with the National Water Act, but the implementation is a very big challenge.
IP4Q5	South Africa in particular has a very progressive environment in the water sector. The problem is that the government is struggling with the implementation at various levels.
IP6Q9	[…] we have very well prepared legislations and laws on paper but when you look what is going on out there, you will see it is a different story.
IP7Q5	We have a policy to do this, but it is not implemented. I suppose my last comment on IWRM is in the implementation that is a lot of critic.
IP8Q3	-I think the major problem with the management of water resources is the enforcement. -So in my view, the concept of IWRM is an excellent concept, but it is not being practiced.
IP9Q2	The implementation is a big concern in South Africa. We do have a lot of good legislations, government initiatives and good ideas (…). But when it comes to implementation it is a big problem.
IP10Q9	But the challenge is to implement […] it.
IP11Q4	So we have got all the policies and regulatory implements in place. But I would say, what is lacking currently is the enforcement.

Faced with these statements, the following question arises; which factors constrain successful IWRM implementation in the Orange-Senqu river basin?

The interview partners identified a range of problems in implementing IWRM, which refer to lack of capacities on all levels, problems within national and provincial departments, lack of financial and human resources, lack of awareness and lack of scientific background knowledge to adequately understand the hydrological cycle. Constraints for sustainable water management are listed in the following table 19 and will be discussed afterwards in more detail in accordance to their importance (figure 11).

Table 19: Constraints to implement IWRM.
(Source: Own representation)

	National Level	**Provincial/Municipal Level**	**Local Level**
Cooperation	Lack of cooperation and communication across levels and sectors		
Capacity	-Lack of capacity to enforce laws -Lack of capacity to monitor water situation on national level -Lack of capacity to maintain national infrastructure (dams) -Lack of understanding of	-Lack of capacity to enforce laws -Lack of capacity to monitor water situation on municipal level - Lack of capacity to maintain local infrastructure -Lack of understanding of the IWRM concept -Lack of capacity in municipalities to approach integrated	-Lack of capacity to maintain local infrastructure -Inadequate mind-set of population regarding groundwater -Lack of understanding of the IWRM concept -Lack of education, knowledge and skills

	the IWRM concept -Corruption -Partisanship	management plans	
Policies/ Laws	-Lack of political willingness -Lack of cooperation with provincial/municipal and local level -Power differential between ministries are not balanced out	-Lack of political willingness -Lack of cooperation with national level - Lack of monitoring water compliance -Unclear	-Local people do not abide the laws
Resources	-Lack of financial resources to monitor enforcement of laws -Lack of human resources in ministries -Misuse of money	-Lack of financial resources to monitor enforcement of laws -Lack of human resources -Corruption -Partisanship	-Lack of financial resources to participate in decision-making (CMAs too far from rural communities)
Awareness	-Lack of awareness in terms of the ´sustainability´combination (economic efficiency, social welfare and environmental sustainability).	-Lack of awareness in terms of the ´sustainability´combination (economic efficiency, social welfare and environmental sustainability)	-Lack of awareness around water scarcity, thus resulting in wasting water
Science	-Lack of scientific background knowledge such as the hydrological situation and environmental economy	-Lack of scientific background knowledge such as the hydrological situation and environmental economy	-Lack of understanding of scientific aspects such as the hydrological cycle -Little knowledge of climate change

To discuss the constraints according to their importance for the interview partners, the following figure summarizes all identified constraints of the previous table 19, by clustering them alongside the times, they were mentioned.

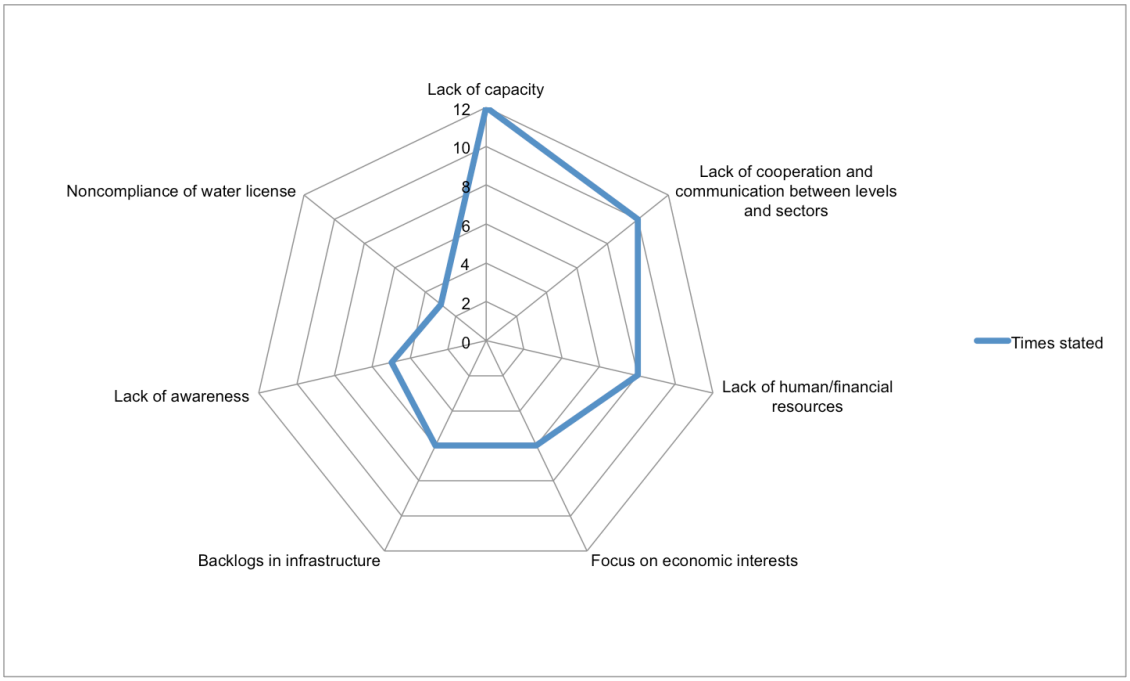

Figure 11: Most mentioned aspects that affect IWRM implementation.
(Source: Own representation)

Lack of capacity

UFZ (2011) assesses that the implementation of IWRM is often unsatisfactory, due to a lack of necessary competencies and skills.

According to the DWAF (2012:172) itself, after one decade of implementing the ´Water Sector Capacity Building Strategy´, lacks of capacities on all levels still remains one of the main challenges in implementing water resources management. Also in terms of disaster risk management within the water sector, implemented through the Climate Change Response Strategy, the DWAF (2012) acknowledges a lack of skills and capacities as a major constraint for successful water management implementation.

A lack of capacity, (including knowledge capacity and a lack of skills on national, municipal and local level), was identified as the strongest force impeding the implementation of IWRM (IP1; IP2; IP3; IP4; Ip6; IP7; IP8; IP9; IP10; IP11; IP12; IP13). At the national level, interview partner referred to a general lack of capacity to enforce the laws (IP6; IP8; IP9) and also to a lack of scientific background knowledge of politicians: “The new government often have no idea about the hydrological situation and environmental economy” (IP3Q8). Without adequate knowledge of the environmental needs and environmental responses to human activities (including climate change, although its impacts are linked to many uncertainties so far), decision-making might not adequately involve the environmental needs, which in turn impact ecosystem services for human beings. Corrupt ministries and partisanship were also mentioned. On provincial and municipal level, a lack of capacity to transform national legislations on lower level and to enforce laws, was identified. Besides national and municipal levels, a lack of capacity is also seen on local levels. In particular, a lack in knowledge capacity and skills to maintain local infrastructure, aggravated by a general lack of understanding of the IWRM concept were also highlighted: “But then you have the rest of us, who actually need to implement IWRM. I don't really know if we completely understand what it is really about, I am talking about communities and the people who are supposed to implement this lovely wonderful concept” (IP11Q9).

To address the listed problems, capacity building programmes are needed to support IWRM implementation (XIE 2006). IP7 states that “Capacity building is really important for IWRM, especially to work with the existing institutions and to strengthen them, because the sustainability factor is four, five times higher if you do it that way” (IP7Q8). According to UNEP (2012), a lack of capacity cuts across all aspects of water resources management, raising the need for capacity building, which “[…] can make the difference between success or failure in moving towards a more integrated approach to water resources management” (2012:76).

Lack of willingness to cooperation and communication between levels and sectors

Productive cooperation and effective communication between different sectors, agencies and different water users is essential to ensure successful IWRM implementation on basin level. IWRM is about cross-sectoral cooperation, to prevent uncoordinated development and use of water resources among different stakeholders with different and competing interests (MORIARTY ET AL. 2004). Communications furthermore assures access to information, especially to the very local level where people often lack access to information and are not aware of their rights (CAP-NET 2009). As IWRM should be implemented at the lowest possible level, cooperation with local governments and local communities present a major step towards successful IWRM implementation. According to MORIARTY ET AL. (2004:7), "[…] [a]ny improvement in coordination or planning of water resource development represents a step in the process, and in many cases local level agreement and capacity-building on better sharing and use will have greater impact than new national laws or international level treaties".

Interview partners furthermore identified a lack of willingness to cooperate between ministries on national level: "So the ministries are not working together […] The ministries kind of work more against each other than working together" (IP1Q10). But also a lack of cooperation between different levels was identified: "People don't talk to each other, there is a big lack of communication between government and local level, NGOs and so on" (IP13Q3). To demonstrate an example for weak cross-sectoral cooperation that affect local level, IP7 gives the following example: "But what is happening is that this canal in the village belongs to the Department of Agriculture. They have no idea what the other people are doing. So the rainwater-harvesting tank maybe was built by the province poverty alleviation campaign. And the tap belongs to the local government. Nobody maybe runs the river, it is supposed to run by the catchment management agency, which is one of the 9 provincial offices 200 km away. So on a village level you have multiple use for multiple sources and that is actually real Integrated Water Resource Management by the community, but on top you have three completely different bodies that have no idea of what is going on the ground, and there is no coordination between their water systems" (IP7Q8). The Water Ministry identifies the lack of communication as a major issue for slow integrated water development advances: "We are going to enforce them {the laws] all to implement our national water plans, but the next hints is the communication" (IP10Q4). Additionally, responsibilities between levels seem unclear: "I think there is a little bit of dispersion between our national and local levels and who is responsible for what regarding the distributions of duties" (IP11Q5). This might be traced back to the fact, that the provincial boundaries do not accord with the catchment areas. Reasons for a lack of cooperation and communication can be linked to insufficient willingness for cross-sectoral cooperation and high transactions costs, thus

presenting a major challenge to put IWRM into practice: “What is not there sometimes is an interconnection between the institutions that make these decisions […] and the challenge here is about transactions costs, because there need to be some way that there is a response from higher institutions to the lower institutions, that are closer to the resource” (IP12Q6). GWP (2003) emphasises that transaction costs must be reduced to achieve sustainable and effective water management.

Lack of financial & human resources

Another concern of the interview partner that aggravates successful IWRM implementation is a lack of human and financial resources as well as mismanagement of financial resources (IP1; IP6; IP9; IP10). Besides a lack of capacity, a lack of investments[15] hinders sustainable water management: “How do you make these things happy together, the social development, environmental conservation and economy? This is the goal of IWRM but in South Africa they have so many other problems, not enough investment and not enough capacity to do this”. Due to a lack of human resources effective monitoring of law compliance seem more complicated: “[…] in many cases we have very well prepared legislations and laws on paper but when you look what is going on out there, you will see it is a different story. That’s because there is not enough people to really look after it and push this and enforce the laws” (IP6Q9). Beside a ´quantitative´ lack of human and financial resources, also a mismanagement of financial resources on all levels presents an issue (IP11; IP13). IP11 gives the following example: “A lot of municipalities go on and on about the fact that has got lack of funding. Well this a maybe a challenge to a limited extend, but I think the bigger problems are how those funds are generally managed themselves. […] You would find that fund that was originally for water demand management for example ends up at buying office furniture. I think the way the funds are managed is quite a challenge” (IP11Q3). Therefore, besides employing more people in divisions and investment in water management, financial resources also need to be management in an appropriate way.

Main focus on economic interests

IWRM aims “to maximise the resultant economic and social welfare in an equitable manner **without** compromising the sustainability of vital eco-systems” (GWP 2013). Sustainable water management only works out, if all three aspects are equitably integrated in water development and implementation strategies. Regarding the equal integration between economic, social and environmental interests, the interview partners stated, that South Africa’s government primarily

[15] According to the interview partners, investments refer to water infrastructure and capacity building programmes

focuses on economic interests and social and environmental aspects are always second in line (IP1;IP8;IP9:IP10;IP11). IP10 summarises this in the following: “I think there has always been a huge emphasis on economic development, when it comes to the sustainable model. The economic component of sustainability will often win out (...). Regarding the social component, I would say it is almost second in line (...) Unfortunately when it comes to environment, that component is often left unspoken for” (IP10Q8). However, economically advanced areas have also shown social and environmental progress as they attract people and skills. As IP10 puts it: “So you would find, as a classic example of South Africa, the most developed municipalities are the municipalities with the highest industrial development. So our metropolitan municipalities such as Equaleni, Johannesburg, so all the economic heads of the country are actually doing best in terms of managing the water resources” (IP10Q8).

Lack of awareness

Raising public awareness around water-related issues is needed to achieve a change in behaviour and to ensure sustainable water management. Raising awareness at all levels is widely acknowledged to support the successful implementation of water (conservation) programs and management activities. Raising awareness is closely linked to capacity building (UNEP 2009).

As presented in Chapter 2.3.2, the free basic water policy as part of the National Water Act by South Africa’s government aims at providing a free basic amount of water to poor communities. It acknowledges the human right to have access to sufficient and clean water by providing water infrastructure to the people. The interview partners identified a lack of awareness e.g. on the local (rural) level, that results in vandalism of water meters and stealing of water pumps. As IP11 has put it: “I have seen it, that even on the very local level, where municipalities for example install a prepaid meter […] they have not consulted the community […] And a 5 or 10 million Rand investment is down the drain, because people have completely smashed the meters” (IP11Q6). Hence, without adequate capacity building and awareness raising, the sustainability factor of infrastructure is suffering. Interview partners also identified a general lack of awareness within the population regarding South Africa’s water scarcity, water pollution and the general economic value of water: “So the average domestic consumer is turning on his tap and they don't realize why water needs to cost money and why it becomes more expensive. They don't realize the pollution problem, they don't realize how much water we are wasting. […] the average South African knows, that we have a major problem around energy […][b]ut we are not aware of how big our water problem is” (IP1Q12). Also a lack of awareness building from political side was identified as a problem: “[…] our national Water Ministry should raise

awareness around the importance of water management, pollution management and so on but they are not fulfilling their duties at all" (IP1Q18). Although the interview partner seemed very critical about public awareness, some progress has been noticed: "[…] the people are just starting to realize […] But I am looking forward very positive in South Africa" (IP9Q7).

Noncompliance of water license

In face of increasing water stress in the Orange-Senqu river basin, the water license is the main political ´tool´ to control water use and pollution within the country. While the government provides the political framework and the rules to water liscensing within the National Water Act, it is up to the municipalities to implement laws and therefore to control water license compliance. According to the interview partners, these responsibilities get confused between national and municipal levels, and high bureaucratic processes may impede compliance monitoring processes. Responsibilities might get confused as the catchment areas do not coincide with the provincial boundaries of the country. A strong clue can be seen around the fact that high volume water users extract water without permission or continue to work under out-dated licenses (IP1; IP7; IP8; IP12): "Unfortunately there is a big backlog on this water use licenses. So your main instrument to control the behaviour of the water users is stuck in the bureaucracy, which is sad" (IP7Q5). IP8 assumes, that "[i]f everybody complied with the license, […] we would have half the problems or even less" (IP8Q3).

Backlogs in infrastructure

The fourth principle of IWRM "*Water has an economic value in all its competing uses and should be recognized as an economic good"* recognises the basic right of all human beings to have access to clean water and sanitation (GWP 2013). South Africa's Constitution ensures access to sufficient and clean water to every citizen in the country. Interview partners evaluate the access to water within the urban areas as generally high, although rural areas and informal settlements struggle with backlogs. Reasons for lacking access to water in certain rural and urban areas within the basin can be mainly traced back to poor and inadequate infrastructure (maintenance): "But the rural areas are struggling very very much to have water systems to deliver sufficient water" (IP3Q6). According to DWAF (2008) an appropriate water infrastructure is necessary to bring the water adequately near to poor people's homes to achieve a minimum state of welfare, to secure the free basic water policy and hence and to implement the National Water Resources Act. Investments in water management will not have significant return without adequate infrastructure (GREY & SADOFF 2007).

Problems with infrastructure are mainly seen as caused by a lack of operational maintenance "(…) people just invest in infrastructure, but not on the operational maintenance" (IP10Q3) and "(…) there is seldom a plan to actually maintain that infrastructure. So you in store something after a time it is all in ruins, because nobody maintained it" (IP11Q3), followed by vandalism and theft of water pumps "Then many people especially in rural areas they vandalize and they steal the pumps" (IP10Q3). Another problem with water infrastructure is seen as leaking problems and insufficient water quality. A lack of appropriate water infrastructure highly impedes integrated water resources management approaches (UNESCO 2009).

6.1.2 Unequal Involvement in Decision-Making

Hypothesis 2:

"The lack of involvement in participatory decision-making of local communities and women within the basin demonstrate that IWRM has not reached its goal of sustainable development yet"

The UFZ (2011) assesses, that the implementation of IWRM is often unsatisfactory, due to inadequate institutional basis for governance and participation and the lack of necessary competencies and skills. According to MORIARTY ET AL. (2004), to put IWRM principles into practice, participatory decision-making plays a major part in achieving sustainable water management. It supports cross-sectoral cooperation and prevents conflicts between different water user groups, by bringing people together, thus allowing them to actively participate in decision-making (UNESCO 2009). Participation is also considered to increase knowledge and awareness of different stakeholders in terms of sustainable use of water resources through the exchange of information. Furthermore, the protection of human's rights on access to water for productive purposes comes along with equal decision-making, especially in a stressed water basin such as the Orange-Senqu where competition between small and high-volume users is already likely to become fiercer. According to UFZ (2011:15), participation means "[…] the involvement of persons concerned by political decision-making, who are not regularly involved in political decision making processes". As full and effective participation underpins the successful implementation of IWRM, it ultimately contributes to social welfare, economic efficiency and environmental sustainability (XIE 2006, UFZ 2011). DUNGUMARO & MADULU (2002) highlight, that the involvement of local communities in water management generally empowers people to communicate and negotiate with other stakeholders with higher authority.

The second principle of IWRM therefore states, that "[w]ater development and management should be based on a participatory approach, involving users, planners and policy-makers at all

levels" (GWP 2013). In accordance with the third Dublin Principle "women play a central part in the provision, management, and safeguarding of water" (GWP 2013), IWRM requires acknowledgement of the importance of the role of women in decision-making processes through the provision of equal participation opportunities in order to achieve sustainable water management. In the traditional top-down approach, policy-makers or planners make centralised decisions without adequately recognizing the needs of local communities, which mostly results in unsustainable water development. As IWRM promotes equal participation of all users, highlighting the important role of women in this context, this hypothesis focus on disadvantaged water users groups on the local level where IWRM is supposed to be implemented (bottom-up approach).

The following section provides an overview of all water user groups in the basin and highlights the main challenges they are facing.

The main users within the Orange-Senqu river basin include commercial and subsistence farmers (e.g. water for agricultural production), industry (e.g. water for mining or power generation) and the municipalities that are responsible for providing water for the local population (water for domestic consumption and recreation purposes) (IP1; IP3; IP4). The statements reflect the data of ORASECOM (2013), who state that the water resources of the basin are primarily used for agricultural irrigation (mainly in in the mid- to lower reaches of the river), followed by domestic consumption (mainly in the upper reaches of the Vaal river) and industrial use. Agriculture amounts to 64 % of water demand, urban and rural supply at 29 % and industry at 7 % (AWIRU 2005).

Faced by the increasing scarcity of water resources, worsened by increasing pollution in the basin and the impacts of climate change, the competition between water users and sectors is likely to increase. Increasing pollution and ecological contamination of surface and groundwater resources within the Orange-Senqu river basin is mainly explained by poor management and human activities such as agriculture (fertilizers), industry (acid mine drainage of gold and coal mining) and informal settlements (improper wastewater treatment), thus heavily affecting the ecosystem services provided by the basin (IP1; IP3; IP4; IP7; IP8; IP10; IP11; IP14). The ecological contamination in terms of microbiological organisms in drinking water is very much linked to improper sanitation and water treatment, causing water borne diseases such as cholera or hepatitis (ORASECOM 2013). The urban areas within the basin most affected by pollution, is the southern Gauteng area, that is home to about 50 % of the basin's total population (ORASECOM 2011).

Concerning the different user groups in the basin, the following graph represents the expert´s opinion on equal participation in decision-making between users, planners and policy-makers.

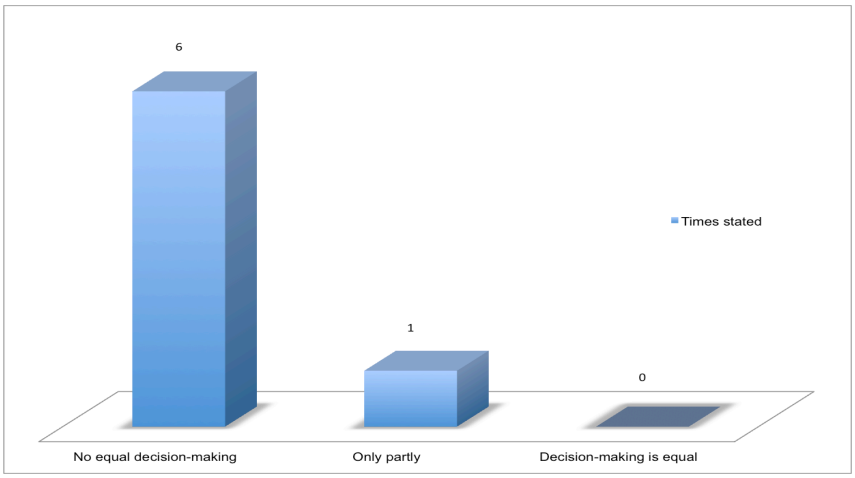

Figure 12: Opinion of interview partners regarding equal participation opportunities in water management decision-making.

(Source: Own presentation)

As can be seen, no interview partner assessed decision-making between different water users, planners and policy-makers as equal. Rather that decisions-making still takes place on the national level, in the hands of politicians: “I would say the decision-making over water resources is mainly dominated by politicians at the moment that is the biggest problem” (IP1Q13). This was even agreed by those representing high-volume users such as industry: “The powerful industries such as the mining industry has much more to say and the rest are less involved in water management” (IP12Q2).

While according to the interview partners, the government and powerful industries predominate decision-making, certain water user groups are very disadvantaged in water management decisions. According to the interview partners, disadvantaged groups include first and foremost (rural) local communities: “If we talk about disadvantaged people, I immediately think of people on the local level who do not have enough access to clean water and treated water and access to enough water” (IP14Q4), followed by women, the black population (due to historical reasons), subsistence farmers and the downstream population. The following figure 13 visualises expert´s opinion on disadvantaged groups in the basin[16].

[16] The term ´local community´ and the term ´subsistence farmer´ were often mixed up, thus we can assume that the interview partners were referring to both.

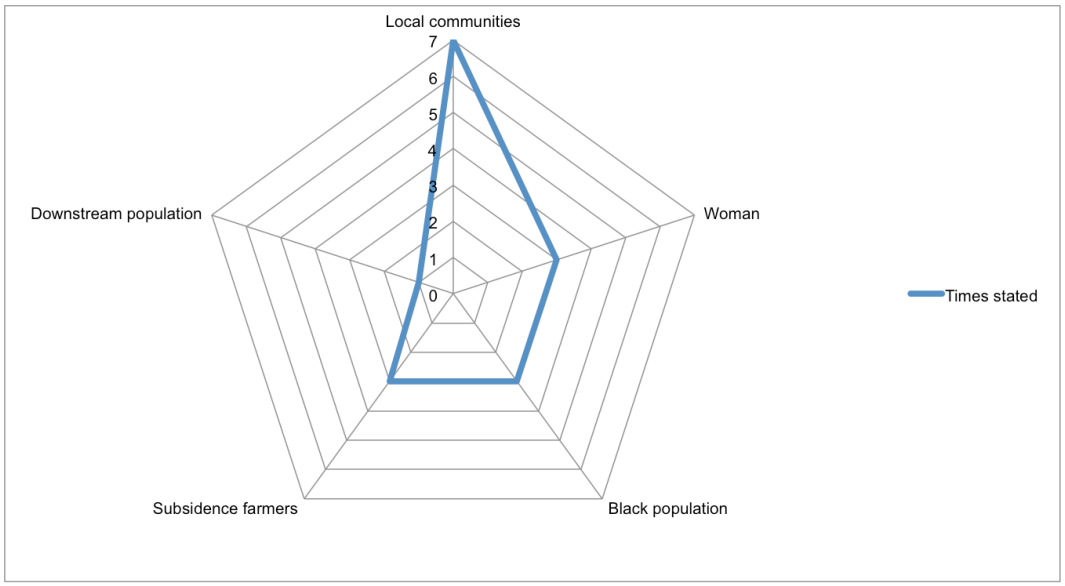

Figure 13: Opinions of interview partners on disadvantaged groups in water management decision-making and participation.
(Source: Own presentation)

According to KOPPEN (2002), water is of high importance for local communities for crop cultivation, livestock or small industries and proper maintenance of livelihood strategies. Due to their immediate and high dependency on natural resources (compared to those in urban areas), these people are vulnerable to any changes in the ecosystem that may be triggered by water pollution or the effects of climate variability or change. The situation for local communities in the basin is worsened by competition over water resources with high-volume users such as commercial agriculture and industry. As summarised by both interview partners and KOPPEN (2002), it is foremost the local communities who are disadvantaged, exacerbated by a lack of participation in public governance structures. Local communities refer particularly to women who are traditionally disadvantaged in decision-making at all levels in order to support sustainable water management (GWP 2013). The DWAF (2012) highlights the important link between gender equality and sustainable water management. Equal participation of men and women in decision-making contributes to the sustainable use of water resources, which in turn contributes to gender equality by giving both women and men access to water and water-related services. The majority of the interview partners felt that decision-making opportunities for women were unequal: "[…] I would say it is still a very male dominated society and there are just a few women that are able to give input into policy documents" (IP1Q15). Meanwhile other interview partners noted certain improvements in participation and seemed more confident: "I would say it definitely has improved" (IP11Q7).

Reasons for lacking participation opportunities for women were mainly linked to ´structural´ reasons, and also some self-induced factors. External factors referred to socialisation and traditional thinking within the society. This being, that women are responsible for all household related activities that are usually very time-consuming, rather than being involved in management decision-making: "[…] the woman travels long distances to obtain and get access to water with containers on their heads, the woman have to prepare meals, it is the woman who need water to bath their children" (IP3Q10). Beside cultural reasons, also self-induced factors for unequal decision-making were identified. This includes a lack of self-confidence of women as well as a lack of reciprocal support mechanisms: "[…] [a]nd one of the biggest problems in South Africa is that woman lack self-confidence. They are afraid and they don't fight for their points" (IP1Q15), and "In certain areas you find more women, but the women themselves also have a problem. I have seen a number of women in positions and they don't help other women to come up into the decision-making" (IP8Q7). The following table summarizes the experts' opinion on gender equality in the basin and their viewpoints on societal or self-induced reasons for lacking participatory decision-making involvement of women.

Table 20: The opinion of interview partners regarding the role of women

IP	Gender Equality?	Societal Reasons	Self-induced
IP1	No		X
IP3	-In urban areas yes -In rural areas gender imbalance	X	
IP4	-Depends on level and area -Woman professionals involved in government department and agencies	X	
IP8	Not yet		X
IP11	Depending on the sector, hardly gender equality	X	
IP12	No		X
IP14	No	X	

Reasons for unequal decision-making can be mainly traced back to a lack of cooperation and communication between different users and sectors in the basin: "We still are still struggling with the separate development in this country, the authorities, consulters, and engineers are planning in isolation from the general public, so it feels very much autocratic" (IP3Q8) and: "[…] the government is not doing enough itself to ensure that all stakeholders such as users, policy makers and implementers and so on come together" (IP8Q8). According to the statements, a

lack of participation opportunities is not only due to a lack of cooperation, communication, historical reasons or policy failure, but also due to a lack of public participation itself: “They are not involved because our public participation process around water in this country is extremely weak” (IP1Q14). This may be due to a lack of willingness for active participation within the population, or more likely a lack of awareness of the participation opportunities themselves: “So the local people are not really involved and I don't think they have a clue what is really happening because they haven't been informed” (IP1Q14).

Summarizing, the decisions are mostly taken on national levels and by the powerful industries, while local communities are disadvantaged, thus indicating a predomination of the traditional top-down water management approach. Without an integrated water management approach, the water development and management will be unsustainable and water security and sustainable development cannot be expected in the near future. As the Orange-Senqu river basin is located in a semi-arid area and is already experiencing water stress, which is expected to increase with future climate change (GWP 2013), equal participation becomes even more important to prevent conflicts. As the interview partners identified local communities and women to be the most disadvantaged groups in participatory decision-making, conflicts might be triggered as different water groups share the same resource with different goals. The interview partners identified conflicts between different water users, sectors due to a) water scarcity b) water distribution issues & costs c) upstream and downstream constellations in terms of water pollution, and d) climate change that could affect food security. All of them directly or indirectly might be traced back of power differentials within the basin and a lack of involvement of the ´people on the ground´.

Potential conflicts and tensions were seen primarily in terms of water scarcity, thus leading to conflicts between different user groups and sectors due to unfair water allocation, competition and conflicting objectives around water: “[o]ne of the biggest conflicts is between farmers and domestic and industry. […] And because insufficient pressure has been placed on our farmers to be more efficient with the water use, they still consume a bulk of our water. Ironically the actual amount of food that South Africa has been producing has actually declined. So they are still using a lot of water but it is not for our food security on national level, because we are now importing food” (IP1Q4) and: “[s]o some of the discussion will be about reallocation between sectors, which is also a highly political issue. So this will be a major cause for conflicts […]” (IP4Q4). Hence, interview partners assessed the uneven water allocation between sectors factor that triggers conflicts, summarizing that “[c]ompetitions itself are not a problem, but often just not well managed and leading to conflicts maybe” (IP12Q1). Although the commercial agricultural

sector contributes to 68 % of water extraction in the basin (ORASECOM 2013), many local communities still face backlogs in access to safe water. As they are highly dependent on ground water resources, polluted water e.g. from fertilizers affect their health and livelihoods. Different water distribution between sectors also triggers conflicts due to financial costs. IP1Q6 comments that the agricultural sector is given favouritism over industrial activities or water for domestic consumption: "[b]ut what is really happening is that farmers can access a lot of water for little money, so industry and domestic consumers in particularly are actually picking up the bill. So the conflict is really about money, around costs of this resource". This however, might not directly traced back of lacking involvement opportunities, rather it reflects the top-down approach in the sense, that decisions about water distribution and costs are taken from provinicial or municipal level. Furthermore, conflicts are also seen to exist between upstream and downstream population: "[…] in a catchment like that you could expect settlements that are affected by upstream activities such as dumping. So the downstream users and also their livestock are affected, because they are consuming the water. So in that context conflicts are possible" (IP3Q4). Also XIE (2006) has indicated the social and environmental consequences for downstream populations, when upstream water and land practices such industrial and agricultural activities directly impact the quantity and quality of water resources in river basins. The Lower Orange-Senqu river basin is thinly populated, while its population has much less to say or they are even ignored in decision-making in water development and management in comparism to the densely populated and industrial heart of the basin in Gauteng. As they are affected of upstream human activities in terms of water quantity and quality, sustainable development is threatened in the downstream areas of the basin. In terms of climate change, the interview partners were not aware of any current conflicts, but rather that they expected conflicts in future due to the impacts on agriculture which may affect food security: "There are some deliveries in terms of food […] in general I think climate change will raise that possibility of conflicts" (IP2Q12).

These conflicts can arise e.g. between industry users, domestic consumers and agriculture. As high volume users, industry and agriculture are estimated to be much more powerful in decision-making than local communities, thus resulting in large power differentials within the basin. Furthermore, they greatly account for pollution through acid mine drainage or fertilizers that affect surface and groundwater resources. As (rural) local communities are considered to be heavily dependant on natural resources (lacking infrastructure forces people to obtain water from boreholes) they are directly affected by the pollution of water created by agriculture and industry.

It is interesting that women, in spite being highly disadvantaged in participatory decision-making, were not said to be involved in any conflict resulting from their lack of participation opportunities.

Other conflicts also exist in the basin, many of which seem to be the result of political frameworks in which the provinces and municipalities have to act in, rather than directly linked to unequal decision-making between users. These types of conflicts include: conflicts between high-volume water users and local communities and also conflicts amongst high-volume water users themselves. As water used for agricultural irrigation purposes is priced (by the municipalities) at much lower rates than that used for industrial use (such as the energy or mining sector), many conflicts have arisen surrounding the unbalanced water pricing between sectors. Future conflicts are predicted to arise from the impacts of climate change, as water scarcity is expected to increase and thus, could affect food security within the basin. As the water scarcity is likely to become stronger, lacking involvement opportunities of certain groups may trigger already existing conflicts, thus heavily affecting the sustainable development of the Orange-Senqu river basin. Facing the unequal decision-making opportunities between different water users in the basin as well as conflicts between sectors and levels, IWRM has therefore not achieved its goals to achieve equity, water security and sustainable development so far.

6.1.3 Climate Change and Water Management

Hypothesis 3:

“Only when IWRM adequately integrates climate change into its planning and implementation strategies, people´s vulnerability to climate change impacts can be reduced and sustainable development be supported”

According to the South African Department of Water Affairs and Forestry (DWAF 2012), the impacts of climate change will reduce water availability, and therefore affect all human activities within the Orange-Senqu river basin. As projections of future climate change impacts are plagued by many uncertainties (SCHNEIDER & KUNRTZ-DURISETI 2002), the need to address the expected socio-economic impacts is becoming more pressing (DESER ET AL. 2012: 527). Thus, FUNKHOUSER (2013) demands explicitly for better planning and conservation in the water sector, as climate change will likely exacerbate all existing problems.

South Africa is located in an area with a naturally high variable climate (IP3; IP6; IP10; IP12, GWP 2013, AWIRU 2005). Therefore to a certain extent, people in the basin have always been ´forced´ to cope with climate variability: “At the moment people are used to adapting quickly“ (IP6Q7). Nevertheless, the experts stated that climate variability affects people's livelihood and

sectors in different ways and the impacts are expected to increase with progressing climate change: “We know that South Africa’s climate is highly variable, but in a long term climate change is going to exacerbate the situation” (IP8Q2). As climate variability itself is poorly managed because a lack of capacity and scientific knowledge (IP12), many of the interview partners seemed concerned about new uncertainties that will arise with progressing climate change. In particular the magnitude, timing and spatial distribution of temperature, precipitation, runoff or heating-degree days are characterized by major uncertainties (DESSAI & VAN DER SLUIJS 2007). Furthermore, uncertainties are expected to present challenges for all negotiations in the water sector. IP13Q1 summarizes: “If it is so difficult to identify climate impacts how can that [be] negotiated? […] This is important to me, this distinction between how do you manage the uncertainty around climate change. Also related to water in terms of climate change and climate variability”. Another concern involves the difficulty to distinguish between natural climate variability in South Africa and climate change (IP2; IP5; IP6; IP12; IP13). This is mainly due to lacking (scientific) capabilities to understand and predict future climate change (IP2; IP5; IP6; IP12; IP13). IP 12 puts it very clearly:

> “I think at the moment we don't really understand yet, what is going on regarding climate change and these things are going to affect our position in the future. The second thing is that climate change creates too many unknowns. There are examples of dealing with variability and climate change in terms of uncertainty and so on, but there is a lot that we actually don't know. We don't know actually if the hydrological cycle has changed due to climate change. And that is a big thing. The question becomes how to deal with things, you don't know, how you deal with uncertainty. Water resources management is already poor in many places and climate change has blown the problem out of proportion” (IP12Q4).

Despite several uncertainties, interview partners identifed a range of climate change impacts that will be numerous and manifold. While some impacts have long-term consequences such as declining productivity of agricultural land, other impacts are rather episodic such as storms or floods. Changes in the variability of precipitation patterns, higher temperatures and increasing extreme weather events were the main impacts that have been experienced in South Africa so far (IP2, IP5; IP6; IP8; IP14) and are expected to further increase in coming years, thus raising people´s vulnerability to its impacts when not adequately addressed. Although the total annual rainfall is expected to stay the same, seasonal shifts in terms of longer dry periods with more intense and prolonged periods of droughts, as well as shorter rain periods with more intense precipitation (thus triggering flooding) are expected (ORASECOM 2013).

The major challenges of future climate change impacts is seen around increasing water scarcity within the Orange-Senqu river basin (IP2; IP4; IP5; IP6), thus affecting agriculture, food security

and people's livelihood. Also more conflicts are expected, as increasing drought frequency may affect agricultural production and therefore threaten people's security in the basin (IP2; IP13).

Table 21: Observed trends, impacts and expected future impacts of climate change

	Direct Impacts	Indirect Impacts	Expected future Impacts
Temperature	-Increase of temperature, especially along the coastlines -Decreased water availability	-Eutrophication of lakes and water reservoirs	-Reduced water availability -Reduced agricultural productivity -Decline in harvest yields, which threatens food security -Peoples security threatened
Precipitation	-Changes in precipitation pattern -Shifts in seasons: shorter but more intense rainy periods -Longer dry periods -Snow in unusual regions	-Water pollution because of longer dry periods -Melting glaciers in Lesotho and therefore changes in river flow of the Orange-Senqu	-Reduced agricultural productivity -Food security threatened -Peoples security threatened -Uncertainties -Drought might affect food security
Extreme weather events	-Increasing disaster frequency -Increasing magnitude of disasters Increase of: -Field-fires -Large-scale floods -Droughts -Damage to infrastructure -Increase of poverty related problems	Harder for societies to cope with higher frequencies and magnitudes of disasters	-Reduced agricultural productivity -Food security threatened -Peoples security threatened -Uncertainties -Poverty

According to IPCC (2007), vulnerabilities to climate are strongly correlated with climate variability, especially in terms of precipitation variability in semi-arid areas, emphasizing that "[i]ntegrated Water Resources Management should be an instrument to explore adaptation measures to climate change [...] (IPCC 2007:196). Therefore CARE (2007) highlights the importance to give the most vulnerable people a voice in adaptation policies and programs and provide access to information. Access to information, which includes "[…] appropriate, timely and locally relevant climate information such as weather forecasts, seasonal forecasts and early warnings for climate hazards", highly determines people's ability to act on certain adaptation strategies by responding to changing risks (CARE 2011:iv). By giving vulnerable people a voice in decision-making, adaptation strategies can properly respond to their needs, priorities and aspirations (CARE 2011). According to the interview partners, the most vulnerable groups to climate variability and change within the Orange-Senqu river basin are the local (rural) communities, including subsistence farmers who very much rely on natural resources such as water for animals, consumption and farming, followed by people living in informal settlements (IP2; IP5; IP6). Local communities are generally considered to have the least adaptive capacity to climate variability and change. A reason for their vulnerability is a lack of skills to cope with any natural disaster, a

very low adaptive capacity and their heavily dependent lifestyle on natural resources. Furthermore, a lack of information (e.g. through a lack of education) impedes appropriate farming strategies for small farmers in rural areas to adapt for future climate change: “The commercial, big farmers they are fine, they plan very well and things like that but for the subsistence farmers, there is a need of information and knowledge. These people don't really know how to farm and get the maximum out of their land. Many of them are using the same practices that they used 100 years ago. It has to do with culture sometimes as well, and some people are still believing in the rain queen and they don't worry about sciences“ (IP6Q5). Besides ignorance, unemployment (and associated poverty), poor governance, corruption and a lack of capacities on local levels were seen as major reason for lacking adaptation strategies. Money is seen as a source of basic income that makes people better able to cope with natural disasters. Additionally, flood prone housing conditions are particularly estimated to raise the vulnerability of people in informal settlements. In summary, the expert traced vulnerabilities of local communities back to a combination of the particular geographical exposure of the Orange-Senqu river basin (water scarcity), combined with low levels of human development (especially lack of knowledge and skills) when compared to urban areas (table 22). However, in urban areas vulnerabilities referred to people of informal settlements that lack financial resources to build houses that can sustain floods.

Table 22: Vulnerable groups and roots causes of vulnerability

Vulnerable Groups within the basin	-Local communities -Traditional subsistence farmer -People in informal settlements
Root causes of vulnerability	-High dependency on natural resources (land and water) -Lack of alternatives beside agriculture -Lack information and knowledge regarding appropriate farming strategies -Unemployment -Lack of financial resources to adapt -Lack of skills and knowledge to cope with any natural disaster -Highly vulnerable to natural hazards -Lack of awareness -Poverty -Inappropriate housing in urban areas are prone to flooding -Lack of education

To address vulnerabilities of people to climate variability and change, capacity building programmes are being implemented within the basin. As capacity building makes expertise available and promotes information exchange between sectors and levels, e.g. in terms of appropriate farming strategies for subsistence farmers in rural areas, people are better able to adapt for future climate change. Skills in sustainable agriculture practices help to sustain

droughts better as water is used more efficiently and harvested during rainy seasons. According to IP3, "[…] a better water harvesting [contributes] for an improved water supply" [IP3Q11], which in turn ensures water security and supports sustainable development. IP12 puts it more puts it more generally: "[I]individuals need to have skills, […] to manage water resources effectively and to be adaptable according to the changing world and a changing state of water resources […]" (IP12Q5).

However, capacity building itself is constrained by several factors that impede successful cooperation (e.g. between NGOs specialised in capacity building and local communities) and sustainable development in the basin. Main challenges include a lack of financial resources that would allow proper and constant contact with communities, such as costs for transportation and costs for cell phone calls. Furthermore, IP7 indicates challenges in terms of cooperation with people that face a lack of (scientific) knowledge background and who are not willing to cooperate. Also, as alluding to by this respondent, "[…] changing institutions is in itself a very slow process" (IP12Q8) motivating people and institutions to change is experienced as major challenge to capacity building. This requires a great deal of patience and acceptance of slow progress in capacity building (IP7; IP12). An integrated water management approach is essential to reduce people´s vulnerability to climate variability and change in the basin and to make expertise available through capacity building. This enables people to develop adequate adaptation strategies and therefore, enhance their resilience to the impacts of climate change.

6.2 Recommendations

In the following, the suggestions and recommendations made by all interview partners in how to put IWRM into practice and how best to adapt to climate change, are listed.

Suggestions made by interview partners referred to all levels and included a wide range of aspects such as suggestions for policy, cross-sectoral interactions, capacities, participation and involvement of disadvantaged groups, awareness building, infrastructure upliftment, adaptation strategies for agriculture to climate change and greater involvement of science in decision-making (table 23).

Table 23: Suggestions from interview partner to improve IWRM implementation

	National Government	Provinicla/Municipal Government	Local population
Policy	-Long-term overall upliftment policy -Use predictions of climate change to improve water management -Integrate climate change into policies - Focus on integrated strategies and support the poor, instead of focusing on international issues -Improve monitoring of compliance with regulations	-Promote gender equity -Promote involvement and participation	-Give woman access to different markets to sell their products
Capacities	-Capacity building of government -Involve scientists more in political decisions -Create awareness -Control illegal water use -Monitor the compliance of the water license (focus industry) -Promote further decentralisation of decision-making -Provide capacity training -Facilitate adaptive strategies to climate change	-Capacity building of government -Improve technical skills for water harvesting, water conservation and water recycling -Better management of finances - Support population to create adaptive strategies	-Capacity building of local people -Create awareness around pollution -Create awareness around environmental issues starting from school (environmental education) -Capacity building for maintaining local infrastructure
Cross-sectoral & level interactions	-Increase cooperation and communication and between ministries -Increase cooperation and communication between national and municipal government	-Conform laws to national level -Improve communication to national and local level	-Improve communication to municipal level
Resources	-Increase financial resources to support the implementation of IWRM -Increase the number of human resources in divisions to enforce IWRM -Stronger involvement of the private sector	-Increase the number of human resources in municipal government to enforce IWRM	-Increase human resources for more capacity building
Equal rights and participation	-Promote gender equality and involve women stronger in government -Stop racism and gender bias	-Promote gender equality and involve women stronger in municipal government -Stop racism and gender bias	-Empower women -Promote equal participation in decision-making and water management -Stop racism and gender bias
Awareness	-Raise awareness around water-related issues and impacts of climate change -Awareness building: Integrate climate change into mind-sets -Rise awareness around climate change -Providing equal access to resources Strengthen local governmental capacity	-Provide access to information to subsistence farmers in terms of climate change impacts	-Create Awareness to stop water waste
Infrastructure	-Upgrade of national water infrastructure -Operational maintenance	-Upgrade local water infrastructure -Operational maintenance	-Operational maintenance of local infrastructure

Climate Change	-Integrate climate change more into decision-making in the water sector	Commercial & subsistence farmer: Adaptation to climate change: -Reduce water use -Adapt to dry farming conditions -Farm with drought-tolerant crops -Diversify crops	
Science	Improve predictions related to climate change -Improve communication between scientists and population in terms of providing access to information's		

Capacity building programs across sectors and levels:

A large proportion of suggestions made refer to capacity building on all levels and sectors to support the implementation of IWRM (IP1; IP6; IP7; IP10; IP11). According to CAP-NET (2011:1), capacity building for institutions and individuals is essential "[…] to manage, develop and use water resources sustainably, and to adapt to increasing climate variability and climate change within a context that addresses gender equity and sustainable livelihoods". Interview partners assumed, that capacity building prevents conflicts in the basin, helps to control illegal use of water resources, leads to better financial management, helps to maintain infrastructure and supports the implementation of IWRM e.g. through effective planning, increased intersectoral interaction and stronger involvement of disadvantaged groups (IP1; IP6; IP11). Furthermore, people on the ground develop skills that directly contribute to improving livelihoods: " […] people should be empowered in a sense that they need to develop portable skills that they can also use for other projects or in their own, if they develop an own business" (IP7Q2).

Upgrade of Infrastructure:

According to UNEP (2009), the physical infrastructure is generally more advanced in countries that have adopted integrated approaches. As water infrastructure is the base to ensure access to water, investments in infrastructure to ensure access to water as well as capacity building are important to enable people to value the water infrastructure and to adequately and sustainably maintain it.

Involve disadvantaged people, empower women and decentralise decision-making

Without the involvement of local communities and their interests and needs, implementation of IWRM is not possible (DUNGUMARO & MADULU 2002). Interview partners identified the rural poor, including subsistence farmers and women as the most disadvantaged groups in participation of decision-making (IP1; IP3; IP4; IP8; IP9; IP10; Ip13; IP14). As competition over water resources is particularly high in the water stressed Orange-Senqu river basin, the protection of poor

people's rights to water for productive purposes is of high importance. Suggestions referred to increasing the involvement of disadvantaged people to provide equal decision-making across sectors and levels. Greater involvement can be achieved through effective communication between planners and water managers with the rural poor and through the provision of access to information, whenever water governance decisions are taken (KOPPEN ET AL. 2002). Interview partners also highlighted the important role of women in water-related issues and advocate for their greater involvement in water management to contribute to sustainability (IP1; IP3). Beside traditional gender inequities, women themselves also need to develop more self-confidence and support each other. Furthermore, awareness building and cooperatives at local levels also contribute to the empowerment of women. Involving disadvantaged people also implied further decentralisation and decentralized decision-making on the basin level (IP3; IP4; IP7), highlighting that "[…] decision-making should be decentralized to the community as much as possible" (IP7Q2).

Raising awareness

Capacity building contributes to raising awareness for water-related issues, including the impacts of climate change. Awareness is important to support integrated approaches and sustainable water management (IP12, UNESCO 2009). Interview partners considered awareness building and environmental education from school level as important, to promote water harvesting, to improve water supply in the basin and to achieve an overall sustainable use of water resources (IP1, IP3; IP8; IP11). IP11 states: "So much more awareness is important. (...) We even should need to start from school, so from basic education where you need to build this culture. So that people coming-out of institutions understand the importance of the water sector and how water resources should be managed" (IP11Q9). Furthermore UNEP (2009) stresses the importance, to raise public awareness about the water effects of climate change, reminding users of the necessity and limitations of water resources for human existence. Awareness contributes to developing climate change adaptation strategies (UNEP 2009).

Increase cooperation and communication across levels and sectors

IWRM is about cooperation and communication between different stakeholders from different sectors and levels (GWP 2013). Interview partners emphasized the importance of cross-sectoral cooperation and the involvement of local communities (IP8; IP9; IP8; IP13). To achieve integrated water management, IP8 highlights that "[p]eople from the water sector have to work hand in hand with people working in agriculture and other sectors, this would mean an integrated way" (IP8Q11). Suggestions for governments refer to better cooperation with lower levels: "The

government should work more with the local level and small farmers and other stakeholders" (IP9Q3). IP13 concludes: "I think IWRM needs to create a good link between local communities and marginalized groups and link them with local and national government" (IP13Q7).

Compliance of water licensing

To prevent tensions between different water users, the water license presents a tool to control allocation in the water scarce Orange-Senqu river basin. As non-compliance of water licensing by high volume users was identified as an impedement to sustainable water management, interview partners demanded compliance from high-volume water users and for the municipalities to improve their monitoring systems (IP3; IP7; IP8).

Integrate climate change to water management plans

Water resources will be increasingly affected by climate change terms of quantity and quality. Water management must respond to new risks through climate change and develop adequate adaptation responses (see UNSECO 2009). However, primarily the most vulnerable groups to climate change impacts have to be identified to develop adaptation measures: „[…] measures to mitigate and adapt to the impacts of climate change cannot be identified without first assessing the vulnerability of existing water management and water functions" UNEP (2009:11). In terms of agriculture, interview partners suggested that more efficient water use and the diversification of crops would be possible ways to adapt to dry conditions in the basin (IP2; IP5; IP6; IP10; IP13). Awareness building is important to draw attention to climate change impacts, to strengthen capacities within the government and to develop adequate adaptation measure, thus enhancing capacities and resilience to climate change (IP5; IP10). To plan for climate change also requires an understanding of the drivers that impact the hydrological cycle and awareness around the interconnections between water and climate change. Providing access to information in terms of what the impacts of climate change are, is seen as a key element to all subsequent adaptation measures (IP2; IP13). Better modelling and prediction would furthermore support climate change adaptation in the water sector, thus demanding for more involvement of scientific knowledge in certain decision processes.

6.3 Summary

According to statements made by the interview partners, little advance has been identified in the implementation of IWRM discussed alongside 3 hypotheses (IP1; IP3; IP4; IP6; IP7; IP8; IP9; IP10; IP11; IP12; IP13).

This thesis identified the disparity between South Africa's water governance framework, which provides the legal framework for IWRM and the implementation of IWRM on the ground. The National Water Act is widely recognized as one of the most comprehensive water laws in the world (DWAF 2012, UNEP 2009, MULLER ET AL. 2009, KOPPEN ET AL. 2002). Nevertheless, interview partners identified several aspects and reasons for the slow process of IWRM implementation. These aspects refer to the national, basin and local level and include a lack of capacities, traditional sectoral thinking, thus leading to a lack of cooperation and communication between all levels and sectors, a lack of awareness of water scarcity and pollution, and a lack of understanding the IWRM concept. The following figure 14 shows stakeholders' views on aspects that affect successful IWRM implementation in the Orange-Senqu river basin.

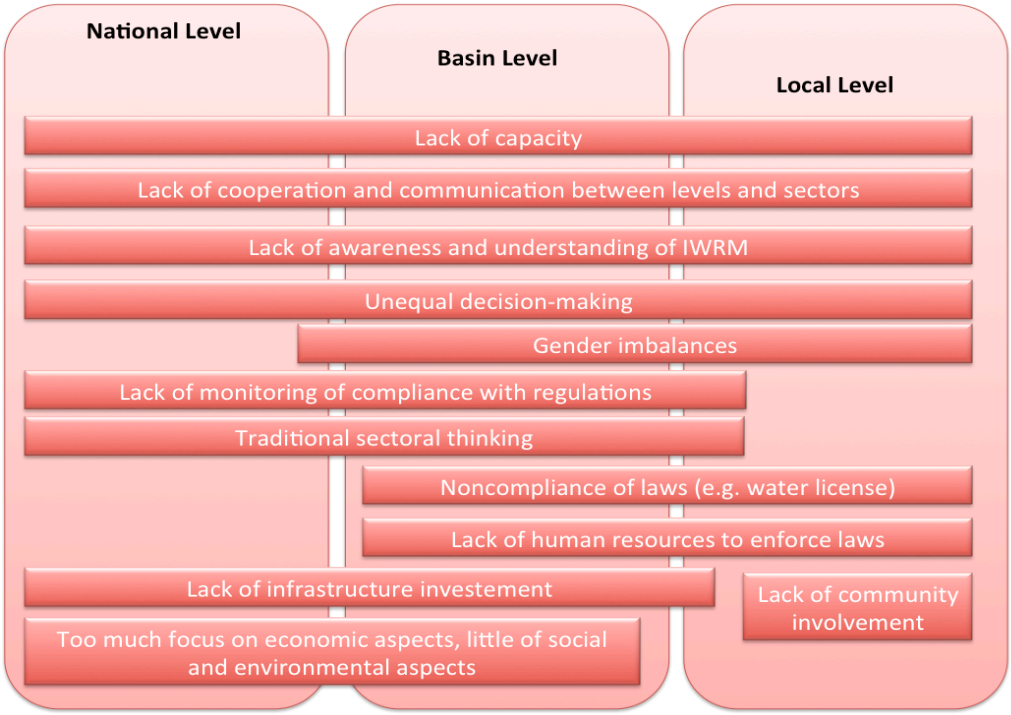

Figure 14: Aspects to affect successful implementation of IWRM according to the interview partners. Source: Own presentation

The Dwaf (DWAF 2012:ii) summarizes, that although "[p]aradoxically South Africa has a fairly well developed water management and infrastructure framework which has resulted in a perceived sense of water security (urban and growth areas) […]", IWRM faces many challenges.

This thesis furthermore highlights the importance of participatory decision-making for sustainable water management. However, despite the decentralisation policies (Catchment Management Agencies) of South Africa's government to promote decentralized decision-making and to

increase the involvement of local communities, interview partners assessed involvement and participation in the basin to be unequal. The local (rural) poor, people in informal settlements and women were identified to be the most disadvantaged and marginalised in decision-making and the most vulnerable groups to climate change. As the involvement of *all* stakeholders is estimated to be "[…] highly significant to the implementation of IWRM" (UFZ 2011:15), a proper `bottom-up´ approach is obviously lacking so far, thus affecting successful IWRM implementation in the Orange-Senqu river basin. Capacity building is important in order to reduce vulnerabilities of people to the impacts of climate change and to enhances their resilience to climate change impacts, although some challenges such as high costs or a lack of willingness to cooperate present major obstacles for capacity building to succeed.

Despite all challenges that were identified as impeding IWRM implementation, interview partners made several recommendations to support sustainable water management in the Orange-Senqu river basin. Recommendations refer to national, provincial/basin and local levels and tackle a range of aspects such as capacities building, awareness building, further decentralisation processes needed to involve local communities and women, a need for stronger focus on social and environmental aspects especially from political and municipal sides and an improved monitoring of compliance with regulations were all demanded. Investments in water infrastructure would for example raise access to water, thus enabling people to improve livelihoods and build resilience against climate change impacts. The following figure 15 provides a summary on all given recommendations by the interview partners.

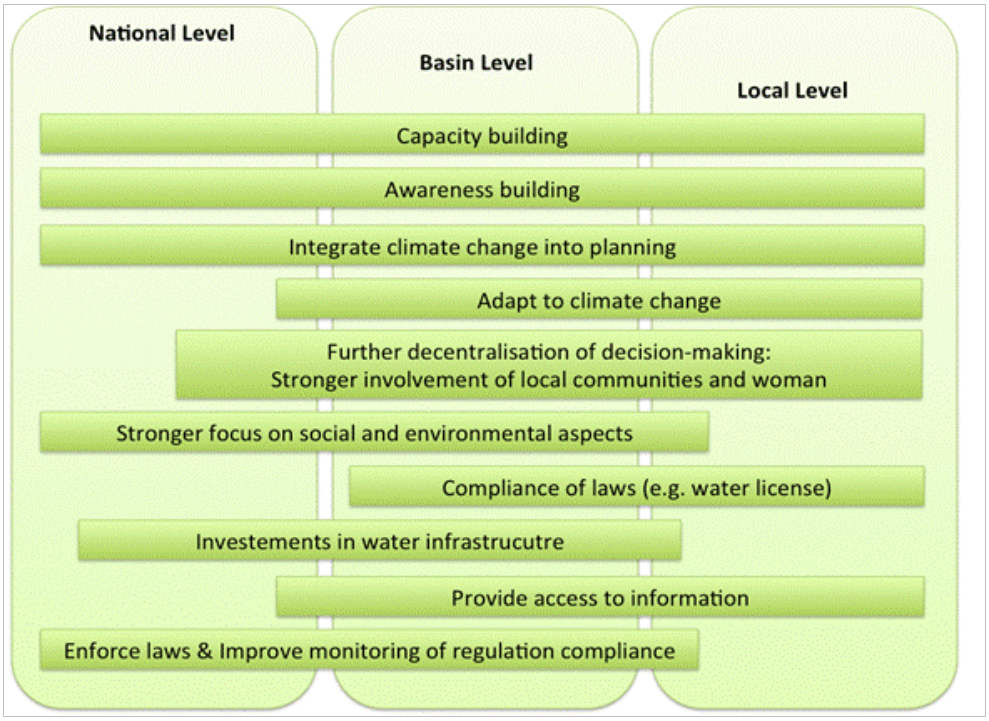

Figure 15: Recommendation for successful IWRM implementation according to interview partners. Source: Own presentation

As certain groups are highly disadvantaged in participation opportunities, capacity building is facing challenges to support sustainable water management and the impacts of climate change are likely to worsen water scarcity in the basin, projections of future development poses many questions. Although the experts evaluated the implementation in the Orange-Senqu river basin as disappointing so far, nevertheless some improvements have been observed. These include improved access to water and sanitation services, particularly in rural areas in the last two decades, and higher awareness around water-related issues within the country.

Nevertheless, IWRM is a slow process and it will still take several years to achieve water security and the overall goal of sustainable development within the basin.

7 Conclusion and Outlook

This chapter summarises the key findings of this Master thesis. Following this, it discusses some of the limitations of this study and finally gives an outlook for further research.

7.1 Summary of findings

Building on the 14 in-depth interviews conducted with relevant experts in South Africa, this thesis presented an analysis of expert´s views on the disparity between the legal water governance framework and the actual IWRM implementation within the basin, including equal decision-making opportunities between different water users and the importance to include climate change into water management strategies.

Overall it can be concluded, that although the experts perceived the South African water governance to be advanced, little progress in the implementation of IWRM in the Orange-Senqu river basin has been experienced so far.

The interview partners identified many aspects that affect successful IWRM implementation at basin level. These aspects referred to national, provincial/municipal and local levels as well as to cross-sectoral cooperation between all levels and sectors. Obstacles included first and foremost, the prevalence of traditional sectoral thinking, most noticeable in the lack of cooperation and communication between levels (for example there is almost no dialogue between national and local levels). This was also observed on the national level itself (ministries hardly cooperate and responsibilities sometimes seem unclear) and also at municipal and local levels (there is a lack of information exchange between institutions who work more against each other than to act in concert). Another huge constraint to IWRM is linked to a lack of capacity, which was observed at all levels. On the national level, a lack of scientific background knowledge regarding the hydrological cycle, the impacts of climate change and a general understanding of the IWRM concept are seen as major obstacles for developing adequate policy decisions for water management. On the municipal level, the knowledge capacities of those who enforce policy or legislation was seen as lacking and further aggravated due to a lack of human resources to maintain compliance with regulations. A lack of capacity on municipal and local levels also results in non-maintenance of water infrastructure, thus impeding successful implementation of IWRM. The World Bank states that (2012:1), “[…] adequate and well-maintained water infrastructure is a necessary condition for economic growth and poverty reduction”. A lack of awareness around water-related issues as well as corruption, poor workmanship, partisanship,

lack of political willingness, a lack of financial resources or even mismanagement of money are additionally seen as obstacles to implement IWRM.

The interview partners identified the rural poor (particularly women) and those in informal urban settlements as being the most disadvantaged and excluded groups in participatory decision-making. Additionally, these groups were also identified as being highly vulnerable to the impacts of climate change. As climate change will increase natural climate variability, a higher frequency and magnitude of climate extremes such as longer dry periods and shorter but more intense rain periods have been experienced so far. As local communities are already disadvantaged in decision-making, the impacts of climate change might overwhelm their ability to cope with future climate change and trigger conflicts. Conflicts are already seen around uneven water distribution and costs between sectors and levels.

However, the experts gave several recommendations in order to tackle those problems and to support sustainable water management in the basin. First and foremost, the experts called for capacity building on national, municipal and local level. Capacity building plays a huge role in the support of IWRM implementation through which people can develop awareness of water related issues and the impacts of climate change, thus enhancing the resilience of the population.

Environmental education was also suggested to raise awareness for environmental issues, beginning from school age so as to achieve more acceptance and acknowledgement of the importance of sustainable water management. Awareness campaigns within the population were seen as potential ways to tackle pollutions issues and to reinstate the economic value of scarce water resources in the basin. As IWRM stands for equal participation in decision-making over water resources between different users, the involvement of marginalized groups such as local communities should form a primary focus. Furthermore, as these groups are considered to be highly vulnerable to climate change impacts, access to information on adaptation measures would help to build resilience.

South Africa's water governance is considered to be one of the most advanced in the world, providing the theoretical framework for IWRM. Although the interviewed experts identified several obstacles for successful IWRM implementation, most of them seemed generally optimistic for the future of IWRM.

7.2 Limitations of this Work

This paper was written as a Master's Thesis, thus following an ambiguous research objective and faced by many restrictions in time and space, the scope of this study is limited. The time and resources allocated for this thesis severely prevented a more comprehensive study.

First of all, as the primary research focused on interview partners mainly at national and provincial levels, this has led to certain concessions: Despite sometimes working at local levels, the interview partners did not represent those directly affected by IWRM. Thus, their knowledge of certain issues, such as the involvement of local people, is limited to their individual experiences and background knowledge. As result, their views must be considered carefully and may not reflect the opinions and ideas of those directly affected by water scarcity, water pollution and the impacts of climate change. Due to time and capacity constraints, it was not possible to interview marginalized groups themselves, which may have been very interesting and may have produced different views to those of the experts that were interviewed. To interview people in rural areas or in informal settlements would require possession of adequate transportation and knowledge of the area, as well as the assistance of local guides. Thus, it was not adequate for the author to take this risk, especially regarding the sometimes insecure nature of parts of Johannesburg and Pretoria.

Secondly, to collect as much information on IWRM and climate change as possible, a relatively diverse and extended interview questionnaire was developed. Although it was reduced and simplified several times in advance before the field-trip, the analysis of the interviews showed that some terms were not clearly differentiated (such as conflict/tension or coping/dealing/adapting with climate change) which may have affected the interview answers.

Thirdly, the discussion in chapter 6 is worthy to discuss. As IWRM is a highly complex concept, it was very hard to focus on both what makes IWRM work, while at the same time evaluating the whole of process of IWRM implementation, the role of climate change and it's constrains to succeed sustainable water management at the same time. Although many hypotheses were developed during the coding process itself, only three were presented and further discussed in detail. Furthermore, as the third hypothesis tried to analyse the importance to include climate change into water management strategies, it was not possible to properly focus on adaptation strategies that are important to reduce vulnerabilities to climate change. Rather it tried to highlight the importance to integrate the impacts of climate variability and change into water management to achieve water security and sustainable development. Although the author attempted to discuss as much given information as possible from the results (in chapter 5) but even reducing this to only 3 hypothesis, it was very challenging to focus in detail.

Fourthly, the evaluation of statements expressed by the experts, is to a certain extent affected by the knowledge and experience, and is thus somewhat subjective. The process of interpretation and development of hypothesis is also very subjective, despite best efforts to be as open as possible. Therefore, it is better that the discussion be seen as an analysis on which further studies can be built upon.

7.3 Outlook for Future Areas of Research

This Master's thesis focuses on the Orange-Senqu River Basin, a large river basin that stretches above four countries, namely South Africa, Lesotho, Botswana and Namibia. Due to time and capacity constraints, only the South African part of the basin was analysed in terms of IWRM implementation. Future research could focus on transboundary water management and cooperation strategies and/or conflict potential between the four countries.

As, for this thesis only experts from national and provincial levels were interviewed, another suggestions for future research refers to the choice of interview partners. IWRM promotes a participatory decision-making approach involving of all different users. Therefore, further investigation of and interviews with marginalized groups such as the rural local population and people of informal settlements is recommended, particularly to evaluate perceptions and awareness of water related issues, the impacts of climate change and their views towards participation opportunities in decision-making processes.

In consideration of the various national laws, acts and processes in the water sector, it would be also quite interesting to have a closer look at South Africa’s water governance and the legal framework for IWRM. Regarding the assumption that the water crisis is a crisis of governance, a future area of research could focus on South Africa´s water governance more in detail.

In terms of climate change, adaptation strategies to climate change despite prediction uncertainties would also form an interesting focus.

Furthermore, to return to the basin in a few years so as to access progresses made in IWRM implementation, would also be an interesting extension to this master's thesis. As water scarcity and therefore competition between users is likely to become more aggressive in the basin in future, another study of the progress of IWRM implementation would be interesting.

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Annexes

Annex 1: List of Interview Partners

Interviewpartner	**Institutuion/Organisation**	**Interview foucs**
Tracey McTray	University of Johannesburg/Geography	IWRM
Clare Kelso	University of Johannesburg/Geography	CC
Dr. Isaac Rampedi	University of Johannesburg/Geography	IWRM
Christoph Moa	ORASECOM, Centurion	IWRM
Smangele Mgquba	Director of Climate Change at the Department of Water Affairs and Forestry, Pretoria	CC
Prof. Hannes Rautenbach	University Pretoria, Geography/Meterology	CC
Victor Munnik	MVUALA Trust, Johannesburg	CB
Chris Moseki	Water Research Commission, Pretoria	IWRM
Dr. Xuelilang Cai	International Water Management Institute, Pretoria	IWRM
Fred van Zyl	Department of Water Affairs and Forestry, Pretoria	IWRM
Zama Sagalaba	WRP, Midrand	IWRM
Nick Tandi	Cap-Net, Pretoria	CC and CB
Salome Bronkhorst	ACCORD, Cape Town	CC and IWRM
Bennie Schloms	University of Stellenbosch	IWRM

Annex 2: Interview Guideline

1. Introductory Part

- What is the aim of your organisation and in what regions is (name of organisation) involved?
- You are working on International/National/Local Level. Do you cooperate with the International/National/Basin/Local Level? If so, with who?
- What is the aim of this cooperation?
- How is this contact maintained?
- How important are your cooperation's to contribute for a sustainable water resources management?

2. Main Part:

2.1 Water Resources, IWRM and Role of Government

- Which are the ecosystem services of the Orange-Senqu river for South Africa?
- Which are the main factors that threat the (quality of) water resources in South Africa?
- Who are the different water resources user groups in in the Orange-Senqu Basin?
- In your mind, how many people in South Africa have access to clean water and sanitation?
- Are there any water resource conflicts in South Africa and especially in the Orange-Senqu Basin?
- If yes, how does the National Water Policy address those problems?
- What are the main problems regarding the management of water resources?
- Which role does government play for the sustainable management of water resources?
- Does the government provide water infrastructure?
- How does the government ensure that international and national agreements are reached and maintained?
- How would you evaluate the cross-sectorial linkages/cooperation's between the international, national and local level?
- How do the Ministries link up and work together?
- Do you think the policy will result in sustainable water governance?
- If not, then what needs to be done?
- According to your expertise, are users, planners and policy-makers involved adequate in the decision-making for water planning and management on local, national and international level?
- Are there any disadvantaged people und vulnerable groups regarding decision-making of water management?
- Is the local community/indigenous involved adequately in water management?
- In your mind, exists gender equality? How are women involved in the decision making on local/national and international level?
- Do you have any recommendations, how decision-making could be more equitable?
- Does IWRM contribute to an economic and social welfare while addressing the environmental interests?
- How does the government raise the awareness of the importance of water management among policy-makers and the general public?
- Do you have any suggestions what could be improved regarding IWRM? (Government, Cooperations etc.)

2.2 Climate Change, Vulnerability and Role of Government

- How would you estimate the impact of current cc on South Africa (observed trends)?
- Where do you see the greatest future impacts?
- How does cc impact the water supply and quality in the basin?

- Does cc affect the quality of agricultural land and if yes, how?
- In your mind, does cc affect food security?
- Does cc affect water management? If yes, how?
- How do the people deal with the impacts (drought periods, decreasing or irregular precipitation)?
- What are coping strategies for people as a response to climate-related changes?
- What are important capabilities that are lacking?
- Are there certain groups, which are clearly more affected than others? If yes, which ones and why?
- In your opinion, which are root causes that that trigger the vulnerability of people?
- Does cc have an impact on the security for the individual (human security)? If yes, how?
- Are you aware of cases where this has lead to conflict/cooperation?
- To what extent is environmental change and human security issue for the government?
- How does the government reduce the impact of cc?
- How would you estimate the adaptive capacity to cc in South Africa?
- What would your recommendations be to improve national/regional policies on cc adaptation?
- What would your recommendations be for regional/local livelihoods on cc adaptation?
- How could vulnerabilities be reduced and resilience to the impacts of cc built?

2.3 Capacity Building for IWRM

- Do you promote CB on institutional/organisational or individual level?
- How do you promote CB? (trainings, seminars etc.)
- What are the most important objectives of CP?
- Which role does participation play?
- What are the most important issues and problems across sectors that must be addressed by CP?
- Are marginalized groups such as poor and women considered in particular?
- Which role does CB play for the management of water resources?
- Does CB support the implementation of IWRM and if yes, how?
- Which key benefits do people living within the basin catchment have due to CP?
- Which are the aspects affecting the success of capacity building?
- How would you evaluate the importance of CP for water management and human security?
- Which are the constraints and problems of CB?
- Do you have any recommendations regarding CB for water management?

3. Concluding Part:

- From your point or of view, are there any additional remarks or any gaps I did not address during the interview?
- Do you have any questions regarding my research or myself?
- Do you have any other contacts of interest?

Annex 3: Quotes from the Interview Partners

The first column refers to the number of interview parnter, while the second column refers to the paragraph in the specific interview. The third columns represent the quotation that was used for the discussion in Chapter 6. To not loose meaning of single sentences, the whole paragraph inlcuding the uestions is listed.

Interview Partner 1

IP1	Q1	I: Which are the ecosystem services of the Orange-Senqu River for South Africa? R: It is huge, because it is our biggest river. Of course we have agriculture particularly for irrigation purposes and industry, especially when you look up the upper Orange and the tributary rivers. The Vaal for example flows through heavily industrialized area. It starts in Mpumalanga so a lot of that water is drawn for the cole mines, the power stations and the industry in this region. Then the water flows through Gauteng which is also a heavily industrialized area. So you see the water of the Orange River and the tributaries are heavily used for industry, but obviously also for urban water supply. Gauteng is our smallest province but it is our most densely populated area with more than 10 million people and although not all of them rely on the tributary Vaal for domestic water supply, the majority of the population do. Furthermore most of our power stations need to water to work and a lot of them are very old, so they are not very water efficient anymore. So you will find these power stations along the river that has been damned for these purposes of the power generation.
IP1	Q2	I: Which are the main factors that threat the (quality of) water resources in South Africa? R: Poor management and sewage are big problems. So we need a new technology in this area. Obviously not everybody has access to flushing toilets, so the informal disposal of human waster is also a significant problem. We have the major problem in our rivers with ecola (bacteria) account, which is very high. The only rivers in South Africa where you do not find ekola in the rivers would be in the Drakensberg, where the rivers rises from. Another problem is gold mining, so the river contains radioactive material from the uranium. Furthermore, acid mine drainage is a significant problem in the Orange river due to the coal and gold mines. And then pollution from agriculture i must admit, especially where we have very high densities of cows in small areas, and the pollution flowing out of that is absolutely horrendous. Also nitrates and phosphates are a serous problem. Probably less from our industry, because they are slowly improving their methods although they are not innocent of course, but certainly the pollution incidence from our industry has reduced. And then there is a general plastic pollution problem, people are dumping illegally.
IP1	Q7	I: Who are the different water resources user groups in in the Orange-Senqu Basin? R: Farmers would be a significant user group, they are taking water out of the river for domestic water supply. The farmer for their agriculture and the municipalities for their water supply, i would say those are the two biggest one in the Orange-Senqu basin. But if you take the entire basin with the tributaries it is gonna be the power stations and industry.
IP1	Q3	I: In your mind, how many people in South Africa have access to clean water and sanitation? (in %?) R: Well it is getting better, i cannot remember the exactly percentage account but it is much much higher, than it has been ever in the past. So i would say overall the majority of the people do have access to clean water coming out of taps. There are few bad cases unfortunately, so some town and rural areas that don't, but the majority of the population does. They might not necessarily have their own tap in the house, they might have a yard tap or they have to share the tap. Unfortunately less in the area of sanitation, we have been less successful in removing the bucket system. So we do have quiet a few people that are still using the bucket system for toilets. Nowadays the majority of the people want to have flushing toilets, which is actually a disaster, because the flushing toilets are expensive to install, it must be connected to the water mains, with is not a good option for a water stressed country like South Africa. But it is becoming an issue of class and status, you considered a second class citizen if you do not have a flushing toilet.
IP1	Q4	I: Do you know if there are e any water resource conflicts in South Africa and especially in the Orange-Senqu Basin? R: Well there are lots. One of the biggest conflicts is between farmer and domestic and industry. But the conflict is not really seen around water but whats is really seen is around costs. Because our water at the moment is quiet cheap, although people would stay that. But what is really happening is, that farmers can access a lot of water for little money, so industry and domestic consumers in particularly are actually picking up the bill. So the conflict is really about money, around costs of this resource. And because insufficient pressure has been placed on our farmers to be more efficient with the water use, so they still consume a bulk of our

		water. Ironically the actual amount of food that South Africa has been producing, has actually declined. So they are still using a lot of water but it is not for our food security on national level, because we are now importing food. The numbers of farmers have declined over time, but the amount of water they are using stayed the same and we are importing food. So something is going drastically wrong.
IP1	Q5	I: If yes, how does the National Water Policy address those problems? R: Well apparently they are trying to rewrite the national water act to address those problems. And this is gonna link to your next question about the main problems regarding the management of water resources, we have three pieces of water legislation but i am going to talk now mainly about the National Water Act, because that is the key piece of legislation. The National Water Act has been considered for years to be an international piece of legislation, but if you read it, it is obviously that it is written by scientists. One of the main problem is that the National Water Act devided the country up into catchment areas. Very logical from a scientific perspective in terms of river basins, but both catchment areas do not correspond with particular boundaries at all. So we have got provincial boundaries, we have local boundaries which do not correspond with these catchments. So part of this problem is that we are supposed to have these catchment management agencies, which are supposed to have all representations of all the stakeholders, like domestic and farmers, industry and so on but the problem sis that is not not correspond with the political boundaries and politics matters more than anything else. so many decision do not get made by the catchment agency, but they get made at the political level. And the main problem is that there are bigger interests on the political side, for example how to create jobs and business, to bring in money and then all the environmental issues just get ignored. So the main issue is about politics and a lack of capacity. So here in South Africa we do have a lot of environmental legislations, but the trouble is, we can not enforce them because we have a lack of capacity and there is a lack of political willingness.
IP1	Q6	I: What role does government play in sustainable management of water resources? R: So the legislation is set up in the whole country, so the government has to do a lot. But the government on the one hand does not always have the money to enforce these legislations, they do not always have the capacity and there is a lack of political will. That is one reason why the quality of water has declined in the last 15 years. We have serious water problems, especially around solution. So we need to strengthen our civil society, we also need to strengthen our professors to get involved.
IP1	Q7	I: Does the government provide water infrastructure? R: It just depends on which level. So national government runs the dams. We have got about 550 government dams in this country, this is a massive number and these are just the government dams! If you take private dams into account, you could probably triple that. The National Water Act basically nationalized our water resources. So the state controls all surface water in this country and they have to look after it on behalf of the citizens of South Africa. So the state owns the water of this country, so one of the government jobs is to build dams. We have governmental organizations who provide the purification infrastructure and they pump the water to the municipalities. And on the local level you have to local government, who has to build the infrastructure. So they have to build the water lines and they have to run the sewage system, they pump the water to thesis taps and they will bill you for that water.
IP1	Q8	I: How does the government ensure that international and national agreements are reached and maintained? R: Thats is a bit complicated, because it is a long process of drafting from national legislation and then public participation, going into the provinces and parliament and cabinets. If we sign international agreements, then it will get signed by the president and endorsed by cabinet and by provinces to ratify international agreement and then actually we have to pass and draft national legislation, that will enable us to comply with our international agreements. But it always depends on various departments, so for example the kyoto protocol is the job of the department of environmental affairs that enforce the agreement.
IP1	Q9	I: How would you evaluate the cross-sectorial linkages/cooperation's between the international, national and local level? R: I would say our biggest problem are our national government departments, because they lie between international agreements and the local national level. But there is a serious shortage of staff, so they just so not have enough people. And these people, i do not want to say they are stupid or uneducated, but there is a mismatch between their qualification and what they have to do. But also a mismatch what they can do and what they are expected of them, so the kind of goals that they have to achieve is very hard sometimes. So to evaluate the cross-sectoral linkages i would say it is weak and weakest link is at our national government department level.
IP1	Q10	I: How do the Ministries link up and work together? R: They don't. They kind of working more against each other than working together. At the more local and provincial level the people do work more together as much as possible. But in general it is all about politics and territory and that is one of our huge problems of acid mine drainage, because the department of mineral resources, the department of energy and the department of water they are fighting about responsibility. So the department of mineral resources can give mission to open a mine without the agreement from the water minister that they can have a water liscense to extract water, so thats the whole debacle that they just operate without a water liscense. And it was local NGOs, wildlife societies, local farmers all freaking out because it is a very barren area of this country water wise. Now there will be an international investigation if it can still keep that as a world heritage side. So the ministries are not working together.

IP1	Q11	I: Do you think the policy will result in sustainable water governance? R: Oh it hasn't. It is a beautiful peace of law, the national water act and in some parts it just hasn't been implemented especially when the catchments doenst match with he political boundaries. They basically say they are going to redraft it. Although the National Water Act is not perfect, i would rather keep it than to rewrite it, which could be a disaster.
IP1	Q12	I: So in your mind, what needs to be done? R: We need to regrow our civil society, because the average South Africa know we have a major problem around energy, so there are sometimes periods without electricity and the mines were forced to close and in 2008 this country lost 50 billion Rand from our electricity not functioning just in january. And the average South Africans also knows that we have a serious problem in education, but there is a huge movement in the last years where ordinary citizens say, "enough is enough, we want our schools to be fixed". But we are not aware of how big our water problem is. And it is gonna hit us unfortunately much later, it is not gonna hit us so much now but in future. And the average even educated people and even journalists are not aware for example, that the government signed to build the next two dams in Lesotho. So financially water will be a problem in future and then in terms of pollution it is gonna be a disaster in future. So civil society really need to develop capacity around that topic and we need politicians that we can hold to account and we need academics to help to build capacity in our country and do research in this. This National Water Act that was drafted by scientists, so by very educated people, those kind of people need to get back into the game and start giving input to policies and start being vocal in the media.
IP1	Q13	I: According to your expertise, are users, planners and policy-makers involved adequate in the decision-making over water water? R: No. I would say it is just way to dominated by politicians at the moment, that is the biggest problem. So the average domestic consumer is turning on his tap and they don't realize why water needs to cost money and the fact that it is become more expensive. They don't realize the pollution problem, they don't realize how much water we are wasting. We have serious leak problems. So we are cleaning the water, we are pumping it all the way up to municipalities and then a lot of water gets lost due to leaks. The decision making mainly takes place on national level but we just don't have enough people and these people often don't have the right capacity to do it. There are a few good ones, but it is just not enough. A lot of good of well educated people are going away for example to Australia or new Zealand.
IP1	Q14	I: Are there any disadvantaged people and vulnerable groups regarding decision-making of water management? R: Oh yes shame, especially the user on local level, these poor people they are really not involved in the decision making. And what really concerns me in the long run is that they have been severely limited to how much water they can have, free of charge. As we have the free basic water policy which i was involved with. We knew that we have to get people to pay for water, because if people do not pay for water, they don't appreciate it and they waste it. And obviously in a country like South Africa with regular droughts that we have, we are a water stressed country and we can't have people just wasting water, so they need to pay for it. Cleaning the water costs money, building the dams cost money and our water is basically an industrial product where you have to pay for. And then i got involved in doing research in very vulnerable disadvantaged groups and one of the conclusions that came out was that we can't force to pay South Africans for the water. There are a lot of traditional people who still think water comes from god and it is their right to use it and that kind of stuff so at the end we concluded, that we can force people to pay for water but we have to give them a certain amount free and that became free basic water. That was our recommendation. What we didn't realize is that an election was around the corner. So to our amazement this thing went through to cabinet level and the next thing he announced was free basic water across the country. The problem was that the election was around the corner and the ANC never asked us, how many liters exactly the people would need. According to the UN, it is 25 liters of water per person per day. But that is a refugee amount, a minimum amount in refugee camps. So they took this 25 liters and they said, with an average of three people in a household and they ended up with 6000 liters of free basic water, but it is certainly not enough. It is not enough for flushing the toilet, it is not enough if somebody is hit positive because they require a lot of extra washing for example. So free basic water has been trashed in South Africa and if somebody asked me again today, i would have said they need 12.000 or even 13.000 liters per household per month based on our research. So we need to change the free basic water to 13.000 but even that is not a lot of water and especially poor and disadvantaged people who needs to use extra water, they are forced to pay for it. And what concerns me, that in future the water is becoming more and more expensive. So these people are not really involved i don't think they have a clou what is really happening because they haven't been informed. They are not involved because our public participation process in this country is extremely weak and the best example i can give you, is the etolian disaster in Gauteng. They build new highways and the people have to pay a toll now. Many people were angry but the public participation just was not big noun to change something. So imagine how badly the public participation is around water.
IP1	Q15	I: In your mind, exists gender equality? How are women involved in the decision making on local/national and international level? R: Shame, obviously no, this is Africa. Even our president recently went on tv and said a man must get married and have babies, oh my god thats so funny. I don't even know how many wires and fiancés he have, we all loose track. I think he has about 5 or 6 woman and around 20 maybe 22 children. So something is not ok in this countries. So in general you will meet woman in key positions, but i would say it is still a very male

		dominated society and there are just a few woman that are able to give input into policy documents. And what I also find is and which is one of the biggest problems in South Africa is, that they lack self confidence. They are afraid and they don't fight for their points.
IP1	Q16	I: Do you have any recommendations, how decision-making could be more equitable? R: Self confidence trainings for woman. And particularly men in South Africa need gender training because they don't know about the extent they dominate the woman. I meet educated man in serious positions who are calling woman "chics". It is a really man dominated society. When i was in New Zealand for example, all the men are calling woman "lady".
IP1	Q17	I: So one of the main goals of IWRM is to contribute to an economic and social welfare while addressing the environmental interests. Do you think it works like that in South Africa? R: No, i think the economical aspects is more important. We do create jobs, either if they are good or bad but the haven't really focus on social welfare, in terms of qualitative good and well paid jobs. If you ask a South AFrica to choose between the environment and a job, they will choose jobs every single time. There is not even a debate. And the people wouldn't even ask about the qualityof this job and how long the job lasts and how much the get paid, they just see the job and money.
IP1	Q18	I: How does the government raise the awareness of the importance of water management among policy-makers and the general public? R: They really don't. Our national water ministry is very weak with a lack of capacity, they are corrupt and there is a lot of partisanship. So these people are supposed to raise awareness around the importance of water management, pollution management and so on but they are not fulfilling their duties at all. It is very sad but it is true.
IP1	Q19	I: Finally, do you have any further suggestions or any gaps i didn't remark during the interview? R: We need to employ more people in this divisions, we need to build the capacity and choose people who are better qualified for this job. And then we need political will. And one of the biggest faults is ignoring wetlands. Our wetlands are in the major threat and in a semi-arid country like South Africa wetlands act as huge stores of water, and in terms of droughts and floods, the wetlands help to mitigate that. But we are destroying our wetlands every day and we ignore them. They are also under researched but everybody thinks the anybody else is looking after and responsible for the wetlands. We are losing wetlands every day. The whole of Gauteng is a grassland and a wetland area its not only on the coast.

Interview Partner 2:

IP2	Q1	I: Which are the ecosystem services of the Orange-Senqu River for South Africa? R: It is huge, because it is our biggest river. Of course we have agriculture particularly for irrigation purposes and industry, especially when you look up the upper Orange and the tributary rivers. The Vaal for example flows through heavily industrialized area. It starts in Mpumalanga so a lot of that water is drawn for the cole mines, the power stations and the industry in this region. Then the water flows through Gauteng which is also a heavily industrialized area. So you see the water of the Orange River and the tributaries are heavily used for industry, but obviously also for urban water supply. Gauteng is our smallest province but it is our most densely populated area with more than 10 million people and although not all of them rely on the tributary Vaal for domestic water supply, the majority of the population do. Furthermore most of our power stations need to water to work and a lot of them are very old, so they are not very water efficient anymore. So you will find these power stations along the river that has been damned for these purposes of the power generation.
IP2	Q2	I: Where do you see the greatest future impacts for South Africa? R: I would say water shortage as one of the biggest and possibly impacts on agriculture, due to changing seasonality effects. Furthermore there will be changes for communities that rely directly on natural resources.
IP2	Q3	I: How does climate change impact the water supply and quality? R: I think at the moment there are other things that are directly affecting the quality of water such as people, pollution, overuse of water resources, mining. So i would say at the moment climate change doenst directly affect the water quality it just compound with these factors. So climate change is just worsening the existing problems.
IP2	Q4	I: Does climate change affect the quality of agricultural land and if yes, how? R: Yes, we think so. Maybe it is a little bit to early to know whether if climate change is affecting agriculture, but we do have quite a few kind of seasonal droughts, but also quiet a few wet seasons and i think potentially it could affect it quiet severely in a long term.
IP2	Q5	I: In your mind, does climate change affect food security? R: Yes i would say that, especial for local communities to people that basically produce will be affected
IP2	Q6	I: Does cc affect water management and if yes, in which way? R: Definitely, there is a relationship between climate change and water management. I think predictions related to climate change would help with water management.

IP2	Q7	I: How do the people deal with the impacts?What are coping strategies for people as a response to climate-related changes? R: I think the impacts can be quiet severe but i am not sure if the people necessarily need to deal with them yet. I think in a lot of areas climate change is worsening poverty related problems but particularly more for rural communities. I think people do make certain adaptations, so it is more about the poverty impact that is worsening and that the people are coping with that but not really dealing. Other attempts are to diversify livelihoods and trying to change into other forms of direct income, so labour related activities. But i wouldn't say these are really effective coping strategies in a long term.
IP2	Q8	I: What are important capabilities that are lacking? R: I guess an understanding and predictions of the impacts, so the actual science but also the communicating that science to the people, so making it understandable for them and helping them access to these information would be very useful, because it enables them to plan. The opportunity for wealth creation supporting other opportunities.
IP2	Q9	I: Are there certain groups, which are clearly more affected than others? R: Yes, especially the rural poor that directly rely on natural resources, especially the people conducting rainfed agriculture more than anybody else, for example in the northern provinces where it is very dry. And then the population living in the coastal areas such as Cape Town, because of severe coastal flooding that tends to affects urban poor communities and informal areas much more dramatically than others. It is also an issue of housing in urban areas,so the quality of houses is more prone to flooding. But i don't know if you directly attribute it to climate change but there is a lot of flooding recently.
IP2	Q10	I: In your opinion, which are root causes that that trigger the vulnerability of people? R: So poverty definitely, and a lack of alternatives.
IP2	Q11	I: Does climate change have an impact on the security for the individual? If yes, how? R: I suppose especially on water for areas that rely on water resources and i think water is becoming one of the biggest problems in South Africa in the future and this will affect peoples security.
IP2	Q12	I: Are you aware of cases where this has lead to conflict/cooperation? R: Not directly. There are some deliveries in terms of food but it is not directly related to climate change, but in general I think climate change will raise those problems.
IP2	Q13	I: To what extent is environmental change and human security issue for the government? R: I think it is quite important but the climate change white paper that came out recently focused more on mitigation, output and demands for greenhouse gas emissions. So it does not focus so much on vulnerability. But the government should focus more on an integrated strategy and how to make en effect of the people that are more affected. So the government focuses more on international agreements and on what the rest of the world is focusing on, but that is not really specific to communities within the country.
IP2	Q14	I: How would you estimate the adaptive capacity to cc in South Africa? R: I think it varies a huge amount on different regions and different people depending on how directly their lives are involved with activities. If you look at the poor communities, they have the least adaptive capacity.
IP2	Q15	I: What would your recommendations be to improve national/regional policies on cc adaptation? R: More of a focus on vulnerabilities and then kind of targeting overall upliftment, so paying attentions to problems like service delivery issues, access to resources so looking at a more board level vulnerably instead of just focusing general policy which downs really target vulnerable groups. So to identify those who are likely to be the most vulnerable and rely most directly on resources and looking at overall uplifting programmes. But also which resources are likely to be affected and targeting those for groups, so now it is more of a macro level policy and not really focusing on individual groups.
IP2	Q16	I: What would your recommendations be for regional/local livelihoods on cc adaptation? R: At service delivery on local level should be looked at more in more detail. Another problem is a lack of capacity at local level and government and what they are able to do, so local government capacity has be strengthened.
IP2	Q17	I: How could vulnerabilities be reduced and resilience to the impacts of cc built? R: I think we tend to focus on managing after extreme events, but in long term an overall upliftment policy not only in the context of climate change but in general is very important.
IP2	Q18	I: How could problem-solving capacities be strengthened? R: A lot of training and awareness building. People who are dealing with these things and strengthening the capacity within the government and the service deliveries. There is a big lack of capacity and understanding of impacts. it is also important to make the knowledge available in terms of what climate change impacts there are. A lot of people are not aware of these facts and especially people involved in agriculture need a better accede to those informations.

Interview Partner 3

IP3	Q1	I: Which are the ecosystem services of the Orange-Senqu river for South Africa? R: I am not very familiar with this basin but i know. I can think of agriculture, fishing, ecosystem integrity, water supply and energy but also ecological processes
IP3	Q2	I: Which are the main factors that threat the (quality of) water resources in South Africa? R: Pollution by human activities. We are talking about industry, we are talking about mining, we are talking about agriculture and their contamination but we are also talking about informal settlements. These people are taking land without permission, they occupy the land, there is no infrastructure, no toilet facilities and no water and they waste a lot which affects the catchment, the environments in general and the water as well.
IP3	Q3	I: Who are the different water resources user groups in in the Orange-Senqu Basin? R: In the guideline of water quality of the Department of Water Affairs they identified close to 7 different type of users. You have the water for household consumption, water for agriculture, water for recreation, water for industry and others as well but these are the most important ones.
IP3	Q4	I: Are you aware of any water resource conflicts in South Africa and especially in the Orange-Senqu Basin? R: No i am not aware of any direct conflicts there, but in a catchment like that you could expect settlements that are affected by upstream activities such as dumping. So the downstream users also their livestock are affected, because they are consuming the water. So in that context conflicts are possible.
IP3	Q5	I: What are the main problems regarding the management of water resources? R: The water supply and the demand in terms of provincial government who have to provide water of quality and quantity to households. The water quality is very good in urban areas, the people in the rural areas depend more on the groundwater which often contains heavy metals due to human activities. So the main problem is water quality and water portability in terms of water infrastructure on the supply side. On the demand side we have the problem, that many people do not know how to use the water resources wisely. The water still has a free sense because it is very cheap and we have got the National Water Act which allocates 6000 liters of water per indigenous household every month. So these people who don't have a financial obligation often don't understand that water is a scarce commodity. Another problem is the water used by mining. Mining is very big in our semi-arid country , our rainfall is very variable and varies spatial, so water is not always available where it should be.
IP3	Q6	I: Does the government provide water infrastructure? R: Yes, the government has very much to provide the infrastructure in urban and rural areas of this country. But the rural areas are struggling very very much to have water systems to deliver sufficient water.
IP3	Q7	I: Do you think the policy will result in sustainable water governance? R: Yes i think we have of of the best in the world. The National Water Act has recently been regarded by the United Nations Environment Programme and they said it is one of the best legislation in water governance. In terms of water supply they distinguish between ecological and human reserve. In South Africa you need a water user license to extract water, for example the industry who are polluting a lot. So the polluter must pay for the cost of rehabilitation of that catchment, lagoun or wetland.It is still a new legislation and i think it is good but we are still struggling with the correct implementation in South Africa.
IP3	Q8	I: According to your expertise, are users, planners and policy-makers involved adequate in the decision-making for water planning and management? R: No i would not say that it is adequate or equitable, we still are still struggling with the separate development in this country, the authorities, consulters, and engineers are planning in isolation from the the general public, so it feels very much autocratic. There is just not enough cooperation between government and catchment management agencies for example. Furthermore we don't have enough public participation. We would like to have an equitable decision-making, but that is not were we are at the moment. We have got a wonderful peace of legislation with the National Water Act, but the implementation is a very big challenge. The new government often have no idea about the hydrological situation and environmental economy.
IP3	Q9	I: Are there any disadvantaged people and vulnerable groups regarding decision-making of water management? R: Yes, very much. Especially in removed areas also to our historical legacy of water planning. In the past we used to have areas for blacks and areas for whites, the government is trying to address that by bringing all the infrastructure to all areas in the country. But it is still in progress and it takes a long time to make it equitable so that everybody has access to clean water.
IP3	Q10	I: Is the local community/indigenous involved adequately in water management? R: I think the national level has got much more expertise but local government and communities are not really involved. I: In your mind, exists gender equality In terms of water management? How are women involved in the decision making on local/national and international level? R: I think in urban areas you don't see gender bias in water supply and demand but in the rural areas there is a

		gender imbalance, because the woman travels long distances to obtain and get access to water with containers on their heads, the woman have to prepare meals, it is the woman who need water to bath their children and the men are normally not involved. So there is a gender bias, especially in traditional societies.
IP3	Q11	I: Do you have any recommendations, how decision-making could be more equitable? R: I think decentralization, so that local government must approach more power and making decisions closer to the people. There should be more catchment management agencies and a better water harvesting for an improved water supply. Also water conservation and water recycling has to be improved through environmental education. Cooperatives at local level are important to empower woman.
IP3	Q12	I: Does IWRM contribute to an economic and social welfare while addressing the environmental interests? R: There are spatial variations. In areas like the Western Cape you have good a good water management, good government, people with knowledge and skills and in general good economic, environmental and social aspects and development, but in general to achieve this in the country it will still take many many years till we have this sustainability. But the government is really trying.
IP3	Q13	I: Do you have any suggestions what could be improved regarding IWRM? R: We should hold our principles, so every one of us has to take action and national and provincial governance's have to cooperate in a better way. The industry but big business in general should adopt to the water principles and act more environmental-friendly.

Interview Partner 4

IP4	Q1	I: Which are the ecosystem services of the Orange-Senqu river for South Africa? R: Agriculture is a big thing, flowed by industry. Hydropower is not a big thing in the Orange,because there are not so many opportunities. These are more in the Lesotho highlands . And there are two large dams on the middle Orange river, the Gariep and the Vanderkloof dam, generate hydropower. You also find there conflicting objectives for water resources management. The hydropower generation affects the water flow.
IP4	Q2	I: Which are the main factors that threat the (quality of) water resources in South Africa? R: It is agriculture and everything that relates to agriculture, and industry such as heavy metals from the mining industry. These are the major issues. Urban pollution is an issue in terms of biological terms and it is probably getting worse.
IP4	Q3	I: Who are the different water resources user groups in in the Orange-Senqu Basin? R: Beside agriculture and industry, but when it comes to water supply for urban and industrial use, it is large utilities that are in charge of, so here in this region where we are now it is rand water.
IP4	Q4	I: Are there any water resource conflicts in South Africa and especially in the Orange-Senqu Basin? R: Oh yes. The resources comes to an end lets say in the newt 10 to 15 years. Obviously they are building new infrastructure but it will become more and more expensive. Water productivity is higher in any other sector than the agricultural sector, which is currently the largest user. So some of the discussion will be about reallocation between sectors, which is also highly political issue. So this will be a major cause for conflicts.
IP4	Q5	I: If yes, how does the National Water Policy address those problems? R: It does. South Africa in particular has a very progressive environment in the water sector. The problem is that the government is struggling with the implementation at various levels.
IP4	Q6	I: What are the main problems regarding the management of water resources? R: Obviously there are quantitative and qualitative problems. At this point we are focusing on qualitative problems, but i think the future will be the quantitative problem, worsening by climate change.
IP4	Q7	I: Does the government provide water infrastructure? R: Yes they do, all the large dams are government property. There are also a big number of private dams as well. The water utilities are parastatal. You have major problems of water utilities in Freestate for example in terms of technical and commercial losses.
IP4	Q8	I: How would you evaluate the cross-sectorial linkages or cooperation's between the international, national and local level? R: It does happen within the country and between the sectors and i think there is a general cooperation between the countries. Obviously you have one large player and three rather small players, so one of the small players is downstream countries.
IP4	Q9	I: According to your expertise, are users, planners and policy-makers involved adequate in the decision-making for water planning and management? R: South Africa is in a process of decentralizing in terms of subbasin catchment management agencies, some of these not necessarily within the Orange-Senqu Basin, but these institutions are already functioning. It is a long way to go, but eventually it will work.

IP4	Q10	I. Are there any disadvantaged people and vulnerable groups regarding decision-making of water management? R: I guess so, yes. Land and water were unequally distributes in the previous South Africa. There is a legacy on that that try to address this problem but again, it is a long process and it is gradually happening and it is also a thing of gender .
IP4	Q11	I: In your mind, exists gender equality in terms of water management? How are women involved in the decision making on local/national and international level? R: You can look at different levels. So the professionals are involved in government department and agencies, in the more engineering dominated fields it is very male dominated area, in the environmental area it is half half, but in general i would say especially in governments that it is still more man dominated. Some projects on local level try to work with children, so that they reach more the woman than man.
IP4	Q12	I: Does IWRM contribute to an economic and social welfare while addressing the environmental interests? R: I would think so. Obviously there are fundamental economic needs and requirements but i think they try to manage at the same time social, but also environmental issues, although there still has to be done a lot.
IP4	Q13	I: Do you have any suggestions what could be improved regarding IWRM? R: The decentralization process, because decisions have to take place motor on sub-basin-catchment level. But that seems to be a long process and another big issue is the reallocation between sectors.

Interview Partner 5

IP5	Q1	I: How would you estimate the impact of current cc on South Africa such as any observed trends? R: Yes, we do have some observed trends. Snows for example is one extreme event that has been really unusual in South Africa. Normally it is just common in the Drakensberg and the Lesotho Highlands, but a few weeks ago we had snow in Johannesburg and Pretoria right in the middle of the day, which is very unusual. It hasn't been like that since 1984 i think. I can tell you about a work where we looked at natural disasters, so certain natural hazards, that are showing us trends. We do have observed trends that we cannot deny in terms of increase more than in the number of hazards but also in shifting of rainfall patterns. If we look at the dates of the South African weather services, there seems to be a trend to more field fires. So in this booklet you find all the graphs and trends. So it is about floods, snow, hail, tornados, wind, fires where has been observed an increase in the number of disasters. We have seen floods in the last two year that we have never seen before in South Africa. Floods like in Thailand, so very large scale kind of floods. And not only in the number of disaster-frequency, but the magnitude also has increased to such an extend that societies can't no longer cope in respect in between the process of coping, there is always another disaster than even reverses it even more that the disaster before.
IP5	Q2	I: Where do you see the greatest future impacts? R: The Water. Especially in terms of water quality, but we just do not have enough studies that proves what i am saying at this point. The rain has been good for the last 16 years, but are still having a lot of challenges . Water scarcity is really becoming one of the major problems. The second one is food security. We have already seen disasters that have affected food security to an immense extent. Field fires and droughts we did not really have in the last 10 years, but the tendency is, if once we get hit by a drought it kind of reverses everything. Floods are also a problem, in december 2011 it was a nightmare, we had a very very wet season so that as well affects food security and prices.
IP5	Q3	I: How does climate change impact the water supply and quality? (Orange-Senqu Basin) R: We are currently busy with studies that would tell us exactly about the impacts. [...] So we are really expecting uniform impacts, each river catchment will respond in a certain way. For example number 14, which is more or less in a desert area in the lower Orange where you hardly get water anyway, the response wouldn't be the same such in area number 7, which is basically in a very wet area. So we need to study this impacts and shouldn't generalize. But we still havent really seen what the impacts are in the system themselves, what we are trying to figure out at the moment. Because it will be hard to draft adaptation strategies without knowing how knowing how the systems are responding.
IP5	Q4	I: Is there a link between climate change and water management? If yes, how? R: Yes it is definitely a big topic on our a gender now, one of the top thing. We even now have an entire unit that is dedicated to demand management, water conservation and demand management. And that unit is looking exactly at that link. Though we can't say now exactly what is going to happen, that doenst mean we should stop our adaptation strategies. We need to plan, we need to include the climate projection into our planning, we need to focus on demand side management and water conservation and we need to put targets that people comply, that is the whole basket of management. We have got a resource director that looks at environmental management for water and where we are using too much water where the resource can't regenerate. So those units are looking at establishing these targets between the user and the supplier.
IP5	Q5	I: How do the people deal with the impacts such as droughts for example? R: Also coping strategies tend to differ from place to place. Coping strategies for a drought for example, depend

		on their livelihood which can differ from the next person.
IP5	Q6	I: What are important capabilities that are lacking? R: South Africa has a high level of unemployment, but money is your source of your basic livelihood. And it makes you better able to cope with any natural disaster, and another person doesnt have any. Beside the unemployment, there is a very low level of skills in this area. Many people still live from subsistence farming and traditional farming methods, which doesn't come from ignorance but they just don't know what else to do. They are not well positioned for example to deal with genetical modified seeds and all this sort of things. So it is just he basic farmer who is living day to day, from hand to mouth just to survive. And these people are not in the best position for coping capacities with any natural hazards. So these people would go though a drought and they start to recover and then a floods comes. These subsistence farmer don't have anything else to rely on beside their land. So coping and adapting is not easy.
IP5	Q7	I: Are you aware of cases where climate change this has lead to conflicts? R: No, not really.
IP5	Q8	I: To what extent is climate change issue for the government? R: We report our studies to the parliament and the cabinet. It is really a to agenda and we have finished finished the policy now with the "South African White Paper on climate Change" and that paper is managing departments to start working individually and to report everything to the cabinet, in terms of observed and studied impacts of climate. So it is an issue that we are taking very seriously and which is taking seriously by the government.
IP5	Q9	I: What is the government doing to reduce the impact of climate change? R: Each department tis doing its own work. For example what the White Paper does is to mandate the department to do investigation. Our next reporting deadline is november 2012, where we basically present the investigation up to this point, the impacts that have been seen and suggestions how to address those impacts. In terms of the water chapter it give you informations of what is recommended and of what needs to be done, but this is not necessarily.
IP5	Q10	I: What would your recommendations be to improve national/regional policies on cc adaptation? R: We can't really improve anything because we just started, so it is not just about changing things, it is more about to integrate climate change in what we are doing. There are no brand new policies or changes, but we have to enhance the way we are doing and how to do it better.
IP5	Q11	I: How could vulnerabilities be reduced and resilience to the impacts of cc built? R: Building resilience is very challenging in the sense that we can only do so much. Households play a key issue in building resilience. Poverty is really there, we cant deny that, so we have to provide employment, capacity building and trainings of emergencies and these sort of things that would help people to build resilience and reduce vulnerabilities. Many books talk about building resilience, but hands on, they never talk about how to do that. That is what we are trying to find out at the moment.So there is a gap between theory and praxis. And there is always that assumption that the government knows what the community wants, which is sometimes completely different of what they really want. And the answer is, that it is not always about money, it is about visible development. In terms of reducing vulnerabilities, you have to create adaptive measures to development. Adaption strategies must been adapted to new conditions, on floods for example that we never had before.

Interview Partner 6

IP6	Q1	I: How would you estimate the impact of current climate change on South Africa in terms of any observed trends? R: That is a very difficult and risky question to us. South Africa is not a single entity, the country is located in the subtropics of the world so in the same latitude the Sahara and the mediterarean areas. In other words our rainfall is highly variable as same as the temperatures, according to the rainfall and seasons. So despite of climate change we are living in an area where we already have huge fluctuation, we have natural occurring droughts, we have very wet periods, we have snow, we have warm periods. Thats why i think that south Africa or southern Africa general is better prepared to adapt to large fluctuations already and we are prepared to do that. It is not like the tropics where you always get rain or other regions. So that is the first thing. So if you look at climate change there are two aspects. The first one is to look at changes that occurred over the past fourty years. According to the IPCC the global warming extended quiet significantly consistently over the past 40 years. So if we look at observations over the last 40 years in terms of rainfall and temperatures as the two most important ones, there is definitely a warming taking place. The unusual thing is, that the warming is more along the coast line and where we have more cities and industry. But this is different to the IPCC projections, that the central continental part will warm faster than the coastal part. So this is the first thing we observed, so we have a little bit of a conflict between the observations and the IPCC.My feeling is that the slower warming over the interior might be because of urbanisation and industrialization, where a lot of particles are released into the atmosphere which might even contribute to a cooling. This has not been researched, but it would be a very interesting study to look at. But beside of that there is a clear signal that South Africa is warming, there are some studies over the last forty years. If we look at observations of rainfall over south Africa, you know South Africa has a wetter east during summer month and during the winter in june, july and august we have wetter area over the western area such in Cape Town and the coastline. If we look at the annual rainfall, we couldn't detect any changes in rainfall over the last 40 years. So in South African the average annual rainfall is still the same. if you look at the IPCC projection hundred years from now, are also saying that

		annual rainfall will be very close to normal despite an 2 or 3 degrees increase in temperature. So the average annual rainfall wont change according to our own observations and according to IPCC, but this is contradictory to what some people telling us that Africa is going through severe droughts or wet conditions. Also if the summer rainfall areas in the eastern part of South Africa are becoming a bit wetter, this is very close to normal. The problems in South Africa is actually what is happening in the year, because the average annual rainfall is not changing, but in the year there are indications that the summer seasons are becoming a little bit shorter and if the annual rainfall stays the same but the season gets shorter, we are getting more intense rain. and this might have significant impacts, because we have a shorter period with more floods and a very long dry period, although the same amount of water will fall over the year. So that is for the summer month. As far as water management is concerned is that if we can capture the water that is falling about this short period in reservoirs for the longer dry periods, we might sustain this. But this is a big problem, how we are ring to do this and catch the water of this short rain period. The winter rainfall, where you have the Western Cape and the coastline the observations are indicating that the rainfall season appear to become a little bit longer with the same amount of water over the year and that might result in drier month, because the rainfalls now are more stretched out. So this is already observed in the Western Cape, they have some water stress and according to the IPCC the are also projections of drier conditions over the Western Cape. So you have to distinguish between the winter and the summer rainfall and the projections and observations, that sometimes totally opposite.
IP6	Q2	I: How does climate change impact the water supply and quality? (Orange-Senqu Basin) R: O k if we look at water supply, the annual rainfall will not change so much, but due to the spatial changes we will have to make provisions. The other thing is that South Africa is getting a lot of its water from Lesotho, where you have very high mountains with snow on it. So if the warming is continuing we are having now, the snow which is s a reservoir of water, might start melting in Lesotho, rainfall might start to reduce over the Lesotho mountains. We have the risk of loosing snow in Lesotho which have have effects on the run-off and the water falling down. In terms of water quality and climate change you will probably have bigger problem of pollution because of a longer dry period and the pollution doesn't get washed away.
IP6	Q3	I: Does climate change affect the quality of agricultural land and if yes, how? R: We always have to remember that South Africa is located in a dry area, so I always tell farmers that when it is dry, it is not unusual. In the first part, despite of climate change, farmer must adapt more to farming dry conditions. We are not living in a wet area and some people are forgetting this, they are using a lot of water and they don't plan for a dry region. People must start adapting more to survive in a dry region and to farm with crops that are drought-tolerant. So in general we are heading more into a dry scenario in future.
IP6	Q4	I: How do the people and especially the farmer deal with the impacts of climate change? R: There are two types of farmers in South Africa, the subsistence farmers who are just farming on their little peace of land for their own use and these people are really affected not only because of climate change but also by the variability of climate, thats the one more poor farmer. And the you have the big commercial farmer. At the moment the Department of Water Affairs is looking at the big frames because they are using about 75 % of all the water from the country. So they are using to much water, so there should be a shift in that area to farm with less water, because we are not a water right country. And with the growing population we will have to cut down our water use. The effect of climate change and climate variability on smaller farmers is actually a sec on problems. The bigger problems are environmental problems. I am working in a project in a small community and when I asked about the biggest problem they have, it wasn't climate, it was animals eating their crops, poor soil and so on. These people live from year to year, they don't worry about fifty years from now, although the commercial might worry more about that.
IP6	Q5	I: What are important capabilities that are lacking? R: The commercial, big farmesr they are fine, they plan very well and things like that but for the subsistence farmers, there is a need of information and knowledge. These people don't really know how to farm ad get the maximum out of their land. Many of them are using the same practices that they used 100 years ago. It has to do with culture sometimes as well, and some people are still believing in the rain queen and they don't worry about sciences. So the whole concept of selling science to farmers in such as ways that it is acceptable and understandable is still a big problem and also in water use and climate change. Also to some extend to the commercial farmers.
IP6	Q6	I: Are you aware of cases where this has lead to conflict? R: I don't think in South Africa, i know about Central Africa such as in Uganda, they have big problems with that issue. We sometimes have droughts and floods but i don't think its leading to conflict.
IP6	Q7	I: To what extent is environmental change and human security issue for the government? R: i think there are bigger issues that the government have to deal with at the moment, like poverty. Climate is not very high on the Agenda. As I already said, South Africa is a country with already big extremes in climate and people sort of have to adapt to that. At the moment people are used to adapting quickly. I think it is not a priority at the moment, there are more serious problems that government needs to look at, such as job creation and poverty and things like that.
IP6	Q8	I: How does the government reduce the impact of climate change? R: There is a very active mitigation strategy going on in government.As a target to 2025 they want to turn the carbon emissions in the atmosphere, which is very ambitious but there are very good strategies in place. But if this is gonna happen is another question, because on the other side we must grow our economy and poverty and job creation goes inside with more industrial activity and with more pollution. And this is much more important at the moment

		than turning the carbon. We still have a lot of coal stations, but the government is planning to change more to nuclear energy.
IP6	Q9	I: How would you estimate the adaptive capacity to climate change in South Africa? R: The capacity of the people who know something about it, is very limited in South Africa. I think we can't even do all the research we want to do in the small communities of scientists that are working on climate change, so the knowledge capacity and the people who have to enforce policy or legislation is very small. And therefore in many cases we have very well prepared legislations and laws on paper but when you look what is going on out there, you will see it is a different story. Thats because there is not enough people to really look after it and push this and enforce the laws.
IP6	Q10	I: How could vulnerabilities be reduced and resilience to the impacts of climate change built? R: People re already used to fluctuations in climate, so the impact will be that severe but the most important thing if we look at agriculture is to plan and farm for dry conditions. The water use has to be reduced, because we are living in a dry country.
IP6	Q11	I: What does climate change mean for water management for the government? R: Not a lot. In the water sector there is not a lot of talk about climate change. It is two different departments that are handling climate change. The director of climate change is located in the Department of Environmental Affairs, but they still consist of two separate departments. My feeling is, that there is not a lot of talk going on. The water people are more concerned about the growing population and the demands for water in the future. Climate Change and the impacts on water resources is not really a big topic, they are more focused on how will we supply water to the rapidly growing population in the future.

Interview Partner 7

IP7	Q1	I: What are the most important objectives of CP? R: If you look historically, the first objective was local ownership decision making,so put people in a position where they are able to do that, so they can argue with the engineer where for example where the tap was must go and so on.
IP7	Q2	I: What are the most important issues and problems across sectors that must be addressed by CP? R: An important issue is decision making and that decision making should be decentralized to the community as much as possible. The second one is that people should be empowered in a sense that they need to develop portable skills that they can also use for other projects or in their own, if they develop an own business. So there is a strong move at the moment for skills to be recognized, so for the endpoint of training to be an official certificate, that they can also use elsewhere and is not only limited to only our purposes. This strong move is across all the sectors.
IP7	Q3	I: Are marginalized groups such as poor and women considered in particular? R: Absolutely, that is the basis of our work. We work at essentially with people in rural areas, that used to live in the homelands, so the people who got discriminated by the margin labor system, a lot o the man went for mining or industry, so there is a high proportion of woman in rural areas.
IP7	Q4	I: Which role does CB play for the management of water resources? R: The management of water resources is a much newer area. There are a number of things we do. We do support of strategies for local government who do water conservation in the demand management. So they also have a community component,that we take young people because there is a very high unemployment rate and they are then trained to be barefoot plummers, or they detect leaks. Water demand management is more is resource issue than a service issue. In terms of government issues we have only started recently, that was the main of my work , to look at subcatchment forums, citizen participation in these forums. South Africa adopted pretty much 20 years ago the IWRM . Between 1990 and 1994 where a lot of water policy was written and then the White Paper came out in 1994. So in1992 the whole IWRM concept was completely accepted in South Africa by the water sector. So it divided the country up into 19 catchments, where you would have the catchment management agencies that would be basically a secretariat from all different sectors would be presented there. Sot this secretariat would be an office, on each of the 19. There are also a subcatchment forums within the catchments which are concerned with everything within in the catchment. They are very interesting to work with, because all the promises of IWRM for participation is local knowledge, community of practice so people get to know each other and talk to each other, representivity and so on is all possible because they are so small.
IP7	Q5	I: Would you say that capacity building supports the implementation of IWRM? R: [...] So on the one handy we ended up with a campaign, that was supporting the government incentive scheme to be successful. So we came to multitakeholder mutual capacity building where people just learned form sharing and so on. So then we had regular meeting to talk to each other and everybody presented its own problems. The official sometimes even took us for a walk through, through the wastewater work. The common way is to see the broken pump and just report it to the government. So it is a direct way of complaining and much easier than having a march. I also know a lot of experts,so people who are specialized in acid mine drainage, waste water treatment and we discused forums such as the National Water Resources Strategy to revise, which is a document from 2004 but it is now revised. there are the most important water resource strategies issues . The are some changes now, for example the 19 catchment have reduced to 9. For the Vaal river, 8, 9 and 10 has

		been combined. So they have fewer agencies, so it is to cut down the bureaucracy. for the community point of view it is a challenge because the agency is now farer away form the people. So it it important ow to strengthen these forums , so that they are as powerful as possible. But we have a number of problems. The two typical problems in water quality illustrated the power relationship. The one is ironic because the polluting wastewater works along to the local government, so the government is the polluter in this case. It is difficult to force them not to pollute. Ina forum the other participant are not really strong enough to force local government. The other big problems in the country is acid mine drainage from the gold and coal mines. The gold mines are up to 120 years old and some coal mines are just starting up today. So it is different in many aspects but the power relationships are similar. It is different for the forum to hold a mining polluter to account. You can bring the facts to the forum but the water officials don't necessarily act against them. Sometimes they do, sometimes they don't. In one of the forums it was the nephew of the president who ran the mine , so people were politically scared. So you see there are a lot of problems with catchment management at the moment. Probably the most instrument that you have for regulation the water us, is the water use liscence.
IP7	Q6	I: Can everybody have this liscence? R: Some work on their old licenses and don't stop their business, but there is no legal system in place to control the water use.
IP7	Q7	I: Which are the aspects affecting the success of capacity building? R: I think capacity building is mainly affected by people really need the capacity that you are building. The crucial issue for capacity building is where the people really need and want it.
IP7	Q8	I: Which are the constraints and problems of capacity building? R: The basic finances, so to get a venue, to get transport to the venue and to communicate to people, so the costs for cellphone. These are relatively small costs but then those communities they are an obstacle, so the costs of meeting, communicating , transport thats one obstacle. In some instances in water resource management in this governance issues , the people (37:09) learning. So you may work with people who do not do chemistry at school, and to explain all the processes going on by acid mine drainage, this takes a very long time. But in general people get it, if you are patient enough. So in some of the citizen science aspects it takes a longer time, because you have to do basic sciences as you start.
IP7	Q9	I: Do you think IWRM is really implemented in South Africa? R: From one prospective we need take water and call water as a resource , you make it an object that can be managed and bought with money. So in that sense IWRM is part of a family of management approaches which gives power to technical and financial people. It can be criticized for that, also from some people in South Africa. so most people really crizicite IWRM on the basis on whether it works as promised. So the first part of the critic goes to, is it imported form a northern model and is it appropriate here. So if you look at the african critics. the one is institutional it says that IWRM is a basic institution. -Then there is a more technical critic that says that IWRM depends on having adequate infrastructure interns of dams, pipelines and so on. So we in South Africa do have a lot of dams and water detention for the dry country, but there are big areas like the areas we are working in in the poor areas that were under provided and where the infrastructure now has been built but also that at least 2 million maybe more live in places where slopes are really bad or they are so thinly distributed, that it is difficult to have infrastructure. IWRM maybe doenst have the technical base in South Africa to just apply those principles. If you look at the water situation in a village there is a river maybe a dam, an irrigation cal, so multiple sources of water but also multiple users. If you look at a woman for example that has water for food gardens, hygiene,, washing, water for livestock.
IP7	Q10	I: Do you have any additional remarks? R: There are quiete a few things that you can criticize on IWRM and I would particularly critizite it because it essentially assumes a nutria system. But in fact there are a lot of power differentials, so there are very strong players like the big water users such as the industry, the miners. So in terms of water use the farmers that use most of the water there are groups that are traditionally advantaged , they benefited from apartheid, maybe they are whites, maybe they have business and then they meet in IWRM settings like in forums or other settings they meet with people who are not in the position to challenge their power. And I think it is a fundamental weakness of IWRM if that power differential is not balanced out. So what you need is an activist state. A tranformatory state that wants transformation and that practices affirmative action, capacity building, material, support for weaker groups so that really supports participation, not just in policy but in many practical things. So one of them is capacity building. Capacity building also implies making expertise available. So if there is a community group supported by an NGO, then give a budget so that you can hire a water quality expert that can come and explain something, that can look at documentation and summarize it, the summary from the point of view of the interest and agenda of that weaker party. So I think that should come from an activist state that makes participation real in those term. Without that you will find that communities are not interested or they try and become alienated and give upso that IWRM will end up just being a discussion and a decision making platform between the state and big water users. And I would also say that in IWRM, in this country of water scarcity, the main concern is about water allocation, so the volume of the water and who gets it, but that tends to focus the attention only on water use which is important, but in terms of environmental sustainability you need people to participate as activists that are custodians. The main interest is not in using water, but its main interest is looking after the water, in terms of water conservation, protection, protection of the water quality and actions against the threads to come to the water resources.

Interview Partner 8

IP8	Q1	I: Which are the ecosystem services of the Orange-Senqu river for South Africa? R: We have ecological requirements or what we call the reserves in terms of the National Water Act, where it is required of any water user to ensure that if you use water you are aware of the amount of water that is required to sustain there in the ecosystem services. So it is an issue of looking at impacts in terms of both quantity and quality. The National Water Act prioritizes the allocation. The very first is the reserve for ecological services, which is the only right in terms of water use. all other users are in terms of the offerization, so that amount of water that has to be left for sustain the ecosystem, a component of that is to sustain for livelihood. We also have international obligations, that gives 10 % of the reserves for allowing water for example, because we share our rivers with Mozambique and other countries. There is also water for strategic use like generation of energy and electricity. So of the amount which is left, most of the water is used by agriculture maybe in average around 75 %. Ecosystem services is a bit of a comply issue, because part of it is what we call "water to sustain the ecosystem". But even if you have that, in terms of our activities we may impact on the ecosystems anyway, because the way we behave as industries for example. If you release water into a system or into an environment, you should ensure the quality.
IP8	Q2	I: Which are the main factors that threat the quality of water resources in South Africa? R: I think the major one in terms of quality is the mining, because we have a big problems in South Africa with acid mine drainage. But it is also a historical problem, it is an accumulation effect of the historical practices of using water not properly. But it always depends where you are. If you are at an area where there are a lot of industrial activities like in Gauteng, water quality is a big problem. In the rural areas but also in the urban area they had issues of onside sanitation and practices that are not proper, for example people that are putting on toilets in areas that are vulnerable to impacts of groundwater. Groundwater and surface water do interact, so if there is a problem here, it can causes problems downstream somewhere. Issues of improper sanitation of many people in one area could be a problem. Land use practices in general is also a big thread. We know that South Africas climate is highly variable, but in a long term climate change is going to exacerbate the situation in terms of eutrophication problems and we have some of our dams with a lot of algea not necessarily as the result because of climate change at this junction but also because of the water use upstream regarding the return flows from agriculture and the municipalities. So their salts are accumulating in the dam triggering eutrophication. So there are number of problems but always depending on where you are.
IP8	Q3	I: What are the main problems regarding the management of water resources? R: I think the major problem with the management of water resources is the enforcement. Everybody who uses water, depending on the volume, needs a license. But the question is, if the people comply with the liscence conditions. If everybody complied with the liscence, I think we would have half the problems or even less. But there is no efficient and effective compliance and this by the way, cannot just be insured by the Department of Water Affairs. You can imagine in a local government setting, the Department of Water Affairs is not responsible for what is happening there. Somebody who manage me the land and who is responsible for deciding on who stays where and what activities can be done and not. If I were the municipalities then I would demarcate areas, that are vulnerable and should not actually being used for activities. But the current scenario is, that thinking of municipalities is not developed so far yet and people maybe do not understand certain issues. But the major thing is because a lot of things are driven by the economy, rather than working at the whole issue of sustainability and how we balance economic beneficiation of the resources with the proper water that don't the water resources. So we break every law on the book, even the constitutional. It states that if you use water, you must be mindful of the future generation that will use water as well and you also must be mindful of the environment. So actually the major problem is the issues of compliance the end of the day, how do we ensure that people do comply, but they don't. There are other problems as well, but this is the major one.
IP8	Q4	I: So everybody needs a water liscence? R: The people, using just water for their own need´s, don't need a liscence [...]
IP8	Q5	I: Which role does government play for the sustainable management of water resources? R: The government should plays a regulator role, because the government has to use the liscence as a way of ensuring how water is used. The Act is very clear, if you look at Section 3 of the National Water Act, it makes the minister to be the custodian of all the water resources. They have to ensure the use, management and ll this is done sustainable. The government has a huge responsibility and and play a big role in terms of ensuring protection though the liscence. Even when the government is not directly responsible, at the end of the day, it is generally accountable to whatever happens to water. if people do not have water in the townships, although the government doesn't provide the water but the municipalities or the water board for example, but still at the end of the day the national government is still responsible.
IP8	Q6	I: How does the government raise the awareness of the importance of water management among policy-makers and the general public? R: In the beginning of the year we have water weeks, where they go around. So government also publish on newspaper with slogans "Please save our Water" and other slogans to create a sense for using the water sparely. But i think it is not always enough. What the government should do regarding the lack of resources, is not for itself to try to do all these things, but through other people who are responsible in their own right. For example within the municipalities area they are responsible for the management of water and those management approaches should be in form by what the government has. The government has got integrated management plans and so on but it is a

		matter of having the capacity such as the bodies and people who are doing it. We should give people the guidelines. The government has to monitor the water resources in terms if the situation is getting better or worse. The Department of Water Affairs for example is configured in a way to address these issues, but there are always changes associated with capacity.
IP8	Q7	I: Do you think the policy will result in sustainable water management? R: Policy is import an, because it directs you. But the important thing is to enforce the laws. We have good a number of polices but we have the challenges and the isn't necessarily resulting in sustainable water management until you don't apply. So what we need is not policy formulation, what we need now is policy practice in order for sustainable management. Every user causes an impact , but we have to use the water resources in a sustainable way which means you have to ensure, that you are mindful of consequences.
IP8	Q8	I: According to your expertise, are users, planners and policy-makers involved adequate in the decision-making for water planning and management? R: No i don't think they are all equitable involved. There are good policies, which ensures the equitability but i don't think it is really happening at the moment. You can't only blame the government of that. People are breaking the laws every day. Perhaps the government is not doing enough itself to ensure that all stakeholders such as users, policy makers and implementors and so on come together. But the responsibility lies with all of us to ensure that it works out. But what you often find in South Africa, that we often beat the government in terms of being useless. The rules are there, but it is also up to the users. What we need, is a huge changing behavior. I give you an example. We have a huge problem with plastic in South Africa and you would see many dumps next to roads. What the minister of environment did, was the people to pay for the plastic bags now whereas you got them for free before. The people wanted to save money and didn't buy it and started to ensure they don't use a lot of plastic bags. Now you don't see so much plastic flying around anymore so you see, how the policy translated into something helpful. So its a mainly an issue about money.
IP8	Q9	I: In your mind, exists gender equality in terms of water management? How are women involved in the decision making on local/national and international level? R: Not at all. I think it is extremely inadequate. If you look at the WRC, most of the projects are run by man, you almost don't see woman doing that, although there is an improvement to an extent. But there is still a lot to be done. there are a lot of attitudes, behavior, man who don't have a space for woman at all this at different levels. We are not even talking about woman being a president in South Africa. There is not even a talk of a woman being a candidate.There are some ministers who are woman. <in certain areas you find more woman, but the woman themselves also have a problem. I have seen a number of woman in positions and they don't help other woman to come up into the decision making. I think woman have a huge challenge. On one hand there are the man, who are very conservative and who don't want to recognize that woman can be better than them and on the other hand, there are woman, who think, now i am here and i am the only one and i am the best. In general i am very critical, we have to do more in this area.
IP8	Q10	I: Do you have any recommendations how decision making could be more equitable? R: My recommendations would be to give woman who're good in their field, to give her the chance to do that. But woman in certain positions should also give more space for the other woman as well. What what should happen is that we must talk about capable people and not say she is a woman and can't do this. But we also should woman push into position where they don't fit. We need to give them space and give them the necessary training. In my project, there are four woman leaving the project, but this is not enough regarding the 22 projects, so 18 other project leader are men. That is a drop in the ocean. So we should woman give to opportunity to lead projects and putting them in positions of power and decision making. We have also to allow people making mistakes, nothing can be perfect but who knows, they might even doing better than man. They have their own style.
IP8	Q11	I: Does IWRM contribute to an economic and social welfare while addressing the environmental interests? R: Well it will work when there is IWRM in practice. It is always a matter on degree. You have excellence but then you have huge things, that are not going well. So in my view, the concept of IWRM is an excellent concept, but it is not being practiced. In the water sector they are talking about it for years about IWRM. But when you look at their appliance what is all about water and by the way there is also groundwater. Until we can be able to say here is a project, the surface water component, the groundwater component and the quality component will have the same budget and are equitable, then we are there. People from the water sector have to work hand in hand with people working in agriculture and other sectors, this would mean an integrated way. We have to work in an integrated way to translate something, but we havens reached that stage.
IP8	Q12	I: Do you have any suggestions that could be improved regarding IWRM? R: My suggestions is, we should stop being specialists. Transdisciplinary and multidisciplinary would be more useful for this concept. I think until you see somebody working in land affairs, having a component that deals with water or somebody working in energy having a division that deals with water, you have to integrate them. The key to this is to practice how to approach. As specialist you only see your small area, but you have to understand other things as well. Everybody must be a water manager in the context of other things, that could have unintended consequences of what i am doing now. People have to be mindful of everything that is happening around them. Scientist for example are experts in their field but if you ask them to write a paper, they sometimes can't write in a way to attract people and want to read. Water experts should just see the water, they must understand the land, the air and all the interaction.
IP8	Q13	I: Do you have and addition remarks or are there any gaps i didn't address during the interview?

		R: I think maybe i want to emphasise a few things to give you my opinion on the National Water Act and water resource management. I believe we should all pursuit of sustainable water resource management, planning and use but at the same time we need to understand what we mean by that. In my view, if we talk about sustainability everybody has to be a water resource manager and everybody lives downstream. I think we should have this mentality. We should better manager our resources, we shunt be too dependent on somebody called government and we should take the responsibility as well ourselves. Creating awareness is a huge issue, but tho be more done and being improved and these issues should also find the way to curriculums at school level. The children must be taught in these things and grew up with these issues. The entire society should look at the things from different angles. I think a peace of paper is not enough, but the practice is much more import an and the people must apply the policy laws. People also have to learn from each other to improve their adaptive management. We also should have the right people in the right places, but we have the wrong people in the right places and the right people in the wrong places. People should be appointed on the basis of their knowledge and we should not judge by skin color for example. The issue of gender is also a huge one, but it is not only the mens fault, it is also because they don't help each other. They also have to change their mindset and then things will be ok.

Interview Partner 9

IP9	Q1	I: Which are the main factors that threat the quality of water resources in South Africa? R: For South Africa I don't really know which is the biggest polluter, if its mining or agriculture. It is is also region specific.
IP9	Q2	I: What are the main problems regarding the management of water resources? R: The implementation is a big concern in South Africa. We do have a lot of good legilslations, government initiatives and good ideas, the hydrology sector is quiet advanced, and the international science community is very strong. But when it comes to implementation it is a big problem.
IP9	Q3	I: Which role does government play for the sustainable management of water resources? R: The government should work more with the local level and small farmers and other stakeholders.
IP9	Q4	I: How would you evaluate the cross-sectorial linkages/cooperation's between the international, national and local level? R: at the moment it is very fragmented. There are not good links and different stakeholders should work more together and cooperate though sectors. But the government work is also limited and people have to apply the laws.
IP9	Q5	I: According to your expertise, are users, planners and policy-makers involved adequate in the decision-making for water planning and management? R: No, right now they are not. There is a lack of communication. Even we, the researcher are not adequate involved and especially the small people like farmer are not really involved in he decision making. We need to deliver our fundings and find the way to the policy makers, we need interaction and the policy makers have to change their mind and better approach to science.
IP9	Q6	I: Are there any disadvantaged people and vulnerable groups regarding decision-making of water management? R: That is a big problem in South Africa. Naturall the woman who don't play a small role in water management from agriculture to domestic use. Other secotrs such as subsistence farmers, don't really have to say a lot in water management, they are just not adequate represented. I think there is a strong environmental interest and awareness which is very good, but when it comes to implementation, it is not very strong in terms how to conserver the environment and also maintain agricultural output and sustainable water development and conservation.
IP9	Q7	I: Does IWRM contribute to an economic and social welfare while addressing the environmental interests? R: That is the main goal of IWRM, but the people are just starting to realize about the importance of this combination. But i am looking forward very positive in South Africa.
IP9	Q8	I: Do you have any suggestions what could be improved regarding IWRM? R: Every state and every person wants to develop, but these developments requires more natural resources including water. How do you make these things happy together, the social delevopment, environmental conservation and economy? This is the goal of IWRM but in South Africa they have so many other problems, not enough investment and not enough capacity to do this. People have been talking big things about a long time , but people need to stop walking and rather doing small things such as small investments to support the implementation. We have to look at the action on the ground for a better water management.

Interview Partner 10

IP10	Q1	I: Which are the main factors that threat the quality of water resources in South Africa? R: The National Water Act sees water as a natural resource from a natural background. So there are different types of water, and a mudd driver doenst mean that its bad. Domestic pollution is a problem of bacteriological pollution and domestic waste. Certain industries also pollute quiet a lot and then we also have the mining pollution. Basically we have all the sectors polluting due to agricultural pesticides, fertilizers, the industry is polluting and also illegal

		settlements. On urban side we got backyard industries which rains washes of and ends up in the rivers. In terms of water pollution, you don't only have the chemical side, you also have the physical side in terms of temperature for example as well. We compare South Africa with Europe, but Europe has a very stable type of flow and they have a good capacity. We don't have absorbtial capacity.
IP10	Q2	I: In your mind, how many people in South Africa have climate change to clean water and sanitation? R: The official figure is that 94 % of the people have access to clean water. We are talking about cleans water that is our target. So we are monitoring that and putting it together. But what happens is, that the operations is not always as it should be. We are now putting the schemes for the municipalities and we do some assessment for functionality whether it is working or not. So we believe that about 74 % functional (u.). 95 % should be, but just if they operate properly. These schemes are being vandalized, they are not well maintained and we have to look on how we operate and maintain our systems. And even in terms of the drink water quality we do have the systems, we have a lot of wastewater systems, we have got the infrastructure but the people are not professional, there is no capability and skills etc. In principle we have 95 %, but in reality is about 74 %. It all depends on the professionally of the municipality.
IP10	Q3	I: Which role does government play for the sustainable management of water resources? R: I know at least 10 types of sustainability. If you are on a business and use the water efficiently, then you a sustainable status. so in doing that, we are looking at water resource sustainability, so is the water there at a sustainable basis at the (u) insurance. We try to issue 98 % insurance for domestic purposes, but for agriculture it varies between 70 and 90 %, so this is all security side but there is also the water quality side. So we are doing lot of studies and we are (u) people wastewater as well. The second security point is how the people treat the water, because they don't treat it properly, which is a security risk. The third one is the infrastructure, so do they actually pump the water and is it flowing for water security came through because there is no elecritcity. The water might be there, the infrastructure might be there but there are not at least pumps than the security side. Then many people especially in rural areas they vandalize and they steal the pumps. The same thing on waste, so if they don't maintain the systems, thats a problem. If the people don't treat water properly, there is an environmental impact on the pollution side. And that impact with economic impact, because the downstream must paying more , and there is a social impact. So there are a lot of sustainability issues and we try to assess this whole business. Sustainability is also about variability, so can you afford it? We know that it is becoming more and more expensive to run water and people just invest in infrastructure but not on the operational maintenance.
IP10	Q4	I: How does the government raise the awareness of the importance of water management among policy-makers and the general public? R: We want to make water central to our planning. The people from the national departments must look on they checklist, before they plan anything. The second we bring in is a the whole total water footprint. That means not only how much water you use, what you your impacts on the water resources and how do you contribute the welfare and the benefits of the country. We are going to enforce them to all escorts to have water plans but the next hints is the communication. There are also other big issues like better discipline, awareness trainings, school capacity building. And certainly the pople have to pay for water to become aware of the value of water resources. We are busy in initiating the whole things, but it is not good enough at the moment.
IP10	Q5	I: How does the government ensure that international and national agreements are reached and maintained? R: In the National Water Act we have a protocol of how we allocate water. And international negotiations means commitments. So we have our agreements and protocols and certainly we have certain international forums where we talk and negotiations. So there is a management side and policy side.
IP10	Q6	I: How would you evaluate the cross-sectorial linkages/cooperation's between the international, national and local level? R: We do have international relationships, so we maintain issues at all units. Our minister goes over there, which is a formal business. -On local level we try to get sectors to participate and get involved regarding catchment management.It takes a bit slower, there is still a lot to do. We have only established two catchment management agencies so far, but there are a lot of smaller forums. We try to support active forum partnerships though sectors. The government is busy with integrated outcome agreements were we work together between departments. Its is not perfect but we are working on this.
IP10	Q7	I: According to your expertise, are users, planners and policy-makers involved adequate in the decision-making for water planning and management? R: There are different dimension of equitability, but you also have the political side. People come to politicalize the water and it makes it very difficult. But if you have a scarce resource, on the one side we want to make sure that people have basic water and especially in the rural areas we are moving to get water to the people. It is not really enough, but it is a scarce area. So thats our number one priority and we allocate water to these areas. If you go to our urban areas we put in big schemes to ensure there is no discrimination. Everybody in an urban area is being planned for to get water. So it is up to the municipalities to make that happen. There is a coverage in between poor and rich to get water of all the urban areas. and now we are busy with rural areas as well. Two other area we are talking about, is not the water allocation as such but the benefits of the outcome. If we take water away from the industries, mining and agriculture, so the formal formal professional systems, there will be no jobs. Formal agriculture generates 70 % of the rural jobs. The the people are not just benefiting of from getting water, but we give them jobs. We we can't just measure volume wise. So this is part of our strategy to deal how we allocate the

		business. There are concern about equitiy in terms of people all want to have their own food garden. But this is no reality, the water is s expensive, you can't food gardening at every household, because we just don't have this luxury. So we have to rethink our uses in terms of sharing and the benefits f water use. But certainly there are equity policies on water allocation to bring back water back to farmers what we call the "Water Allegation Reform".
IP10	Q8	I: In your mind, exists gender equality in terms of water management? How are women involved in the decision making on local/national and international level? R: The Department of Water Affairs has a gender unit, there are targets for gender actions.Of course there not be no discrimination. If we go out to give water to the people, I don't go out and put water for woman. You go to their household with the children who all should benefit. we can't go out and say woman get first, because it is to cost. But in general the woman are benefiting in principle and the criteria about dignity for woman, they are benefiting the most in this business.
IP10	Q9	I: Does water management contribute to an economic and social welfare while addressing the environmental interests? R: We have a very modern water act. In chapter one specifies the purpose of water management. So it says, the water must be protected, controlled, managed and there are various purposes such as contribute to politics, economic interests, soacial welfare and contribute environmental interest. Thats a legal requirement of chapter one of our act. In the second thing in the Act, we declare water for the environment and the people basic services as a priority. We state the environment as a priority. In practice we do have problems, because more than 60 % of our environmental areas are under thread in terms of our river systems. We have to ensure social and economic development. We have a lot of conservations studies and we try to answer with certain solutions. But the challenge is to implement and get money to do it. So there is a challenge but we also have to change the mindset of using groundwater.From economic side i would say we have done it, agriculture is a difficult one because it is becoming vey expensive for them and on the social side we put a basic services and we prioritize them but i do believe, we are not effective enough.
IP10	Q10	I: Do you have any suggestions what could be improved regarding IWRM? R: The groundwater management. Groundwater is an essential part of our solutions. And we have reinstate its importance. So you have to change the culture and the ties one is, that it is the cheapest solution to build a dam. We have to build dams, because in average only 6 % of the rainfall ends up in rivers and has impacts on the flow. If we don't dams, we don't have water i South Africa, because our base flow is so low. You can't import water from long distances. Strategically it is a must. But we can't committing on ourself, we are loosing our champions and expertise on that. We had a special unit and we have to reinstate it. Furthermore we have to protect the groundwater resources because there is a lot of pollution not only from domestic areas We have t strengthen our governance regulation as it is a strategic local source. We have to do better modeling of where the water is and we need experts to find the water. We we also say, ebofer building a dam we should find the water first. The protection management should be improved, local government don't manaage it. You also have to find technology to improve the water quality.
IP10	Q11	I: Do you have any additional remarks regarding water management? R: Oh yes, climate change. We are already in a water stressed country, we have got a naturally highly variable climate in space and time. Variability is normal in South Africa. Now we put all the people on top of it, so it is stress on stress, we already build a lot of dams, we pollute and climate change will be even more stress on the stress. And in terms of capacity building there has to be improved a lot. We furthermore have t control illegal use, get a better financial management, infrastructure, discipline, control, better planning, technology, effective use, these are the new areas but we don't have all the skills. So we need capacity to operate schemes. IWRM is bot just about catchments, it is also about linking economic and politics and we have to influence mindsets.

Interview Partner 11

IP11	Q1	I: Which are the main factors that threat the quality of water resources in South Africa? R: Of of the biggest things has been the acid mine drainage. I think our industrial mining and power generation sector has had a lot to do with that. Just to give a a bit of background: our law is the "National Evnironmental Management Act" in NEMA and it talks a lot about conserving water quality. But it places a lot of emphasis on companies taking care of water resources. I know section 28 talks about the duty of care which i don't think has been undertaken properly here in South Africa. Our agricultural sector is also quite big, if you logo at fertilizers and pesticides obviously they are threaten the quality of our water resources as well, if they are not managed properly. Also we also have had a lot of sanitation backlogs, so providing people with proper satiation facilities that plays a huge role, particularly in our rural areas, where people would just dig up their own pits. This contaminates our groundwater resources, which particularly the people in the rural areas use, because they generally don't have a lot of access to the conventional system that we use to gain access to water. I think for me, these would probably be the three main factors.
IP11	Q2	I: In your mind, how many people in South Africa have climate change to clean water and sanitation? R: I think at the moment the backlog is sitting at about 8 million i stand corrected. It is also at the website of the Department of Water Affairs, where they deal with all the backlogs. I would say we have between 60 - 70 % coverage at the moment. So around 40 % who still don't have access to proper water and sanitation.

IP11	Q3	I: What are the main problems regarding the management of water resources? R: We are currently involved in a project from the Department of Water Affairs, called the Rapid Response Programme. We had the opportunity to visit quite a lot of municipalities. Some of the general things are the human capacity, which is a big thing in terms of skills. We have a huge shortage in our country, particularly the technical skills that are required to manage systems properly. A lot of municipalities go on and on about the fact that have got lack of funding. Well this a maybe a challenge to a limited extend, i think the bigger problems are how those funds are generally managed themselves. So maybe it is not the availability of money so much the problem as the way in which it is used. You would find that was fund that was originally for example for water demand management by ends up buying office furniture. I think the way the funds are managed is quite a challenge. I also think our municipalities have also inherited a lot of problems interns of the past political dispensation. there was a limited population that was provided properly for water resources. So and particularly in the poorer areas as the townships for example, the infrastructure that has been instored is actually not adequate to me regarding the population demands. And that is a huge problem, so we sit with the huge infrastructure backlogs, so infrastructure that needs to been upgraded. Corruption is also a big problem is our country and also poor workmen ship. There are certain things that have to be done over and over and over again, because they won't done properly the first time around and this wastes a lot of resources. I feel that is a reflection of how things are managed currently. And also our infrastructure acid management is just lacking at the moment. People want to see infrastructure being in stored but there is seldom a plan to actually maintain that infrastructure. So you instore something after a time it is all in ruins, because nobody maintained it. this is also a big factor in South Africa.
IP11	Q4	I: Which role does government play for the sustainable management of water resources? R: Our government is South Africa is the custodian of our water resources. Currently they are playing what you call the regulatory role. so they developed the policies and regulate how water services are managed. However there has been a lot of decentralization in terms of the powers ad the responsibilities. Previously government was actually responsible for also implementing things on the ground and installing infrastructure. But that role has changed and I think, in some respects it has caused quite a lot of confusion and for some municipalities (u). Yes the powers may have been decentralized but the fundings sometimes is not as well, so the physical decentralization isn't as effective so that you would find a lot of problems there . Yes of course our government does play a role there are a lot of policies that are in place, i think South Africa is very advanced when it comes to our acts and our policies on water management. We have got the "National Water Resources Strategy" which is reviewed every 5 years, we have our regulations in place also in cooperate water conservation and demand management. We have got our "Water Services Act" which is very good. So we have got all the policies and regulatory implements in place. But I would say, what is lacking currently is the enforcement. I think, the laws are only as good as the paper they are written on, if there are no mechanism to actually enforce what the Act is saying. I think one of the challenges as well is that our local municipalities, because of the decentralization i have spoken about, are autonomous bodies. In some ways they are not really accountable to our government, the may be regulated but there is no actually chain of accountability and there it is where it becomes really difficult. Even when things start growing wrong in municipalities, when they try to enforce them now, to stick to the rules, it becomes very difficult to a government. And this is just of of the challenges that need to be looked at further.
IP11	Q5	I: How would you evaluate the cross-sectorial linkages and cooperation's between the international, national and local level? R: [...] But I think there has been a lot of improvement there. I know our water resources side has been working closely with some of the other countries in developing a common model to manage the water resources. At the national and local level I think that relationship has improved somewhat, but I think a lot of improvements still need to be make. I think there is a little bit of dissension between our national and local levels and who is responsible for what regarding the distributions of duties.There still needs to be done in terms of understanding, on national level as a secotra leader and on local level. And the role of the Department of Water Affairs actually being a regulator and not an implementor,sometimes I think it gets mixed up. Our municipalities are constantly asking for money, but this is not how we should work. Municipalities should be self sustaining and they are expecting the Departmenf of Water Affaris at the national level to keep giving out money, which shouldn't actually be happening. So in terms of those linkages and that cooperation needs work, in terms of cooperations with other sectors that can also be contentious, because some of our objectives are quite different. I give you a classic example.
IP11	Q6	I: According to your expertise, are users, planners and policy-makers involved adequate in the decision-making for water planning and management? R: No, i wouldn't say that. We have got a law in South Africa, called PAJA, which is the Promotion of Administrative Justice. My opinion is that we undertake public participation processes, but it is not because we really want to listen to each other. I have got a preconceived idea, I want to implement a particular project. I am doing this only, because I have to and I am bound by law, but not because I am actually going take into account what they are saying. And I think you find a lot of these issues, particularly when it comes to water quality issues. Our users suffer a lot and I think their voices are not really being heard. One of the challenges also are the transaction costs, that are involved in identifying who the culprits are and actually taking them to task. Usually the people who get harmed are the people who generally don't really have the money to be able to undertake those processes. So I don't think, we have got equal voice, I think there are a lot of presumptions that are our governments have made. I have seen it, that even on the very local level, where municipalities for example instore a prepaid meter, a water measurement device. whee you get a connection in stored, you get a water meter and it calculates how much water you use and the municipality can bike you for that water. But they havent consulted the community, they don't know what it is what the people are actually wanting, what their perceptions are of meters. And a 5 or 10 million Rand investment is down the drain, because people have completely smashed the

		meters. A meter is s water measurement device, so when people get a connection installed, they get a water meter and it calculates how much water you used and then the municipality charges you for the water. So people go there to install devices, that the community and the water users don't actually understand. And they are completely vandalized those installations, we we are sitting in a situation were you wasted 5 or 10 million Rand, because you havent actually consulted. And you see this a lot. So do they have an equal voice? No. Do they have equal participation? Not, absolutely not. There is a lot that needs to be done.
IP11	Q7	I: In your mind, exists gender equality in terms of water management? How are women involved in the decision making on local, nationa level? R: That is also a little bit difficult to answer. I would say it definitely has improved. If I look particularly at the secotr we are working in, engineering sectors is heavily towards the male gender. That could be due to a number of factors such as socialization, so that woman generally don't choose engineering as a career, although I think that is also changing quite rapidly. So maybe the next generation will see better involvement. But at this stage I don't feel that it is enough. Be do a lot of community based projects.So we get to hire people. The people who generally come forward and who submit, it is men! I would like to see that trend really start to change quite radically. Yes, we do get woman that come in, which is wonderful, but I think the bias is still generally towards the male gender. I can't blame them entirely for that, this that the current situation and how the skills have been dispersed for historical reasons and the way we have been socialized in the patriarchal society And it is interesting, because I think in Subsahara Africa your largest work force particularly in terms of agriculture, 80 % of your workforce is woman. But in terms of just obtaining the necessary skills, there is still a lot that need to be done. The participation is there and it is improving, but it is just not enough yet.
IP11	Q8	I: Does IWRM contribute to an economic and social welfare while addressing the environmental interests? R: The issue of sustainability is a nice concepts when we think about three pillars: envrionement, social and economic. It will change form time to time, depending of the politics of the time. I think there has always been a huge emphasis on economic development, when it comes to the sustainable model. The economic component of sustainability will often win out, because that is where muscle and the money is to make things move. So you would find, as a classic example of South Africa, the most developed municipalities are the municipalities with the highest industrial development. So our metropolitan municipalities such as Equaleni, Johannesburg, so all the economic heads of the country are actually doing best in terms of managing the water resources. These areas attracts, the skills, the salaries are generally better so the engineers would want to go there, they have got entertainment and all facilities what people want, which make a comfortable living and that is what attracts and leads to a better water management, at the end of the day. So the economic component of sustainability often wins out. Regarding the social component, I would say it is almost second in line and that is because people intend to become very vocal. We had a lot of protests related to service delivery, people feel they aren't receiving clean water, proper sanitation, so around that particular component. This is often in smaller and rural municipalities because they don't have the same level of access to water services as you would typically find in metropolitan municipalities. Because of that, people are becoming more and more vocal, which is also a good thing in some respects. And thats why I think the social component of sustainability is coming next on the list. Unfortunately when it comes to environment, that component is often left unspoken for. We are very pericentric in the way that we approach the environment. We extract form the environment, because we need the resources and services they provide and thats all it is good for. Just recently we have had to really shift our focus to what we are putting back into the environment, the waste thing, function of the environment, how much is it actually able to cope with, where are the limits and I think we already achieved some limits, because we are always extracting but putting nothing back to help sustain it.I think there has been quite a mind shifting that we are very dependent not he environment and as such, it is actually in our own interest to look after it. If you look at climate change talks for example, is its something that has really only started receiving the spotlight more recently. Because the environment has starting to show science of strain. So I don't really know if IWRM model is working as efficiently as it should. As I said, we receive emphasis at different stages depending on the level of crisis that we are experience in that particular component at any one time. I don't know if we ever achieved it simultaneously. I am not criticizing it completely, because I think it is a good concept, but it is time that we start looking at things in a more integrated manners. So that is definitely a positive step, but it is going to take a while not to just know this model cognitively, but actually start to translate those principles into behavior.
IP11	Q9	I: Do you have any suggestions what could be improved regarding IWRM? R: I would definitely say training is required. I think we are sometimes very esoteric in the way that we understand this concept. You have got an elite view, that really know what IWRM management is, how it should be interpreted and translated into behavior. But then you have the rest of us, who actually need to implement IWRM. I don't really know if if we completely understand what it is really about, i am talking about communities and the people who are supposed to implement this lovely wonderful concepts, that we have got floating around in the air. And this is my problems sometimes with academics and I include myself in this. Because we live in our own bubble and we use these big word and it is nice, but weather or not it actually comes to life at the level that it should, I don't think it does, so I think training ad capacity level both at national and local level, in terms of engineers and in genearal for all the different sectors that need to be implementing, is very important. And this is not restricted to the water sector, that involves agriculture, that involves our financial sector and so on, so training in that respective is certainly regarded and particularly at community level. Because that is ultimately where this peace of paper gets brought to life. So much more awareness is important. In terms of our partnerships with research institutions, we need even from the university level, I think people coming out of university don't often understand the challenges in the water sector. We are also not attracting the right kind of skills I think. The water sector has been very quiet in that,you find that a lot of engineers leave school, want to make quick money and the best thing to go into, is construction. But we need to work a lot closer with our institutes of learning, we even should need to

		start from school, so from basic education where you need to build this culture. So that people coming-out of institutions understand the importance of the water sector and how water resources should be managed. From a financial perspective, there are a lot of models floating around, but one of the things that may help, is public private partnerships. We re currently embarking on a similar project. You would find that the private sector often attracts most of your skills and in terms of helping municipalities at local level, forming partnerships between public institutions like municipalities and the private companies, which are often bringing in fundings and expertise and skills into projects, such as the GIZ. The Emfoleni project is a wonderful one. The Vaal Catchment is very stressed at the time and a lot of municipalities sitting here in Gauteng are actually drawing water from this source. Now, Sasol which is a very big company with fuels and energy and drawing from the same source an they are a huge user. And what they have looked at the moment, is that there is such a huge inefficiency in the way that municipalities are using water here and the closest municipality is actually the Emfoleni municipality. From a risk management perspective they have seen that it is actually in their best interest to not just focus on conserving water, but also go outside of the own processes and invest in a municipality that can improve their efficiency. And by doing that, actually making more water available. within that catchment, so that the supply obvisouly isn't compromised to the processes. I think, it is a wonderful model. We are very busy with the project at the moment, we are doing energy ratification in the houses in the community, we doing education and awareness in that same community, looking at the bulk infrastructure, cleaning it out, making sure that the management is running properly. So greater involvement from our private sector might be a huge benefit to improving the way that things are managed. Even our municipalities are having that outside influence and having external impacts means, there is a little bit of pressure put on them to actually start doing things and to perform. And I think, t is about time now.

Interview Partner 12

IP12	Q1	I: Which are the main factors that threat the quality of water resources in South Africa? R: I would like to split them between the problems that we have always had in water management and secondly, what are the drivers that are changing, who we understand water. The old ones have to do with pollution of water resources, that reduces the availability of water for desired quality. Allocation problems ins the sense that groundwater allocates at all. If allocated in some places it takes recognition of how much water you are actually having. There is evidence now of over depletion of rives in many places, and there is of course competition for water and so allocation in many times doesn`t respond to a wide stakeholder group. Competitions itself is not a problem, but often just not well managed and leading to conflicts maybe. That is the water resources management side , we could step on to the water services.Once you give water to local authorities or to people that provide sanitation and drinking water services, often doesn't have reached the whole population yet. Access to water and sanitation should be a human right, but if you look at the statistics it is not really. So the service deliveries is poor and the quality of the system and the sustainability are problematic. These is a sort of overview, what I call the old problems. What is happening now is, that we have a growing population change, a movement of the people from rural areas into cities and then climate change. If you combine the issues of demographics and the issue of climate change, it creates many other problems, for example how we are going to achieve the food security in different places. These things that are mainstream water, are becoming very central to how we understand water. I think at the moment we don't really understand yet, what is going on and these things are going to affect our position in the future.
IP12	Q2	I: Are there any disadvantaged people and vulnerable groups regarding decision-making of water management? R: [...] They have this role and the opposite happens in terms of how the decisions are made at higher level, about how much water should be allocated per household, to agriculture and the environment. They should become a big part of this, either in water user associations, farmer associations and whatever structures, and they don't. Woman have a lot of undocumented power and influence on decision that are not formal, but in generally woman at local level have to say as much as they should about water decision making. thats the first. The second is, there has been a lot of capture by policy makers and weak government in trims of how water is allocated to the most powerful of industries, such as agriculture and big mining business. We have a whole range of stakeholders and the concentration is always about, which is the industry which gives us the most jobs, which is the industry which give sue the most GDP contribution, but there are a lot of other values that water has ad there are many other stakeholders don't necessarily have a contribution to GDP or jobs that should have a say in how water is managed. The powerful industries such as the mining industry has much more to say and the rest are less involved in water management.
IP12	Q3	I: Do you have any suggestions what could be improved regarding IWRM? R: Yes. First at conceptual level and then we go down to implementation. At conceptual level, if you look at the principles of IWRM and there are a couple of things that have been of debate and perhaps could be improved. The first is that it is clearly spelled out and recognized that water is a political good, it is also a economic and social good, but it is very much a political good. When people make negotiations about allocation at international level, these are really international relation negotiations and not negotiations about water resource management at all. And some people forget, that water is a strategic resource for a country.If they don't have enough water to be food secure, they fears about instability and so the decision jumps out of the water managers desk onto a politicians desk. But what we need is to accept, that politics is a very mainstream water management issue and find a way, to educate politicians about good water resources management. The second is, in the definition of IWRM from the global partner watership, is says its about managing water and land resources. somewhere along the line, the land resources got forgotten I think at least in practice and now we just talk about the water in the river. But it is not the only water, there is also groundwater, green water in soil moisture, but there is no talk about

		that. So I think, we need to go back to the definition of IWRM , have someone who calls themselves a water manager, influence not only how water is allocated out of a river, but also integrate the other places where the resource is found, which is groundwater, which is soil moisture and try to make an optimal use of the diversity of the forms in which we find water resources. The third one would be the idea of water as a social and economic good. Agriculture has been the biggest user of water. There are a lot of complaints that agriculture wastes water, but there is more to be said about the allocation of 70 - 80 % that agriculture uses. But e need to unpack the values that water has beyond just the allocation for agriculture. The culture, the way of life is around that and before we can influxes these people, we need to understand the different values.
IP12	Q4	I: Does climate change affect water management? If yes, how? R: The first thing is, water management is being in a lot of places very poor in coordination and in many things, thats why we had to come up with this idea of IWRM, starting of about 1992 with the first principles. But I think, if you take a survey around the world, variability of water is in itself very poor managed. Variability affects peoples life, agriculture etc. Before they have putting place systems to actually deal with variability, you have an extra layer of complexity now, that is been added, which is in itself climate change. I think there is a poor response to climate variability, because of poor capacity. Climate change only makes that worse, now you had these bigger problem. Planing is so difficult, people just don have the capacity. Te second thing is, I think it is created to many unknowns. There are examples of dealing with variability and climate change in terms of uncertainty and so on,but there is a lot that we actually don't know.We don't know actually if the hydrological cycle has changed due to climate change. And that is a big thing. The questions becomes, how to deal with things, you don't know, how do you deal with uncertainty. Water resources management is already poor in many places and climate change has blown the problem out of proportion. We also have to know how to deal with the growing pollution and climate change. It just makes us appreciate more that our management decisions may not be as effective for addressing the future.
IP12	Q5	I: What are the most important objectives of Cap-Net regarding capacity building? R: Ok first a definition of capacity building and then the expected outcomes on water governance. Institutionally, we break down capacity into a generic three point, that individuals need to have skills, the organization for whom it work need to have the ability to create change and to manage water resources effectively and to be adaptable according to the changing world and a changing state of water resources and thirdly, the thirdly that policies and institutions need to create the incentives for better water resources management. So those would be the three levels of capacity development. What when you are doing all this as well, what then is supposed to happen. I think, what then is supped to happen, is a better water governance, so basically the decisions that are made in response to the first problem, I talked about. And those decisions have to improve and to response to science, they have to take into consideration the views of many stakeholders. And ultimately we have to see an improvement in some indicators that have to do with the state of the resource and the institutions that are managing the resource. An example. When we say institutions have to improve, we have been saying for a long time that water has to be managed at the basin level. But what we need to see for example, that capacity development is number one, stimulating that these organizations are developed to manage water at the basin level or where they exist, that they are fully able to carry out their functions . So there are some indicators that show us that there is capacity development. We actually see the allocation of water response to the developments needs of the area in which water resource management is supposed to be embedded. Water Resource institutions are convening a greater reach of stakeholders or at least to be accountable to the population. If they can involve them, they should.We need to see that water qualitative objectives are actually spelled out within the mandate of a basin organization and that indicators for quality are improving. In areas for example where you have floods and droughts, water managers must comprehend these disasters, they need plans and they also have to implement the plans, so that the risk of these disasters either managed or mitigated. Those to me are my priority.
IP12	Q6	I: Do you distinguish between social (community) and individual CB? In which term do they belong together? R: They do in a sense that if we close off a system, lets say a river basin, whether we like it or not, the decisions that are made by community managing and irrigations schemes are going to have impacts downstream of the basin or outside of the basin, if they pollute the water with their agricultural practice it is going to be felt at some point. And the response that has to be made outside of that community, has to be made at a much higher level. So the impacts of activities, show you the link. And if I am sitting as a basin officer and decide that I will not allocate any water for environment and in a few years, the people that depend on fishery downstream can't have a livelihood. The interconnection is clear. What is not there sometimes, is a interconnection between the institutions that make these decisions . So there needs to be a better way and the challenge here is about transactions costs, because there need to be some way that there is a response from higher institutions to the lower institutions, that are closer to the resource. For me the challenge is, at what point should you create the forum for interaction at the least possible cost, not just in financially terms but also where it actually makes sense and where you can get the most leverage in terms of people influencing each other. So capacity development has to target all these different target groups but also create ,when we have training courses, a different diversity of stakeholders, have the ability to appreciate together in the same environment what water resources management should mean. So when we teach IWRM it shouldn't just be politicians or academics, but the interaction of appreciating water resources together. So the challenge is that they have to come together and negotiating about taking decisions. Negotiations and a forum for negotiation are very much an integral part of connecting this different groups.
IP12	Q7	I: Are marginalized groups such as poor and women considered in particular? R: In theory yes, in practice it is very difficult. Personally, I feel a bit let down by the community that calls itself the "Community of Gender" experts, because I am not. And sitting here, I give my best but I can also make mistakes. I

		have taken possibly three gender courses and I would say, I have a good understanding of what the concept and the difficulty is.I have been working in this job now for fours years and in the previous one I also worked in a very similar region in South Africa. And there we did pretty much the same thing provided some finances to get capacity development goal. And what we did for example was, that 50 % of all the scholarships for Masters to study water resource management shall be for woman. And we enforced it brutally, so if you don't find a woman, the class would not start, because we knew they were there. But this is a challenge if you have actual professional training courses, because if you look at people that come from University level into water resources management, you have just about 20 % woman. So that is one example of what we try to do here. But at what point area you actually doing something good and at what point are you perhaps not really advancing gender principles but rather just pushing the number. I think there still remains the real challenge. People are tired of hearing gender, but the problems hasn't gone away. We don't have female professional in the field, at community level we don't have woman formally influencing water resources management. But there are some positives. Currently we are working with some partners in India. And what they are doing is, their law in India said that there should be a quarter reserved for woman in sort of irrigation committees. And their have papers that say for example, 40 % should be woman. And we say to the partners in India now it, that we don't want to have these 40 % woman to not understand their role and to just being numbers. So we are trying to get them to understand, how the water systems works ad everything so that they actually formally take up those positions. But if you ask me have woman being left out, yes it has become a boring topic, but the issues still very much exists.
IP12	Q8	I: Does CB support the implementation of IWRM or which are the aspects that constrain the success of the implementation? R: [...] I think capacity development has not done enough. So in many ways capacity development for IWRM has not achieved its goal. It has achieved some goals, there is now favorable in many places, enabling environment in terms of the law and policies that explicitly say, a state that explicit look at the resource in a integrated manner as a system, that specifically embrace the principles of IWRM, but the implementation on the ground has been a little bit slow. There are a couple of reason for that. Firstly, things go in faces and first you have to motivate people and institutions to change. Which means, a lot of the education that we have been are making is about preaching the gospel of IWRM. And when people open up the space for change, then you can filter in some more specific capacity development. At the Stockholm conference where I have been now, the people said, we are entering into step 2. It is not longer about motivation, it is really about saying how does this new framework actually tackle the problems that people face on the ground. So, changing institutions is in itself a very slow process. Institutions tend to respond to the knowledge of yesterday and never to the knowledge of today. So your research of this year, maybe is influence change happening in 5 years and that it, what we have to change. And what we also need to focus on now, is also providing at much local level with organizations, the incentives for them to change. And a lot of capacity development that is done, is driven financially, also by us. A lot of financial support is coming from cooperating partners in the west. What we need to do is, to not just support the development of knowledge dn pushing through new knowledge, but to support the incentives that forces organization such as water utility and river basin organizations to actually show how they are responding to this knowledge, both from international and local level. The concept in itself with all the weaknesses that I pointed out, can't be responsible for the failure. there are a lot of changes ring on such as climate change, but also the financial systems. So it can't be that be concept is wrong, it has to do something else to do with how organizations work. I think, the experts in capacity building need to do their homework and understand first, what is the logic of how different organization work in different places and respond then to very specific needs of these different organization. We need to be able to provide a framework for them to improve their decisions, without dictating this package. It is about the adaptation of the concept now in terms of the geography of the place.
IP12	Q9	I: Do you have any recommendations regarding CB for water management? R: The most important thing is about understanding the context. There is a paper called "The cathedral and the Bazar" and it is talking about, how IWRM can be responsive to the geography of the place. Because in Botsuana for example, a lot of the water resources they use is groundwater, al lot of the basins they have are shared, it is a big country with a big desert and a population of 2 million people. Just the conditions on the ground tell you that river basin organizations are not the best idea. It would be too costly and perhaps in this situation, the central management of water perhaps make sense. There are many other examples as well. We should not go and say, this is what a typical organization that manages a basin, should like like. I think this is wrong. What is right is to manage water within a basin, what wrong is to assume that you need to have a basin office carrying out this different types of functions. That needs to adapt to the local conditions.

Interview Partner 13

IP13	Q1	I: How would you estimate the impact of current climate change on South Africa in terms of any observed trend? R: Something that I have learned from this edited Volume that we have just produced is that it is extremely hard to identify specific climate impacts from natural climate variability. In localities where people are very dependent on natural resources such as water, it is very hard to say this lack of rain this year or this flood is the result of climate change. If it is so difficult to identify climate impacts how can that be negotiated? Because many people are focussing on climate change adaptation but what they are saying is, lets built capacity and resilience at a local level, so that it makes a difference even if climate change doesn't happen. So if the projected impacts don't realize lets have contributed to development, the management of natural resources, economic growth. This is important to me, this distinction between how do you manage the uncertainty around climate change. Also related to water in terms of climate change and climate variability. From my experience, we looked at pastoralists and how people

		and farmers have adapted. But I am not so familiar with South Africa. Pastoralism is a result of climate variability, people have adapted by climate variability by moving around, by managing the lack of resources. With increasing variability people migrations pattern are changing. If there is a lack of rainfall they are forced to look for other areas, but there might be conflicts with farmers. In Sudan people responded in various ways related to water. They capture water for example to endure the dry periods. There are a lot of NGOS around making water supply more sustainable by bringing in local communities. They are bringing in local communities to be part of the planning processes. It is all about including different stakeholders. Another issue is privatization of land also leaves to privatization of communal water resources.
IP13	Q2	I: Does climate change affect the quality of agricultural land and if yes, how? R: What I have seen in Sudan, because of climate change they struggle to feed their cattle. Climate change according to them contribute to deforestation. This leads to a lack of grazing land which leads to land degradation.
IP13	Q3	I: How do people deal with the impacts? R: A particular response to climate change would be tensions and conflicts. If you go the the rural areas in South Africa you might find that government institutions are weak and local communities have their own systems of resolving conflicts. So from my research in Sudan we are looking at how people are able to respond to climate change. It is import an to build local capacity to deal with climate change. The FAO could also be interesting for you to look at in terms of climate change.
IP13	Q4	I: What are coping strategies for people as a response to climate-related changes? R: I have also done some research about climate induced migration, not necessarily fired but rather voluntary migration. People should diversify crops. NGOs can help to develop a bigger variety of crops. Woman are taught to use products that are more efficient. Furthermore it is important to give them access to different markets to sell their cheese for example. I think certain groups are more affected than others. What you find generally is that woman work on the fields, children may not be able to go to school because the need to contribute to give the family income. The youth is often excluded, they don't have a voice.
IP13	Q5	I: Which are the root causes that trigger vulnerabilities? R: I think the high dependence on natural resources such as water for animals, consumption and farming. A lack of adaption options, they may not have the money to adapt in terms of building dams or to get a water tank. I guess they don't have the entitlements to address a particular problem, sometime they are not educated, they don't have access to markets, poor governance especially on local level. On local level, there is also corruption, a lack of capacity. The government sometimes doenst have capital to focus on local issues. The municipalities dont spend the money properly. People don't talk to each other, there is a big lack of communication between government and local level, NGOs and so on. "Global Crisis Solution" is also interesting to look at for this issue.
IP13	Q6	I: Does climate change have an impact on the security for the individual (human security)? If yes, how? R: It depends on how yo define human security. Some people define it in very direct terms other like UNDP speak about it in very broad terms.
IP13	Q7	I: Are you aware of cases where this has lead to conflict or cooperation? R: In terms of cooperation in the water sector, there is a good author from the States (Sandy Rukhstuhl) regarding cooperations. For me, it is not only a job for government. We have people arguing that the private sector should become involved. Thy have huge capacities and resources for innovation and they can really make a difference in local communities for example. Some people also argue for greater involvement of local NGOs, because they often are run by international NGOs, but they often don't really know the local context. Local communities, local people, woman need to be involved, adaptions options. I think IWRM needs to create a good link between local communities and marginalized groups and link them with local and national government.

Interview Partner 14

IP14	Q1	I: Which are the main factors that threat the quality of water resources in South Africa? R: Water pollutions consists of a couple of problems in South Arica. The first one being the municipalities which doenst take care of the sewage treatment plants. And there are lots and lots of problems, so the bacteriological pollutions of our surface water must be the number on concern in South Africa. The second one, everyone is talking about that right now, is acid mine drainage from our mine industry and all the heavy metals that goes with it. A third concern is eutrophication. Some of the algae produce toxins, which is a big problem in South Africa. These should be the three main concerns in South Africa. The pollution in our rivers end up in dams, which is primarily used for drinking water and irrigation.
IP14	Q2	I: Which role does government play for the sustainable management of water resources? R: You should ask what they "should" play not what they are playing. The problem is basically a political problem. With the new dispensation, people especially in the municipalities as a municipal managers (u) and the people who knew what was going on such as engineers, they were just made redundant. So the knowledge that used to be in the municipalities isn't there anymore. Everything just (u). So the new dispensation is from 1992, and we are almost 20 years down the line now, and the upkeep especially of our treatment works while nothing happened there. So there must be major upgrade of virtually all sewage systems to be safe with our surface water. This involves a lot of money and a lot of knowledge. You don't see a lot of money pumped into this problem.

IP14	Q3	I: According to your expertise, are users, planners and policy-makers involved adequate in the decision-making for water planning and management? R: No really. If we talk about big projects like building of new dams, new irrigation schemes and so on it is the Department of Water Affairs and Agriculture. So it is the government taking the decisions and they have their own ecologists I suppose, but the overall planing is from central government.
IP14	Q4	I: Are there any disadvantaged people and vulnerable groups regarding decision-making of water management? R: If we talk about disadvantaged people, I immediately think of people on the local level who dont have access to clean water and treated water and access to enough water. So in the more rural areas, the water users is lets say 600 liters per person per day and in other areas such as water camps and so on, they even have to deal with 20 liter or even less liter per person per day. Because they don't have free running water in their shacks, they have to collect it from taps, or boreholes or whatever and to bring wherever they live.
IP14	Q5	I: In your mind, exists gender equality in terms of water management? How are women involved in the decision making on local/national and international level? R: I am not an expert in that issue. The woman are mostly involved in the collecting of fire water and wood, they are the people on the ground. They are responsible for the gathering the water for the household.
IP14	Q6	I: Does IWRM contribute to an economic and social welfare while addressing the environmental interests? R: Not yet.
IP14	Q7	I: Do you have any suggestions what could be improved regarding IWRM? R: We must start at local level and we must see that there is an equitable distribution of our water to all our people in south Africa. Which means water lines, stand pipes. I think to give every household access to water will only be possible in the long term. But lets say standpipes within 200-300 meters from household instill better than nothing. In the rural areas there is no purified water available. Those people still have to make use of boreholes or rivers to collect water. But if the river is polluted, it is all what they have. They have to use this water. To have purified water as we do have in our cities for all of our people, it is still a long way to go. We also have the problem of a very high population growth in South Africa. We can't keep up building houses and supplying the infrastructure to all the people. Everybody demands a house, water, electricity but they don't have the means to pay for it. So the tax payer must pay the costs. We try to give everybody in South Africa a very good living means increasing costs. But the costs for that are increasing all the time.
IP14	Q8	I: Would you say that climate change has impacts on the water resources and also on the water management? R: Ja to the better. I talked to my students and we looked at events. The last land wide drought South Africa had was in the early 1980s, so 30 years ago. And since then we have normal or above normal rainfall in south Africa. We have local droughts but not the droughts we had like 30,50 or 100 years ago. We are very fortunate. There are more positive effects, secant complain, I don't say its due to climate change.
IP14	Q9	I: Are there any additional remarks? R: We are in a semi arid country. We can't afford to waste any water and if you pollute water, you are wasting water. If the population continue to grow as it does now, we will have to look across our borders to import water, e.g. the Sambezi River.Or we find a way with new renewable energy to desalinate ocean water, thats the other possibility from the next 20 or 30 years. We are exceeding water at the moment, everybody aspire a better life style, but the better your lifestyle the more water you use.

Thesis Declaration

I hereby declare, that I have completed this Master Thesis, entitled „Integrated Water Resources Management – The Orange-Senqu Basin in South Africa" independently, on my own, employing only the sources and aids specified and cited in the paper. I have identified and acknowledged all words and ideas taken from other work. The submitted electronic copy is identical in form and content to the written version of the thesis.

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Hamburg, 30.08.2013

Place and Date

Name