STRATEGIC ACTION PROGRAMME FOR THE ORANGE–SENQU RIVER BASIN

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The Orange–Senqu River Commission – ORASECOM – was established by the governments of Botswana, Lesotho, Namibia and South Africa to promote equitable and sustainable development and management of the resources of the Orange–Senqu River. This joint commitment was sealed through an Agreement on the Establishment of the Orange–Senqu River Commission signed in November 2000 in Windhoek, which conforms with best international practices regarding the joint management of shared rivers.

The highest body of ORASECOM is the Council, consisting of delegations from each country, supported by various 'Task Teams' that manage projects, and a Secretariat. The Council serves as technical advisor to the member states on matters related to development, utilisation and conservation of water resources of the Orange–Senqu River system. The Secretariat, established by agreement with South Africa in 2006 and hosted there, coordinates ORASECOM activities, implements ORASECOM decisions and is the focal point of the institution.

Strategic Action Programme for the Orange–Senqu River Basin. ORASECOM Report 010/2014.

Produced by the UNDP–GEF Orange–Senqu Strategic Action Programme

Published by the Orange–Senqu River Commission (ORASECOM), www.orasecom.org

This document was developed by the Action Plan/SAP Working Groups of the four basin states. The process was facilitated by Daniel Malzbender.

Published in 2014

Suggested citation: ORASECOM, 2014. *Strategic Action Programme for the Orange–Senqu River Basin.* ORASECOM Report 010/2014.

Design and layout by Handmade Communications
Copy-editing and proofreading by Liz Haines

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ENDORSEMENT

The Strategic Action Plan for the Orange-Senqu River Basin was endorsed by the following Ministers at the 1st meeting of the ORASECOM Forum of the Parties held in Windhoek, Namibia, on 7 August 2014.

1. Botswana:
Honourable Onkokame Kitso Mokaila,
Minister of Minerals, Energy, and Water Resources

2. Lesotho:
Honourable Tseliso Mokhosi,
Minister of Energy, Meteorology and Water

3. Namibia:
Honourable John Mutorwa,
Minister of Agriculture, Water, and Forestry

4. South Africa:
Honourable Nomvula Mokonyane,
Minister of Water and Sanitation

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FOREWORD

The Orange–Senqu River Commission (ORASECOM) was established by the governments of Botswana, Lesotho, Namibia and South Africa to advise them on water-related issues towards promoting equitable and sustainable development and management of the resources of the Orange–Senqu River basin.

ORASECOM and its four basin states have been supported by a United Nations Development Programme–Global Environmental Facility (UNDP–GEF) programme in the development of a basin-wide Strategic Action Programme (SAP) and an Action Plan for each basin country to address a variety of identified water-related environmental concerns. The SAP is a negotiated document that provides a basin-wide framework for the implementation of a prioritised set of national and joint transboundary actions and investments. In the context of the Orange–Senqu River Basin Integrated Water Resources Management (IWRM) Plan, the SAP is specifically focused on addressing priority environmental concerns. At national level, the SAP initiatives are integrated into the respective Action Plan of each basin state.

The SAP is based on an assessment of the priority environmental concerns as identified by the Orange–Senqu Transboundary Diagnostic Analysis (TDA), a scientific and technical assessment of the priority environmental concerns and shared management issues in the basin. For the priority issues, the analysis identifies the scale and distribution of the environmental and socio-economic impacts at national and basin levels and, through an analysis of the root causes, identifies potential remedial and/or preventative actions. The SAP defines technical and management interventions to address these priority concerns at the basin-wide level. It was developed through an extensive consultation process and has been validated at basin-wide level in order to ensure that it reflects the priorities of the four basin states. It is well aligned with applicable regional agreements and policies, as well as the national development and sector plans of the basin states.

Developed under the auspices of ORASECOM, this SAP – together with the Action Plans of the four basin states – forms the environmental component of the Orange–Senqu River basin IWRM Plan.

Southern Botswana is one of the most arid areas of the basin. Large tracts of land are under extensive livestock farming largely dependent on groundwater sources. To make farming economical, the farms are necessarily large and often remote.

Left: The Orange–Senqu River rises in the mountains of Lesotho with its tributaries draining the entire country.

Opposite page: The succulent quiver tree (*Aloe dichotoma*) on rocky outcrops is iconic of the arid western areas of the basin and has been identified as a symbol of climate change.

ACKNOWLEDGEMENTS

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Secondary falls at Augrabies, Northern Cape, South Africa, before the water disappears underground to emerge further downstream.

The development of this Strategic Action Programme (SAP) was funded by the Governments of Botswana, Lesotho, Namibia and South Africa, as well as the Global Environment Facility (GEF).

Political and technical guidance for the development of the SAP was provided by the Action Plan/SAP Working Groups of the four countries, namely:

Botswana:

Tracy Molefi	International Waters Office
Tefo Lobelo	International Waters Office
Otumiseng Mampane	Department of Water Affairs
Joshua Moloi	Department of Forestry and Range Resources
Dr Kefilwe Kebonye-Makgetho	Department of Veterinary Services
Morake Moetsabatho	Department of Wildlife and National Parks
Raymond Kwerepe	Veld Products Research and Development Botswana
Mike Brooks	Debswana

Lesotho:

Felix Malachamela	Water Commission
Ntiea Letsapo	Department of Water Affairs
Nthapeliseng Nthama	Department of Environment
Phokoane Monokoane	Department of Range Resources
Fred Tlhomola	Lesotho Highlands Development Authority
Thabo Nobala	Serumula Development Association

Namibia:

Maria Amakali	Ministry of Agriculture, Water and Forestry
Pauline Mufeti	Ministry of Agriculture, Water and Forestry
Elise Mbandeka	Ministry of Agriculture, Water and Forestry
John Sirunda	NamWater
Dr Gaby Schneider	Ministry of Minerals and Energy
Wayne Handley	Ministry of Environment and Tourism

South Africa:

Peter Pyke	Department of Water Affairs
Mary-Jean Gabriel	Department of Agriculture
Jan Potgieter	Department of Agriculture
Wilma Lutsch	Department of Environment
Dr Kevin Murray	Water Research Commission
Yolandi Els	South African Environmental Observation Network
Marco Pauw	South African Environmental Observation Network

The National Stakeholder Platforms in the four basin states also provided valuable technical input and guidance to the SAP development process.

The SAP development process was facilitated by four national facilitators: Felix Monggae (Botswana), Palesa Mokorosi (Lesotho), Viviane Kinyaga (Namibia), Brian Hollingworth (South Africa), and the regional coordinator, Daniel Malzbender.

Overall policy and technical guidance was provided by the ORASECOM Secretariat, namely the Executive Secretary, Lenka Thamae, Water Resources Specialist, Rapule Pule, and the UNDP–GEF Senior Project Manager, Christoph Mor.

ABBREVIATIONS AND ACRONYMS

a	annum
ARC	Agricultural Research Council
e-flows	environmental flows
ha	hectare(s)
km	kilometre
IWRM	integrated water resources management
m	metre
MAE	mean annual evaporation
MAP	mean annual precipitation
Mm^3	million cubic metre(s)
MW	megawatt
ORASECOM	Orange–Senqu River Commission
OSB	Orange–Senqu basin
PCN	project concept notes
SADC	Southern African Development Community
SAP	Strategic Action Programme
TDA	Transboundary Diagnostic Analysis
tb-EA	transboundary environmental assessment
UNDP–GEF	United Nations Development Programme–Global Environmental Facility
UNFCCC	United Nations Framework Convention on Climate Change
UNOPS	United Nations Office for Project Services
USD	United States Dollar
WIS	Water Information System

© UNOPS/Abigail Engleton

A community member waters plants in a rangeland management demonstration project at Khawa, Botswana. Assisting communities to establish vegetable gardens in this harsh environment helps provide a buffer for food security.

© Andrew Ashton

EXECUTIVE SUMMARY

The Orange–Senqu Strategic Action Programme (SAP) is a strategic implementation programme for addressing priority environmental concerns in the Orange–Senqu River basin. It is closely linked to the corresponding Action Plan of each of the four basin states. In the context of the Orange–Senqu River, the SAP and Action Plans collectively form the core of the environmental component of the Integrated Water Resources Management (IWRM) Plan. The SAP and Action Plans, like the IWRM Plan, are developed for a ten-year planning time span with targets set for that period.

The SAP was developed through an intensive stakeholder consultation process. This process involved intersectoral dialogue to achieve integration in water resources management and, most importantly, national and basin-wide endorsement of the SAP. The political and technical guidance for the SAP came from the four basin countries, through the respective Action Plan/SAP Working Groups as well as a broader National Stakeholder Platform, each structure specifically set up for the purpose of SAP and Action Plan development. In each country, a delegate to the Orange–Senqu River Commission (ORASECOM) Technical Task Team was appointed as the national coordinator of the Action Plan/SAP process. The National Stakeholder Platforms comprised stakeholders representing a wide range of relevant role-players, including both state and non-state participants. While established initially for the purposes of Action Plan/SAP development, the aim is that National Stakeholder Platforms and Action Plan/SAP Working Groups are maintained in the long term and become permanent national counterparts for ORASECOM.

The SAP is based on an assessment of the priority environmental concerns as identified by the Orange–Senqu Transboundary Diagnostic Analysis (TDA), a scientific and technical assessment of the priority environmental concerns and shared management issues in the basin. For the priority issues, the analysis identifies the scale and distribution of the environmental and socio-economic impacts at national and basin levels. Through an analysis of the root causes, the analysis also identifies potential remedial and/or preventative actions.

The SAP is structured around the four environmental priority areas of concern identified in the TDA: increasing water demand, declining water resources quality, changes to the hydrological regime and land degradation.

1 Increasing water demand

The volume of water currently reaching the mouth of the Orange–Senqu is estimated to be, on average, approximately 4,200 Mm^3/a, which represents less than half the annual natural flow, estimated at approximately 11,300 Mm^3. Water is abstracted for irrigation, industry and mining, urban use and livestock farming. The supply-side option of increasing the usable yield from the system to meet increasing demand requires extensive infrastructure. Moreover, the easy (and less costly) options have already been used. Demand-side interventions, such as water conservation, demand management, re-use of water, desalination, rainwater harvesting, etc. need to be further explored and increasingly implemented through an integrated approach.

2 Declining water resources quality

The key water resources quality issues in the Orange–Senqu River system have been identified as nutrient enrichment, primarily linked to increased phosphorus and nitrogen concentrations; increased salinity from acid mine drainage and irrigation return flows; microbial contamination from urban settlements and poorly operated sewage treatment works; and changes in sediment load. In addition, radionuclides, heavy metals and persistent organic pollutants, while not currently posing a basin-wide risk, do show high concentrations in certain localised areas. Therefore precaution should prevail. Although

Kalahari scrub-robin (*Cercotrichas paena*), a cheerful resident of the arid north-western areas of the basin.

Opposite page: Golden Gate National Park, Free State Province, South Africa, near the source of the Caledon River with alien invasive poplars (*Populus* spp.) along the riverbanks in autumnal colours.

© Johan Swanepoel

Having disappeared from large tracts of lands outside protected areas due to poisoning, the spectacular bateleur eagle, *Terathopius ecaudatusis*, is commonly seen gliding above open Kalahari savannahs and on the ground at pans in the Kgalagadi Transfrontier Park.

a common problem throughout the basin, pollution and declining water quality is most severe in the Vaal sub-basin (in South Africa).

3 Changes to the hydrological regime

As a consequence of upstream development, the hydrological regime of the river has changed significantly. Apart from the mean annual runoff being reduced to half the estimated natural flow, the pattern of flow is different to that of the natural river. There is less variability in flow from one year to the next and, within the year, there is a less distinct seasonal pattern. The frequency of smaller floods has also been reduced, with most being absorbed by upstream abstraction and storage. There is less water in the system to dilute increasing volumes and types of contaminants, reduced and altered patterns of flow and flushing and changes in sediment load and balance and river morphology along its length. These changes in the hydrological regime of the river impact downstream ecosystems, including the estuary – a Ramsar site – resulting in a loss of ecosystem services.

4 Land degradation

Inadequate land management associated mostly with agriculture and mining in parts of the Orange–Senqu River basin has led to loss of wetland storage and aquifer recharge, increased sediment loads, deteriorating water resources quality, increased distribution and abundance of alien invasive plants, loss of biodiversity and lowered land productivity. While increasing numbers of people are faced with dividing up the land into smaller pieces, they are also faced with land being less productive. In some parts of the basin, livestock production is in decline and opportunities for community-based natural resource management and alternative livelihood options are inadequately considered. Land degradation is generally perceived as a problem in the basin, and Lesotho specifically regards this as a high priority.

National targets were set to address each priority area of concern over a ten-year time period. Interventions to meet these national targets were then identified. In line with national policies, strategies and plans, SAP project concepts were developed that package the proposed interventions into structured, implementable projects. These project concept notes (PCNs) form the backbone of the SAP and are as follows:

Larger wastewater treatment works in the basin are often well managed. However, the majority of wastewater treatment works serving small towns across the Orange–Senqu basin are not performing to standard.

Addressing: Increasing water demand
- SAP PCN 1: ORASECOM information and knowledge management
- SAP PCN 2: Groundwater management and use

Addressing: Declining water resources quality
- SAP PCN 1: ORASECOM information and knowledge management
- SAP PCN 3: Basin-wide environmental flows regime

Addressing: Changes to the hydrological regime
- SAP PCN 3: Basin-wide environmental flows regime
- SAP PCN 4: Orange–Senqu River mouth management

Addressing: Land degradation
- SAP PCN 5: Control of alien invasive species
- SAP PCN 4: Orange–Senqu River mouth management

These SAP project concept notes are complemented by 25 project concept notes contained in the respective Action Plans which address the identified environmental priority problems at national level.

The implementation of the SAP is project-specific and its implementation mechanism is dependent on the requirements of the lead implementing agent for the respective project. Overall coordination and monitoring of the SAP is through national government structures using their established coordination and monitoring structures and systems. Consequently, close collaboration between the ORASECOM Secretariat and responsible national structures is necessary to ensure coordination and monitoring between the implementation of SAP and Action Plan activities in the four basin states.

Funding is sought for each project, either individually or for a combination of projects. Potential funding sources are primarily national governments, international cooperation partners and, to some extent, the private sector. Importantly, given the extensive consultation process through which the SAP and Action Plans have been developed and their close alignment with national policies and strategic planning priorities, the SAP also provides valuable guidance for targeted budget decision-making and spending at national level.

1. BACKGROUND

1.1 PURPOSE OF THE SAP AND RELATIONSHIP TO TDA AND ACTION PLANS

The Orange–Senqu Strategic Action Programme (SAP) is a negotiated document that provides a basin-wide framework for the implementation of a prioritised set of national and joint transboundary actions and investments to address jointly agreed priority environmental concerns in the Orange–Senqu River basin. The SAP is endorsed at political (ministerial) level and, together with the related Action Plans of the four basin states, provides a basis for the implementation of SAP priority actions at national and basin level, and the integration of transboundary and basin concerns into national legislative, policy and budget decision-making processes.

In the context of the Orange–Senqu River, the SAP (and Action Plans) is closely linked to the basin-wide Orange–Senqu Integrated Water Resources Management (IWRM) Plan. The Action Plans and SAP, like the IWRM Plan, are developed for a ten-year planning time span with targets set for that period. Thus, while the IWRM Plan is a comprehensive plan dealing with a wide aspect of water resources management (including water allocation) and economic development aspects pertinent to the basin, the SAP and related Action Plans primarily concentrate on priority environmental issues and combined they form the environmental core component of the IWRM Plan.

The SAP is based on an assessment of the priority environmental concerns as identified by the Orange–Senqu Transboundary Diagnostic Analysis (TDA) and defines technical and management interventions to address them. The TDA is a scientific and technical assessment of the priority environmental concerns and shared management issues in the basin. With regard to the priority issues, the analysis identifies the scale and distribution of the environmental and socio-economic impacts at national and basin levels and, through an analysis of the root causes, identifies potential remedial and/or preventative actions.

The focus of the SAP is on transboundary and/or common environmental concerns, i.e. those that can only be addressed through collective action of more than one, or even all, basin states. The SAP is aligned with the Action Plans of the four basin states. The Action Plans prioritise the environmental concerns identified by the TDA from a national perspective and identify suitable responses that can be implemented at national level only. Together, the SAP and the four Action Plans provide a comprehensive programme to address the identified priority areas of environmental concerns at basin and national levels.

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Water being released from the Katse Dam on the Malibamatso River, Lesotho. The Katse Dam, constructed during the first phase of the Lesotho Highlands Water Project, augments water supply to South Africa via a transfer system to the Vaal River sub-basin.

1.2 GEOGRAPHIC COVERAGE

Geographically, the SAP applies to the entire basin area of the Orange–Senqu River basin (see Figure 1). The Orange–Senqu River originates as the Senqu in the Highlands of Lesotho, some 3,300 m above mean sea level, and flows westwards for more than 2,300 km before discharging into the Atlantic Ocean on the west coast of southern Africa. With a total catchment area of approximately 1,000,000 km^2, the Orange–Senqu River basin is one of the largest in southern Africa, encompassing the whole of Lesotho and areas of Botswana, Namibia and South Africa. The many tributaries of this westward-flowing river include the Vaal River in South Africa and the ephemeral Fish River in Namibia.

Opposite page: Agriculture in the Orange–Senqu basin is important for food security and job creation, but places greater demand on the basin's water resources than all other economic sectors. Using water-efficient mechanisms, such as drip irrigation in this climate-controlled greenhouse in Rehoboth, Namibia, is becoming essential to ensure that demands are sustainable.

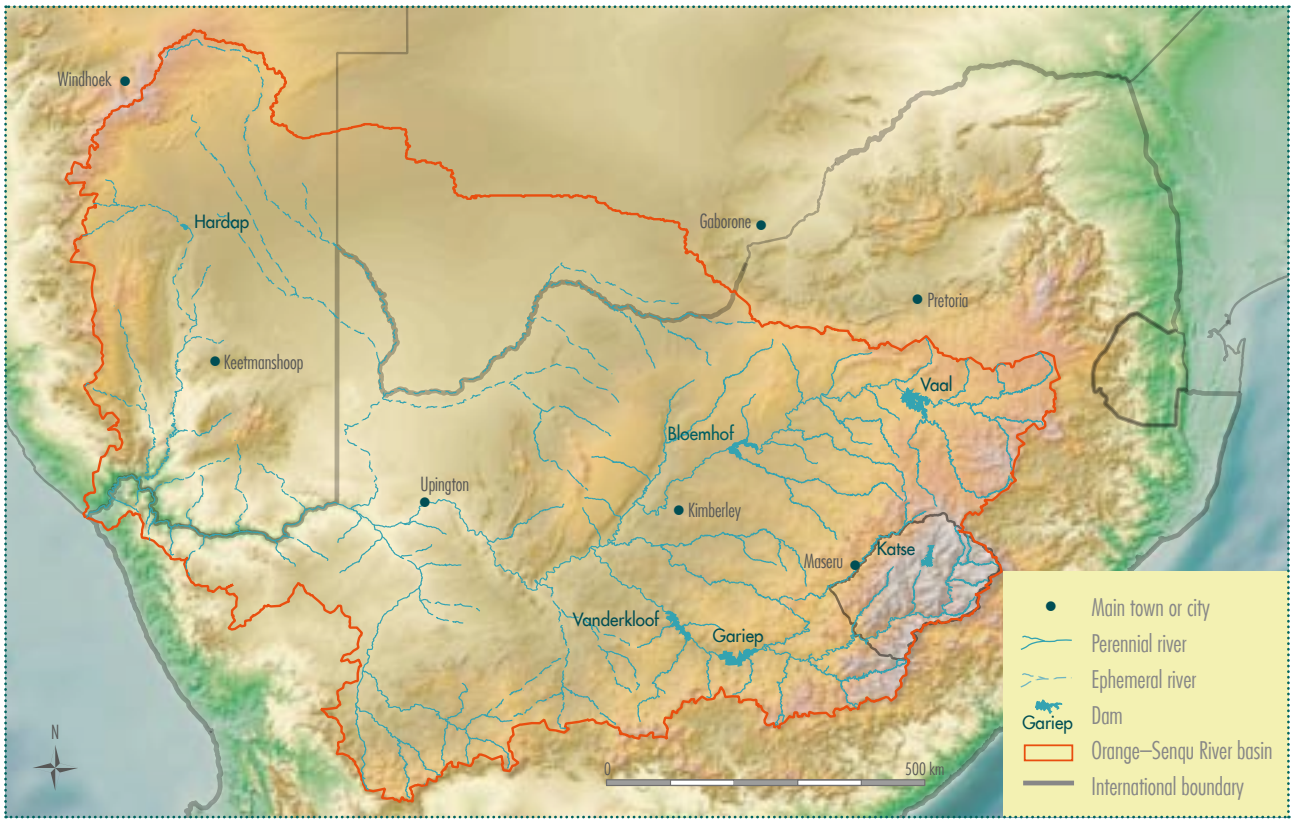

Figure 1. The Orange–Senqu River basin

1.3 SAP DEVELOPMENT PROCESS

The SAP, in conjunction with the Action Plans, was developed through an extensive consultation process in order to ensure that it reflects the priorities of the four basin states. It is well aligned with the four countries' national development and sector plans, as well as the institutional frameworks at basin, national and local levels.

In practice this meant that the political and technical guidance for the SAP and Action Plans came from the countries, through an Action Plan/SAP Working Group as well as a broader National Stakeholder Platform, each structure specifically set up for the purpose of Action Plan and SAP development.

While also being part of the National Stakeholder Platform, the Action Plan/SAP Working Group is smaller in size (between five to eight members), comprised mostly of individuals holding positions in government related to water, planning and finance. Each country's delegate to the Orange–Senqu River Commission (ORASECOM) Technical Task Team was appointed as the national coordinator of the Action Plan/SAP process for their country. With support from the consultant team, the Action Plan/SAP Working Group was primarily responsible for the development of the Action Plan and provided the technical and political guidance for the formulation of the Action Plan. Collectively the four Action Plan/SAP Working Groups formed the regional Action Plan/SAP Working Group, which guided the development of the SAP.

The National Stakeholder Platforms are comprised of stakeholders representing a wide range of relevant role-players, including both state and non-state participants. While established initially for the purposes of Action Plan/SAP development, the aim is that the National Stakeholder Platforms and Action Plan/SAP Working Groups are maintained in the long term and become permanent national counterparts for ORASECOM.

Two workshops of the National Stakeholder Platform were held at national level in each country, in addition to regular meetings of the (smaller) Action Plan/SAP Working Groups. The regional Action Plan/SAP Working Group met three times throughout the process for the joint development of the SAP and to ensure synergy between the four Action Plans as well as between the Action Plans and the SAP.

In addition to the National Stakeholder Platforms and Action Plan/SAP Working Groups, there were other key role-players in the Action Plan/SAP development process. The ORASECOM Secretariat and the United Nations Office for Project Services (UNOPS) provided important political and technical guidance to the process. Likewise, regular information exchange and coordination with other ongoing initiatives, notably the Orange–Senqu Basin IWRM Plan development process, took place in order to ensure technical coherence and harmonisation of the Action Plans (and SAP) with the Orange–Senqu Basin IWRM Plan.

The SAP, as well as the Action Plan in each country, is structured around the four environmental priority areas of concern identified in the TDA:
- Increasing water demand
- Declining water resources quality
- Changes to the hydrological regime
- Land degradation.

Through the Action Plan consultation process, each country prioritised four areas of concern from its national perspective. In response to each priority area of concern, national targets were set to address the concerns over a ten-year time period. Interventions required to meet the targets were then identified. In line with national policies, strategies and plans, project concepts were developed that package the proposed interventions into structured, implementable projects. These project concept notes (PCNs) form the backbone of each Action Plan.

Similarly, basin-wide SAP targets were set for the same ten-year time period and interventions developed to address the priority concerns. As in the Action Plans, the interventions were packaged into structured, implementable projects. The resulting SAP project concept notes are presented in the Annexure. Collectively, the SAP and the four Action Plans comprise an inter-related programme of 25 packaged projects addressing the main environmental challenges in the basin.

1.4 SAP OBJECTIVE

The implementation of the SAP is guided by the following overarching environmental objective:

> Orange–Senqu basin states collectively reduce water pollution, control catchment degradation and mitigate the effects of environmental degradation.

The town of Rosh Pinah in southern Namibia is centred around two mines that produce base metals. Water to sustain the town and mining operations is piped from the Orange River.

Namaqualand, Northern Cape, South Africa, is one of the few areas in the basin that receives the majority of its rain in winter. The rain transforms the otherwise barren landscape to fields of colour in early spring.

1.5 PHYSICAL AND GEOGRAPHICAL CHARACTERISTICS OF THE BASIN

The Orange–Senqu River basin lies within the territories of Botswana, Lesotho, Namibia and South Africa, covering an area of just under a million square kilometres (ORASECOM, 2008). The basin incorporates the central part of South Africa (which represents nearly half of the surface area of the country, and where the main river is known as the Orange) and the whole of Lesotho (where the main river is known as the Senqu). The basin covers the southern part of Botswana and drains most of the southern half of Namibia.

The Orange–Senqu River basin is situated in a region that is largely classified as semi-arid and subject to increasing water stress. The river system is not only transboundary, it also forms some of the borders between these riparian states. The largest part of the basin (64.2 per cent) falls within South Africa and includes the Vaal and Orange Water Management Areas (Table 1). Much of south-western Botswana and southern Namibia are included in the basin which covers significant areas (7.9 per cent and 24.5 per cent, respectively), but contributes relatively small amounts of water to surface runoff (0.3 per cent and 5.2 per cent, respectively). The comparatively small part of the basin (3.4 per cent) located in upstream Lesotho contributes a significant amount of the total runoff in the system (41.5 per cent).

Table 1: Summary of basin characteristics

Country	Proportion (%) of basin area	Contribution to natural runoff (%)	Proportion (%) of basin population	Water use in 2005 (Mm^3)
Botswana	7.9	0.3	0.3	negligible
Lesotho	3.4	41.5	15.4	20
Namibia	24.5	5.2	2.6	76
South Africa	64.2	53.0	81.7	5,389

Source: ORASECOM TDA, 2014

The Orange–Senqu River basin can be divided into three main sub-basins: the Vaal, the Upper Orange–Senqu and the Lower Orange–Senqu (Table 2). Each of these can be further divided into areas practical for the purposes of water management.

Table 2: Catchment areas comprising the basin

Major catchment	Catchment area (km²)
Vaal	196,438
Upper Orange	99,277
Lower Orange	
South Africa	243,313
Molopo–Nossob*	356,788
Fish River (Namibia)	81,630
TOTAL	**977,446**

* Catchment in Namibia and Botswana
Source: ORASECOM TDA, 2014

Rainfall is strongly seasonal over most of the basin: most of the rain falls in summer, generally between October and April, and usually occurs as convective thunderstorms which are sometimes accompanied by hail. Lesotho has significantly higher rainfall than the South African part of the catchment. Moving westwards, rainfall decreases; it is at its lowest at the coast and typically falls in winter. The mean annual precipitation (MAP) of each catchment is given in Table 3.

Table 3: Mean annual temperatures, precipitation (MAP) and evaporation (MAE)

	January average range (° C)	July average range (° C)	MAP (mm)	MAE (mm)*
Senqu†	7–25	0–10	500–1,600	1,000–2,100
Upper Orange‡	16–32	2–18	300–800	1,200–2,680
Lower Orange‡	20–37	4–23	20–300	2,420–3,280
Upper Vaal	20–24	0–16	500–1,000	1,600–2,200
Middle Vaal	16–32	1–18	300–700	1,800–2,600
Lower Vaal	15–32	1–20	200–500	2,646–2,690
Namibia	18–37	6–22	0–250	1,950–3,800
Molopo and Nossob‡‡	20–38	0–23	Molopo headwaters 400–600 middle 200–400 western parts 0–200	1,250–1,650

* A-pan evaporation
† Lesotho part of upper Orange–Senqu
‡ South Africa
‡‡ Botswana part of the basin
Source: ORASECOM TDA, 2014

Kliptown in the densely populated Gauteng Province, South Africa, is illustrative of the informal growth of settlements, which is typical of many urban areas in the basin.

The natural runoff in the Orange–Senqu River basin is estimated at close to 11,300 Mm^3/a, broken down per WMA in Table 4.

Table 4: Naturalised flows

WMA/country	Naturalised MAR 1920–2004 (Mm^3/a)
Upper Vaal	2,452
Middle Vaal	912
Lower Vaal	201
Upper Orange, including Senqu	6,756
Lower Orange	255
Botswana	44
Namibia	651
TOTAL	**11,271**

Sources: WRC, 2008a,b (Lesotho and South Africa); ORASECOM, 2011 (Botswana); Department of Water Affairs Hydrology Records, 1920–99 (obtained October 2011).

Apart from surface runoff, extensive areas (particularly in Botswana, Namibia and the south-western part of the basin in South Africa) depend on groundwater.

1.6 SOCIO-ECONOMIC CONTEXT (INCLUDING CURRENT WATER USE)

The basin has a population of 14 million and combined with people outside the basin who are also provided with water from the basin, it supports more than 19 million people. Thus it plays a vital role in sustaining livelihoods and stimulating economic growth. The four basin countries rely to varying degrees on the system's water resources for agriculture, industry (mining and manufacturing), energy, domestic and subsistence needs, conservation and tourism.

The most economically active and densely populated area of southern Africa is in the eastern areas of the basin, i.e. South Africa's Gauteng Province. Water supplies required to meet these demands and those of large-scale irrigation schemes have been assured

through the construction of numerous dams and a series of inter-basin transfer schemes, mostly on the upper Orange–Senqu and Vaal river systems. Consequently, it is regarded as the most developed river system in southern Africa with some 300 built structures, including a number of large dams and inter- and intra-basin transfer schemes. There are six major reservoirs in the basin with storage capacities over 1,000 Mm^3, and over 90 others. The Gariep and Vanderkloof in the upper Orange sub-basin are the largest dams in the basin. Both have major hydroelectric power stations and also supply water to users in this area, particularly to support agriculture. The largest of these dams are listed in Table 5.

Table 5: Dams on the Orange–Senqu with capacities exceeding 1,000 Mm^3

Dam	Gross storage (Mm^3)	Live storage (Mm^3)	Dead storage (Mm^3)
Katse	1,950.0	1,518.6	431.4
Gariep	5,342.9	4,710.0	632.9
Vanderkloof	3,187.1	2,173.2	1,013.9
Sterkfontein	2,617.0	2,482.3	134.7
Vaal	2,606.8	2,442.5	164.3
Bloemhof	1,511.7	1,239.5	272.2

Although dams, smaller transfer schemes and irrigation schemes play a role further downstream in the Lower Orange, groundwater is of major importance. Groundwater often constitutes the only source of water over large areas of these arid reaches, and it is used for rural domestic supplies, livestock watering and to supply many towns and villages.

Water is critical to supporting both current economic activities in the Orange–Senqu River basin as well as future economic growth and development. A recent study (SADC, 2010) estimated the total water use per economic sector and found agriculture is by far the largest user, followed by domestic consumption, manufacturing and mining (Table 6).

Table 6: Water use per economic sector in the basin (2000)

Economic sector	% Water use
Agriculture	90.76
Mining	0.51
Manufacturing	3.59
Domestic	6.16

South Africa's energy production in coal-fired power stations relies on significant quantities of cooling water. The Lethabo, Tutuka, Camden and Grootvlei thermal power stations are situated in the basin and combined use 150 Mm^3/a. Water is also transferred to the Olifants River basin in South Africa to serve further stations. There are hydropower stations at Muela Dam (76 MW) in Lesotho, and at Gariep (360 MW) and Vanderkloof (240 MW) dams in South Africa. The South African stations are used for peaking power at relatively low load factors.

There is potential on the South African side to develop irrigation, especially for emerging farmers. In Lesotho, considerable development is planned for the Lowlands area and also for further transfers from the Lesotho Highlands Water Project. The Lesotho Highlands Water Project transfers water from Lesotho to South Africa and represents one of the largest water transfer schemes in the world. The option for water transfers from Lesotho via South Africa to Botswana is currently being explored.

Arnot Power Station, Middelburg, South Africa

The urban and industrial demands are geographically concentrated in the upper, eastern parts of the basin, mostly in the Vaal sub-basin, which forms the economic hub of South Africa and, indeed, the southern African sub-region. Historically and currently, the Orange–Senqu basin, and specifically the Vaal sub-basin, have provided the source of water, minerals and energy on which economic development in the region has been based. In spite of the significant development and high socio-economic expectations in this area, the greatest quantities of water are used in the agricultural sector for crop irrigation.

As part of a recent study carried out on behalf of ORASECOM, the area under irrigation within the basin was estimated using a combination of already available databases and the feature mapping of satellite imagery. The total area under irrigation was estimated at 385,321 ha, considerably up on previous estimates. Relatively low-value field crops, such as maize, wheat and fodder crops, such as lucerne, make up over 80 per cent of irrigated crops in the basin. Higher value field crops, such as potatoes, vegetables and certain annual fruit crops, such as sweet melon, make up only about 10 per cent. The move to higher-value orchard and vine crops which tend to be more water efficient and provide a significantly higher net financial return per unit of irrigation water, make up less than 10 per cent of irrigated crops.

The combined effect of abstraction and evaporation is a reduction in the natural runoff by more than 50 per cent. Demand for water is predicted to further increase with economic growth and development in all countries and across different economic sectors (for example new mining operations in all four countries, expansion of irrigation mainly in Lesotho and Namibia, etc.) affirming the need for effective water resources management to maintain these important ecological functions, secure the basin's resources in the long term and ensure sustainability.

The reduction in flow and change of the frequency, size and duration of floods and changing land-use practices adversely affect the quality of the water, the health of the river and the resources and ecosystems it supports, as well as the services these provide.

Several areas of the basin are significant for their biodiversity and importance to conservation. The Drakensberg–Maloti Mountain area is a biodiversity hotspot of high-altitude flora, of which 30 per cent of an estimated 3,100 species is endemic to this area. This endemic zone also supports an extensive network of high altitude wetland bogs and sponges, crucial in the hydrological cycle of the Senqu River. The Lower Orange River passes through the Succulent Karoo biome which contains the highest diversity of arid flora globally and is also a declared biodiversity hotspot. In addition, the river basin supports a number of declared Ramsar sites – wetlands of international importance – including the Orange–Senqu River mouth, shared between Namibia and South Africa. Other Ramsar sites in the Orange–Senqu River basin include Barberspan, Blesbokspruit and Seekoeivlei Nature Reserve in South Africa and Lets'eng-la-Letsie in Lesotho. The Kgalagadi Transfrontier Park features eco-tourism, biodiversity and veld products. Some of these areas and others are protected through the national protected area networks of each country and three transboundary co-management areas in the basin.

As a result of development and high rates of abstraction, some of these wetlands and areas of conservation importance are under threat. The volumes of water and frequency and timing of floods have been altered. Furthermore, water quality is impaired in many areas by seepage, runoff and point-source discharges of municipal, industrial and agricultural effluents, and by high sediment loads from land degradation in many areas of the basin.

In many areas, the largest threats to terrestrial and aquatic environments are poverty and lack of development rather than development itself. In the past, while population

densities remained within certain limits, traditional farming practices and livelihoods coexisted with the environment in a relatively stable way. However, it is now increasingly clear that in many of the most degraded parts of the basin, the two most important driving forces of land degradation are limited land resources and population increase. The result is small farms or more limited access to smaller areas of communal land, low production per person and increasing landlessness.

The shortage and skewed distribution of land and associated resources, such as forest and woodland, together with poverty, lead to non-sustainable land management practices, which is one of the direct causes of degradation. Poor farmers are driven to clear forests, cultivate steep slopes without conservation, overgraze rangelands and make unbalanced fertiliser applications. In many cases the biomass residue that should be used for fertilisation is used as fuel instead, for want of an affordable alternative. The environmental and socio-economic linkages under land use are clear: any solution to land degradation will require solutions to the basic socio-economic development challenges that define poverty in the worst-hit areas.

Only integrated planning of water resources at the basin level can address the environmental and socio-economic development needs in the basin. Consequently, integrated, inter-country efforts are urgently required to comprehensively evaluate the degree of ongoing degradation of the Orange–Senqu and to take action to halt and reverse damaging trends where necessary. The governments of the four basin states are well aware of the critical scarcity of water resources in the basin and are committed to working together to protect these shared water resources and develop them in a sustainable and equitable way for the benefit of all their people. To this end, the Orange–Senqu River Commission (ORASECOM) was established through a formal agreement between the four basin states in 2000. The Commission advises its member states on the development, utilisation and conservation of the water resources of the basin.

1.7 GOVERNANCE FRAMEWORK

ORASECOM

ORASECOM was established by international agreement signed in November 2000 by the governments of Botswana, Lesotho, Namibia and South Africa to promote equitable and sustainable development of the water resources of the Orange–Senqu River basin. It was the first agreement to establish an international river basin institution on a shared river in the Southern African Development Community (SADC) since the Revised SADC Protocol on Shared Watercourses was signed.

The highest body of ORASECOM is the Council consisting of delegations from each country, supported by various 'Task Teams', and a Secretariat. The Council serves as technical adviser to the member states on matters related to development, utilisation and conservation of water resources of the Orange–Senqu basin. The Secretariat, established by agreement in 2006 and hosted in South Africa, coordinates ORASECOM activities, implements ORASECOM decisions and is the focal point of the institution.

ORASECOM provides a forum for consultation and coordination between its member states to promote integrated water resources management (IWRM) within the Orange–Senqu River basin. The IWRM approach helps to manage and develop water resources in a sustainable and balanced way, taking account of social, economic and environmental interests. A primary mechanism of achieving IWRM in the Orange–Senqu River basin is the development of a basin-wide IWRM Plan that will provide the cooperation framework for the management and development of water and related resources. The Action Plans and this SAP form the environmental component of that plan.

Applicable international agreements

In addition to the ORASECOM Agreement, the states have concluded several bilateral water management agreements between them (Table 7). Furthermore, all of the ORASECOM states are party to the main international conventions on environmental matters and consequently have the obligations *inter partes* that these conventions create.

Table 7: International agreements relevant to Orange–Senqu River basin management

Water agreements	Year	Type
Treaty on the Lesotho Highlands Water Project between the Government of the Republic of South Africa and the Government of the Kingdom of Lesotho	1986	Bilateral
Samewerkingooreenkoms Tussen die Regering van die Republiek van Suid-Afrika en die Oorgangsregering van Nasionale Eenheid van Suidwes-Afrika/ Namibie Betreffende die Beheer, Ontwikkeling en Benutting van die Water van die Oranjerivier	1987	Bilateral
Protocol I to the Treaty on the Lesotho Highlands Water Project: Royalty Manual	1988	Bilateral
Protocol II to the Treaty on the Lesotho Highlands Water Project: SACU Study	1988	Bilateral
Protocol III to the Treaty on the Lesotho Highlands Water Project: Apportionment of the Liability for the Costs of Phase 1A Project Works	1988	Bilateral
Protocol IV to the Treaty on the Lesotho Highlands Water Project: Supplementary Arrangements Regarding Phase 1A	1991	Bilateral
Agreement between the Government of the Republic of South Africa and the Government of the Republic of Namibia on the Establishment of a Permanent Water Commission	1992	Bilateral
Agreement on the Vioolsdrift and Noordoewer Joint Irrigation Scheme between the Government of the Republic of South Africa and the Government of the Republic of Namibia	1992	Bilateral
Ancillary Agreement to the Deed of Undertaking and Relevant Agreements Entered into Between the Lesotho Highlands Development Authority and the Government of the Republic of South Africa	1992	Bilateral
Protocol V to the Treaty on the Lesotho Highlands Water Project: Supplementary Arrangements with Regard to Project Related Income Tax and Dues and Charges Levied in the Kingdom of Lesotho in Respect of Phases 1A and 1B of the Project	1999	Bilateral
Protocol VI to the Treaty on the Lesotho Highlands Water Project: Supplementary Arrangements Regarding the System of Governance for the Project	1999	Bilateral
Agreement between the Governments of the Republic of Botswana, the Kingdom of Lesotho, the Republic of Namibia and the Republic of South Africa on the Establishment of the Orange–Senqu River Commission (ORASECOM)	2000	Multilateral
SADC Revised Protocol on Shared Watercourses	2003	Multilateral
OTHER ENVIRONMENTAL AGREEMENTS		
UN Framework Convention on Climate Change (UNFCCC)	1992	Multilateral
UN Convention on Biodiversity (UNCBD)	1993	Multilateral
Convention on Wetlands of International Importance Especially as Waterfowl Habitat (Ramsar)	1994	Multilateral
UN Convention on the Combating of Desertification (UNCCD)	1996	Multilateral
Kyoto Protocol (to the UNFCCC)	1997	Multilateral
TRANSFRONTIER NATIONAL PARK AGREEMENTS		
Bilateral agreement between the Government of the Republic of Botswana and the Government of the Republic of South Africa on the Recognition of the Kgalagadi Transfrontier Park	1999	Bilateral
Memorandum of Understanding between the Government of the Kingdom of Lesotho and the Government of the Republic of South Africa in Respect of the Maloti–Drakensberg Transfrontier Conservation and Development Area	2001	Bilateral
Treaty between the Government of the Republic of Namibia and the Government of the Republic of South Africa on the establishment of the /Ai-/Ais–Richtersveld Transfrontier Park	2003	Bilateral

The member states

Botswana is a democratic republic with a two-sphere government system comprised of national (or central) government and local government. Central government is responsible for developing and overseeing implementation of national level policy and legislation. The country is at present (2012–2014) undergoing a major water sector reform process, including the development of a new water act. The draft Water Bill, once enacted, will replace the currently applicable 1968 Water Act. The National Water Policy (2012) was

established as part of a reform initiative to provide guidance to all economic sectors that are custodians and/or users of water resources in Botswana. Botswana has also developed an IWRM Plan. The reform brings significant changes to the roles of various organisations in the water sector, including a reallocation of responsibilities between the country's water institutions. The Department of Water Affairs will be responsible for protecting, planning and developing water resources. The Botswana Energy and Water Regulatory Authority will deal with licensing and tariffs. The Water Resources Board will be an advisory body to the Minister on water matters and will allocate water resources among users, monitor water resources and develop water resources management policy. The Water Utilities Corporation will be responsible for water supply functions.

Lesotho is a constitutional monarchy, with a King as the head of state and a Prime Minister as the head of a democratically elected government. The country has two spheres of government: central and local. The management of water resources in Lesotho is governed by the Water Act (2008) which provides for the management, protection, conservation, development and sustainable utilisation of water resources in the country. It has IWRM-based water legislation that explicitly recognises obligations from international agreements. However, the lack of an IWRM Plan prevents coordinated implementation of the IWRM strategy. Currently, there are no catchment (or sub-catchment) management institutions. The Environment Act, although enacted in 2001, has not yet been enforced, largely due to a lack of regulations.

Namibia is a democratic republic with three independent spheres of government – national, regional and local. The Namibian legislative framework and institutional landscape for water resources management has undergone a transition towards an IWRM-based approach. However, the Water Resources Management Act (2004) was promulgated but never carried out. It has now been replaced by the new Water Resources Management Act (No 11 of 2013) that was promulgated in December 2013. The Department of Water Affairs and Forestry is responsible for the administration of water affairs and management of water resources. Basin management committees have been established for the major basins in the country. The Namibia Water Corporation is the national supplier of water in bulk. The Directorate of Water Supply and Sanitation Coordination and local government provide potable water services. The water management governance framework is complemented by a relatively strong framework for the management of other natural resources, such as land, biodiversity and protected areas. Recently, a comprehensive climate change policy was developed.

South Africa is a constitutional parliamentary democracy with three spheres of government: national, provincial and local. The National Water Act (No. 36 of 1998) establishes the principle that as the public trustee of the nation's water resources, the national government, acting through the Minister of Water and Environmental Affairs, ensures that water is protected, used, developed, conserved, managed and controlled in a sustainable and equitable manner, for the benefit of all persons and in accordance with its constitutional mandate. Significantly, the Act makes specific provision for South Africa to meet its international water obligations. South African water management legislation is firmly rooted in the principles of IWRM. The National Water Act requires the preparation of the National Water Resources Strategy, the second of which is currently in operation. The process of establishing catchment management agencies for the Water Management Areas in the country is ongoing. The National Environmental Management Act of 1998 further provides for integrated resource management.

Winters can be extremely cold in Lesotho, especially in the highlands, as shown by this frozen stream.

2. PRIORITY WATER-RELATED ENVIRONMENTAL CONCERNS

2.1 INTRODUCTION

The TDA analysed and prioritised water-related problems in the Orange–Senqu River basin. It found that the problems identified were mostly transboundary in nature. The dual effect of human influences and often fragile ecosystems had resulted in a deterioration of the basin's aquatic ecosystems. The functioning of wetlands, riverine habitats, the estuary and groundwater are impaired virtually throughout the basin. This has socio-economic consequences related to the loss of goods, services and opportunities that these ecosystems would otherwise provide.

The SAP is developed around the four priority areas of concern identified by the TDA, namely:

- Increasing water demand
- Declining water resources quality
- Changes to the hydrological regime
- Land degradation.

There is no hierarchy of severity of the four priority areas of concern in the SAP, as each is evident at different degrees of scale and severity in the basin. Therefore, in terms of the SAP, all four areas are treated equally as far as their relevance to the basin as a whole is concerned. Where differences in scale and severity occur, prioritisation is made at individual basin-state level through the Action Plans, so that the Action Plans are targeted appropriately to the important issues of each particular country. An overview of national level prioritisation in the four basin states is shown in Table 8.

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A pristine stream in Lesotho

Table 8: TDA priority areas of concerns in order of priority per basin state

Country	TDA problem areas relevant to individual basin states – order of priority per basin state
Botswana	1 Increasing water demand
	2 Land degradation
	3 Declining water resources quality
	4 Changes to the hydrological regime
Lesotho	1 Land degradation
	2 Declining water resources quality
	3 Changes to hydrological regime – with special emphasis on wetlands degradation
	4 Increasing water demand
Namibia	1 Increasing water demand
	2 Changes to the hydrological regime
	3 Declining water resources quality
	4 Land degradation
South Africa	1 Declining water resources quality
	2 Increasing water demand
	3 Changes to the hydrological regime
	4 Land degradation

Opposite page: Donkeys at a pan near Zutshwa, Botswana. Seasonal surface waters are an important source of water for livestock and wildlife.

2.2 INCREASING WATER DEMAND

The volume of water currently reaching the mouth of the Orange–Senqu is estimated to be approximately 4,200 Mm^3/a, which represents less than half of the annual natural flow, estimated at approximately 11,300 Mm^3. Water is abstracted for irrigation, industry and mining, urban use and livestock farming.

Increasing the usable yield from the system to meet increasing demand will require extensive infrastructure. As the easy (and less costly) options have already been used, demand-side interventions, such as water conservation, demand management, re-use of water, desalination, rainwater harvesting, etc. need to be further explored and implemented through an integrated approach.

In the face of increasing demand, the ecosystems are at risk. This is aggravated by inadequate knowledge of flows and a deteriorating monitoring system. This applies to an even greater extent to groundwater.

Cross-cutting issues related to assuring water supply that contribute to the problem are:
- inefficient use across most (all) water-use sectors;
- losses of water due to poor maintenance and aging infrastructure;
- a limited appreciation of the value of water among many users; and
- insufficient demand-management interventions and incentives to use less water.

Additional transboundary elements which contribute to the problem are:
- the transfer of water out of the system;
- deteriorating water quality;
- limited research and implementation of alternative sources and improved technologies; and
- reduced recharge to groundwater.

Botswana has not contributed surface water to the main stream in recent history and it has little influence on transboundary surface water resources. The Orange–Senqu is a source of water for south-western Botswana through the Middelputs scheme. Recently, feasibility studies have been carried out into transfers from the Lesotho Highlands area to Botswana. The basin area in Botswana is currently fully reliant on groundwater sources, including the transboundary aquifer, to meet its water requirements. Improving understanding of groundwater resource potential is therefore important.

In *Lesotho*, the demand for water is relatively low in relation to the available resources. Historically, irrigation has not been extensively practised. However, due to climate change risks and vulnerabilities, particularly in respect of increasing uncertainty of the timing and distribution of rainfall events, this could change. The development of the Lesotho Highlands Water Project, which transfers water from reservoirs in Lesotho to the Vaal River sub-basin, has a significant impact on the river downstream. Furthermore, inadequate management of the catchment and resultant erosion in Lesotho contributes to sedimentation and loss of storage capacity of reservoirs in Lesotho and downstream in South Africa. Degraded wetlands in the Lesotho Highlands have reduced water storage capacity.

Namibia has identified increasing demands for water from the Orange–Senqu River basin as a priority concern. The quantification of inter-basin transfers, questions around water balance and limited understanding of resource potential, especially related to groundwater, are key issues. Agricultural development priorities, such as the promotion of agricultural production for food self-sufficiency and employment creation, were recognised as contributing to increasing demand for water in the basin.

In *South Africa*, population growth coupled with urbanisation and an increase in the supply of water and sanitation to domestic consumers places pressure on the system.

Thirsty swimming pools, lawns and leafy gardens are typical of the more-affluent suburbs of Johannesburg, Gauteng, South Africa.

Growth in most economic sectors is expected to add to this pressure over time. While no significant increase of irrigated agriculture is expected, there is scope for improving efficiency in areas currently under irrigation.

2.3 DECLINING WATER RESOURCES QUALITY

The key water quality issues in the Orange–Senqu River basin have been identified as: nutrient enrichment, primarily linked to increased phosphorus and nitrogen concentrations; increased salinity from acid mine drainage and irrigation return flows; microbial contamination from urban settlements and poorly operated sewage treatment works; and changes in sediment load. In addition, radionuclides, heavy metals and persistent organic pollutants, while they do not currently pose a basin-wide risk, do show high concentrations in certain localised areas and precautions should be taken. Although a common problem throughout the basin, pollution and declining water quality is most severe in the Vaal sub-basin (in South Africa).

At a time when the types and sources of pollution are increasing, reduced volumes of water in the basin prevent their effective dilution, compounding the problem of deteriorating quality of water resources.

The problem can be largely attributed to certain cross-cutting issues: cost; lack of awareness and lack of incentives to adopt best practices; aging and poorly maintained infrastructure; limited monitoring and ineffective enforcement of compliance; and inadequate closure of mines.

Key elements related to declining water resources quality include:

- eutrophication
- increased salinity and sodicity of soils and water
- localised hotspots of heavy metals, persistent organic pollutants, radionuclides and polycyclic aromatic hydrocarbons
- acid mine drainage
- increasing concentrations of drug remnants
- inadequate systematic monitoring of surface and subsurface water quality
- inadequate enforcement of compliance to water and resource quality standards and implementation of corrective actions

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Increased nutrients in the water encourages the growth of algae, which in turn reduces oxygen content and stream health.

- high cost of appropriate pollution control
- lack of knowledge, capacity and awareness related to pollutants and appropriate measures to deal with them
- increased costs related to water treatment
- health risks
- lack of a basin-wide accident and pollution warning system.

National level surface water quality was not identified as the highest priority for Lesotho, although it does occur in certain hotspots. There are heavy metal pollution problems in the Fish River in Namibia. Overall, the scale of the problem is by far the greatest in South Africa which is more industrialised and has high population pressures. Pollution from the Vaal River sub-basin flows downstream and becomes an international issue where the Orange–Senqu River forms the border between Namibia and South Africa. Six particularly severe problem areas were identified:

1 acid mine drainage in the upper and potentially middle Vaal sub-basin;
2 microbial pollution, for example, at the Vaal Barrage, and treating blue-green algal blooms;
3 inadequate sanitation services, non-functioning sewerage and wastewater treatment works, raw sewage inflows and other waste management threats to surface and subsurface resources related to human settlement, for example, at Christiana and Warrenton on the Lower Vaal;
4 high concentration of persistent organic pollutants at Bloemhof Dam and Barberspan, and leaching of agrochemicals generally; habitat loss and environmental degradation of the estuary;
5 alluvial mining of diamonds and sand extraction (often illegal and uncontrolled) in the middle and lower Orange between Warrenton and Douglas, and Windsorton and Prieska; and
6 current groundwater quality in isolated places around Pofadder and De Aar, for example, as well as the potential threat to groundwater sources from hydraulic fracturing.

In terms of groundwater, Botswana has identified salinity and pollution threats to aquifers as an increasing concern.

2.4 CHANGES TO THE HYDROLOGICAL REGIME

As a result of upstream development, the hydrological regime of the river has changed significantly. Apart from the mean annual runoff being reduced to half the estimated natural flow, the pattern of flow is different to that of the natural river. There is less variability in flow from one year to the next and, within the year, there is a less distinct seasonal pattern. The frequency of smaller floods has also been reduced, with most being absorbed by upstream abstraction and storage.

There is less water in the system to dilute increasing volumes and types of contaminants, reduced and altered patterns of flow and flushing, and changes in sediment load and balance and river morphology along its length. These changes in the hydrological regime of the river impact downstream ecosystems, including the estuary (a Ramsar site) resulting in a loss of ecosystem services. Environmental flow requirements need to be adequately addressed.

The changes in hydrological regime can be attributed to storage and release or transfer of water to meet significant demands at areas and times when water would otherwise not be available. In assuring that these demands are met, disruption of the natural flow of the river compromises the integrity of downstream aquatic ecosystems and the services they provide. The quality of water resources deteriorates and pests and invasive species increase. By providing opportunities in some areas by assuring water supply, other options and potential opportunities are lost, especially those reliant on healthy wetland

habitats and natural resources related to them. In addition, direct costs related to water treatment, environmental management and disease control increase.

In Lesotho, important services provided by the Highland sponges related to flood attenuation and slow release of water in the Highlands are being lost through land degradation.

Namibia and South Africa experience the effects of changes to the hydrological regime, which are felt most severely at the Orange–Senqu River estuary.

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Lets'eng-la-Letsie, the Ramsar site at the source of the Quthing River in Lesotho is under threat from overgrazing and trampling by livestock.

2.5 LAND DEGRADATION

Inadequate land management associated mostly with agriculture and mining in parts of the Orange–Senqu basin has led to loss of wetland storage and aquifer recharge, increased sediment loads, deteriorating quality of water resources, increased distribution and abundance of alien invasive plants, loss of biodiversity and diminished land productivity. At a time when increasing numbers of people are faced with dividing the land into smaller pieces, they are also faced with it being less productive. In some parts of the basin, livestock production is in decline, and opportunities for community-based management of natural resources and alternative livelihood options are inadequately considered. Land degradation is generally perceived to be a problem in the basin and Botswana and Lesotho consider addressing it a high priority: land use should be optimised sustainably.

The problem is driven by a number of underlying factors related to a lack of integrated planning, insufficient understanding of ecosystems, inadequate policy harmonisation, limited alternative livelihood options, population pressures, land tenure, contradictory statutory and traditional rules and poor rehabilitation practices in construction and mining industries. A conflict of interest between interventions aimed at poverty eradication and ecosystem health is a common issue in all four basin countries, as well as issues around tenure systems and dual grazing rights.

Key transboundary elements to this problem include:

- loss of land and infrastructure due to erosion;
- decreased wetland storage potential;
- reduced groundwater recharge;
- reduced water quality in rivers and reservoirs;
- increased abundance of alien invasive plants;
- decreased potential for land productivity; and
- poor coordination and lack of integration between development, and water and environmental sectors.

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3. THE ACTION PROGRAMME

3.1 SAP OBJECTIVES, TARGETS AND INTERVENTIONS

To address the priority problem areas identified by the TDA, through the Action Plan/ SAP consultation process, countries have collectively set basin-wide objectives and targets to be met over a ten-year period. These basin-wide targets are complemented by agreed Action Plan objectives and targets which address the problems at national level. In other words, the SAP objectives and targets and the interventions developed provide the transboundary elements to address the priority problems. SAP objectives and targets cannot be achieved through national action alone and instead require coordinated action within and by several, or more often all, basin states.

The following SAP objectives and targets have been developed.

3.2 INCREASING WATER DEMAND

The SAP objective for addressing the priority problem of increasing water demand is:

The basin-wide understanding of available resources is further enhanced and water-use efficiency is improved.

The following targets for addressing the problem have been identified:

Target 1	Improved basin-wide hydrometeorological and geohydrological monitoring systems are established and data shared by the member states.
Target 2	Recommendations for transboundary environmental assessments are reviewed and adopted by the basin (member) states.
Target 3	Pilot initiatives for improving on-farm water efficiency are upscaled and implemented in priority areas.
Target 4	Potential for alternative options to meet water demand (demand management, expanded wastewater treatment, conjunctive re-use of surface and groundwater, etc.) in the basin have been defined.
Target 5	Understanding of groundwater use potential enhanced and efficiency of use improved.

Left: Hardap Dam, on the ephemeral Fish River, Namibia

Opposite page: *Prosopis*, an alien plant that invades ephemeral watercourses and floodplains in the drier western areas of the basin

Flooding of Mariental in 2000 and 2006 was, in part, attributed to the dense reed growth in the Fish River below the dam at Hardap Irrigation Scheme. The growth of the reeds is an indication that the return flows from the irrigation scheme are high in nutrients. One initiative to help avoid flooding of the town again has been to clear the watercourse of reeds. This would, however, not address the underlying water quality issue.

3.3 DECLINING WATER RESOURCES QUALITY

The SAP objective for addressing the priority problem of declining water resources quality is:

The water resources quality within the basin is improved.

The following targets for addressing the problem have been identified:

Target 1	Basin-wide water resources quality objectives defined and monitoring system established/enhanced.
Target 2	Tools/incentives for reduced agrochemical application in the agriculture sector developed and implemented in pilot areas.
Target 3	Innovative methods for water resources quality improvements identified and implemented in pilot sites.

3.4 CHANGES TO THE HYDROLOGICAL REGIME

The SAP objective for addressing the priority problem of changes to the hydrological regime is:

The adverse effects of the changed hydrological regime are mitigated.

The following targets for addressing the problem have been identified:

Target 1	Basin-wide environmental flows regime agreed and implementation ongoing.
Target 2	Integrated management plan for the Orange–Senqu River mouth (Ramsar site) developed and implementation ongoing.

3.5 LAND DEGRADATION

The SAP objective for addressing the priority problem of land degradation is:

The adverse effects of catchment degradation are reduced and the sustainability of land use is improved.

The following targets for addressing the problem have been identified:

Target 1	Local-level monitoring systems for rangeland conditions (including alien invasive species) developed and implemented.
Target 2	Catchment-protection initiatives upscaled and implemented in priority areas across the basin.
Target 3	Suitable rehabilitation methods and technologies for degraded areas of significance developed and implemented.
Target 4	Monitoring systems relevant to climate change maintained.

Summary of SAP targets, interventions and overview of project concept notes

	SAP targets	Proposed interventions	Action Plan/SAP project concept note	Related, ongoing initiatives	Relevant agreements/ policies/strategies
PRIORITY AREA 1: INCREASING WATER DEMAND					
Objective: The basin-wide understanding of available resources is further enhanced and water-use efficiency improved					
Target 1	Improved basin-wide hydrometeorological and geohydrological monitoring systems are established and data shared by the member states	Water monitoring (quantity and quality) networks of rainfall, flow, groundwater levels and water metering improved; data captured, analysed, modelled and findings distributed	SAP PCN 1: ORASECOM information and knowledge management	ORASECOM Water Information System	Revised SADC Protocol on Shared Watercourses ORASECOM Agreement
Target 2	Recommendations for transboundary environmental assessments are developed, reviewed, refined and adopted by the basin (member) states	Basin-wide transboundary environmental assessment guidelines developed	SAP PCN 1: ORASECOM information and knowledge management	Stampriet transboundary groundwater investigation (UNESCO) Study on environmental flow requirements for Orange and Fish rivers Transboundary water quality monitoring (European Union, GEF, DWAF)	Revised SADC Protocol on Shared Watercourses ORASECOM Agreement
Target 3	Pilot initiatives for improving on-farm water efficiency are upscaled and implemented in priority areas	Establish appropriate technology to measure water abstraction effectively and accurately Develop appropriate incentives to motivate irrigators to improve water-use efficiencies Develop awareness-raising and training programmes on irrigation water demand management and water-use efficiency approaches	Namibia Action Plan PCN 3: Water conservation and demand management in the irrigation sector South Africa Action Plan PCN 4: Water conservation and demand management in the irrigation sector	SADC IWRM pilot project in Keetmanshoop on water re-use	NamWater Demand Management and Water Use Efficiency Strategy, 2012 South Africa NWRS II Agreement on the Vioolsdrift and Noordoewer Joint Irrigation Scheme between the Government of the Republic of South Africa and the Government of the Republic of Namibia
Target 4	Potential for alternative options to meet water demand (increased storage, demand management, expanded wastewater treatment, conjunctive re-use or surface and groundwater, etc.) in the basin have been defined	Integrate the management and use of groundwater and surface water resources	SAP PCN 2: Groundwater management and use Botswana Action Plan PCN 2: Improved fresh water availability and knowledge of groundwater potential Lesotho Action Plan PCN 4: Improvement of groundwater management in selected aquifers within the Central Mohokare sub-catchment Namibia Action Plan PCN 1: Improving groundwater resources management to enhance water supply in the Nossob–Auob sub-basin Namibia Action Plan PCN 2: Improving water-use efficiency and demand management in local authorities	Lesotho Highlands Water Project	Revised SADC Protocol on Shared Watercourses ORASECOM Agreement Treaty on the Lesotho Highlands Water Project between the Government of the Republic of South Africa and the Government of the Kingdom of Lesotho

	SAP targets	Proposed interventions	Action Plan/SAP project concept note	Related, ongoing initiatives	Relevant agreements/ policies/strategies
Target 5	Understanding of groundwater use potential enhanced and efficiency of use improved	Identify the threats and issues to groundwater resources that need to be alleviated by basin-wide management Identify and agree on a uniform groundwater resources management system Establish shared governance of the groundwater resources within the basin	SAP PCN 2: Groundwater management and use Botswana Action Plan PCN 2: Improved fresh water availability and knowledge of groundwater potential Lesotho Action Plan PCN 4: Improvement of groundwater management in selected aquifers within the Central Mohokare sub-catchment Namibia Action Plan PCN 1: Improving groundwater resources management to enhance water supply in the Nossob–Auob sub-basin	UNESCO Transboundary aquifer study	Revised SADC Protocol on Shared Watercourses ORASECOM Agreement Namibia IWRM Plan Botswana National Water Policy
PRIORITY AREA: DECLINING WATER RESOURCES QUALITY					
Objective: The water resources quality within the basin is improved					
Target 1	Basin-wide water resources quality objectives defined and monitoring system established	Basin-wide water resources quality guidelines developed Basin-wide water resources quality monitoring regime refined, agreed and implemented	SAP PCN 1: ORASECOM information and knowledge management South Africa Action Plan PCN 1: Monitoring priority chemical pollutants	Namibia transboundary water quality monitoring (European Union, GEF, DWAF) E-flows (Fish and Orange) by ORASECOM	Revised SADC Protocol on Shared Watercourses ORASECOM Agreement
Target 2	Tools/incentives for reduced agrochemical application in the agriculture sector developed and implemented in pilot areas		South Africa Action Plan PCN 2: Mitigation of impact of agricultural sector on water quality		
Target 3	Innovative methods for water quality improvements identified and implemented in pilot sites		Botswana Action Plan PCN 4: Treatment and re-use of wastewater Lesotho Action Plan PCN 2: Management of water resources quality in Central Mohokare sub-catchment Namibia Action Plan PCN 4: Improvement of water quality management and pollution control South Africa Action Plan PCN 3: Support for wastewater treatment upgrade		Botswana National Water Policy Lesotho Water Policy, 2007 South Africa NWRS2 Namibia National Water Policy, 2000
PRIORITY AREA 3: CHANGES TO HYDROLOGICAL REGIME					
Objective: The adverse effects of the changed hydrological regime are mitigated.					
Target 1	Basin-wide environmental flows regime agreed and implementation ongoing	Synchronise existing environmental flows studies Refine and agree on basin-wide environmental flows scenarios Agreed scenarios implemented and monitored on ongoing basis	SAP PCN 3: Basin-wide environmental flows regime	E-flows (Fish and Orange rivers) by ORASECOM	Revised SADC Protocol on Shared Watercourses ORASECOM Agreement

	SAP targets	Proposed interventions	Action Plan/SAP project concept note	Related, ongoing initiatives	Relevant agreements/ policies/strategies
Target 2	Integrated management plan for the river mouth (Ramsar site) developed and implementation ongoing	Remove man-made structures in the floodplain and mouth area of Orange–Senqu River Align fishing legislation and compliance initiatives on both South African and Namibian sides of the estuary Verify the origin of the elevated nutrients below Vioolsdrift/Noordoewer and implementing agricultural best practice to reduce input	SAP PCN 4: Orange–Senqu River mouth management	Lower Orange River Operational System (South Africa)	Draft Orange River Mouth Management Plan Revised SADC Protocol on Shared Watercourses ORASECOM Agreement Namibian National Water Policy, 2000 Convention on Wetlands of International Importance Especially as Waterfowl Habitat (Ramsar site)
PRIORITY AREA 4: LAND DEGRADATION					
Objective: The adverse effects of catchment degradation are reduced and the sustainability of land use is improved					
Target 1	Local level monitoring systems for rangeland conditions (including alien invasive species) developed and implemented	Development of rangeland monitoring indicators Establishment of rangeland monitoring system	SAP PCN 1: ORASECOM information and knowledge management	Removal of *Prosopis* in collaboration with Kalahari–Namib/European Community project in Botswana	UN Convention on Biodiversity (UNCBD)
Target 2	Catchment protection initiatives upscaled and implemented in priority areas across the basin	Strengthening of institutional frameworks for effective catchment management Rehabilitation of degraded rangelands and wetlands Improvement of ecosystem services functioning of catchments	SAP PCN 4: Orange–Senqu River mouth management SAP PCN 5: Control of alien invasive species Botswana Action Plan PCN 3: Conservation and sustainable land Addressing: Sustainable natural resources use practices for livelihoods improvements Botswana Action Plan PCN 5: Integrated community-based natural resources management for Kgalagadi District (OSB) Lesotho Action Plan PCN 1: Integrated catchment management in the Lower Mohokare sub-catchment Lesotho Action Plan PCN 3: Upscaling of the ORASECOM demonstration rangeland management project for sustainable management of Lets'eng-la-Letsie (Ramsar site) Namibia Action Plan PCN 5: Control of invasive species through integrated management in a pilot area in the Orange–Fish River basin, Namibia Namibia Action Plan PCN 6: Alternative land-use options for improved rangeland conditions and sustainable livelihoods South Africa Action Plan PCN 5: Complementary support for LandCare Programme	Protection of the Orange–Senqu Water Sources – Sponges Project in Lesotho ORASECOM Rangeland Demonstration Project in Mount Moorosi in Lesotho	UN Convention on the Combating of Desertification (UNCCD) UN Convention on Biodiversity (UNCBD) Convention on Wetlands of International Importance Especially as Waterfowl Habitat (Ramsar site) Bilateral Agreement between the Government of the Republic of Botswana and the Government of the Republic of South Africa on the Recognition of the Kgalagadi Transfrontier Park Memorandum of Understanding between the Government of the Kingdom of Lesotho and the Government of the Republic of South Africa in Respect of the Maloti–Drakensberg Transfrontier Conservation and Development Area Treaty between the Government of the Republic of Namibia and the Government of the Republic of South Africa on the Establishment of the /Ai-/Ais–Richtersveld Transfrontier Park

	SAP targets	Proposed interventions	Action Plan/SAP project concept note	Related, ongoing initiatives	Relevant agreements/ policies/strategies
Target 3	Suitable rehabilitation methods and technologies for degraded areas of significance developed and implemented	Development of sustainable land management tools and guidelines Awareness raising on sustainable land management practices Application of sustainable land management practices to reduce degradation	SAP PCN 4: Orange–Senqu River mouth management SAP PCN 5: Control of alien invasive species Botswana Action Plan PCN 3: Conservation and sustainable land Addressing: Sustainable natural resources use practices for livelihoods improvements Botswana Action Plan PCN 5: Integrated community-based natural resources management for Kgalagadi District (OSB) Lesotho Action Plan PCN 1: Integrated catchment management in the Lower Mohokare sub-catchment Lesotho Action Plan PCN 3: Upscaling of the ORASECOM demonstration rangeland management project for sustainable management of Lets'eng-la-Letsie (Ramsar site) Namibia Action Plan PCN 5: Control of invasive species through integrated management in a pilot area in the Orange–Fish River basin, Namibia Namibia Action Plan PCN 6: Alternative land-use options for improved rangeland conditions and sustainable livelihoods South Africa Action Plan PCN 5: Complementary support for LandCare Programme		UN Convention on the Combating of Desertification (UNCCD) UN Convention on Biodiversity (UNCBD)
Target 4	Monitoring systems relevant to climate change maintained	Improvement of the hydrometeorological and geohydrological monitoring and modelling systems	SAP PCN 1: ORASECOM information and knowledge management		Revised SADC Protocol on Shared Watercourses ORASECOM Agreement UN Framework Convention on Climate Change (UNFCCC)

4 SAP IMPLEMENTATION

The SAP has been designed as a portfolio of project concepts. Funding is sought for each project, either individually or for a combination of projects. Potential funding sources are primarily national governments, international cooperation partners and the private sector.

In line with the project approach to the SAP, implementation is not through a central implementation agency responsible for the entire programme. Instead, implementation is project-specific. A proposed implementation mechanism at project level is described in each project concept note.

Overall coordination and monitoring of the SAP is through the ORASECOM Secretariat (where relevant, in conjunction with national government structures) using their established coordination and monitoring structures and systems. Close collaboration between the ORASECOM Secretariat and responsible national organisations is necessary in order to ensure coordination and monitoring between the implementation of SAP and Action Plan activities in the four basin states.

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Above: Martial eagle (*Polemaetus bellicosus*), Botswana

Below: A small-scale farm in Lesotho . Most of the population in Lesotho is dependent on the land for their livelihoods.

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ANNEXURE: SAP PROJECT CONCEPT NOTES

PROJECT CONCEPT NOTE 1: ORASECOM INFORMATION AND KNOWLEDGE MANAGEMENT

CORE DATA	
Project number	SAP PCN 1
Project title	ORASECOM information and knowledge management
SAP priority area	Cross-cutting, contributing to all four priority areas
Short description	The overarching aim of the project is the establishment of integrated environmental monitoring systems at the basin level. To this end, it supports the development of a basin-wide water resources quality monitoring system and other relevant environmental monitoring systems. A further emphasis of the project is on the maintenance and improvement of physical monitoring infrastructure, as well as the integration on knowledge and information management system into the ORASECOM Water Information System (WIS). These aims are complemented by the development of procedures (data sharing protocol, etc.) for knowledge and information sharing and targeted training of professionals on knowledge and information management and systems integration.
PROJECT RATIONALE	
Background	ORASECOM has the mandate to facilitate and promote water-related data and information sharing between riparian states to facilitate effective and efficient water resources planning and management of the Orange–Senqu River basin. Although the riparian states have their own initiatives regarding monitoring and data management, information and links to these data sources need to be shared. ORASECOM also facilitates donor-funded projects to add to the knowledge base and data collection to the benefit of the whole basin. Some of the riparian states also have some data that might require some management and sharing support which could possibly be provided by ORASECOM to the benefit of all basin states. For these and other reasons, ORASECOM developed data management systems to store their own and donor-funded projects and establish links to other data sources. One of these systems is the WIS. These systems are newly developed and need to be grown and maintained according to the needs of riparian states, and to support ORASECOM's mandate to facilitate data sharing.
Project objectives	1 A comprehensive environmental monitoring and observation network is operational at basin-wide level. 2 Basin-wide knowledge and information management is fully operational based on agreed protocols and through the integrated ORASECOM WIS.
Integration with relevant ongoing projects/ initiatives	This project will be a follow on to the initial development of the WIS to refine and update content and functionality of the system. It will also link up with all other future ORASECOM projects which might be required to manage the sharing of final deliverables via ORASECOM data-management systems.
Project outcomes	1 Basin-wide environmental monitoring networks established and maintained. 2 ORASECOM protocol for data exchange and sharing developed. 3 ORASECOM WIS enlarged and maintained. 4 Transboundary environmental assessment guidelines accepted and used by basin states. 5 Capacity of water resources management practitioners strengthened.

Flamigoes at Kamfers Dam, north of Kimberley, Northern Cape, South Africa. Originally an ephemeral pan, it now receives constant runoff and treated water from Kimberley and, since the construction of an artificial island, has become an important breeding site for lesser flamingoes (*Phoenicopterus minor*).

Technical approach

OUTCOME 1: BASIN-WIDE ENVIRONMENTAL MONITORING NETWORKS ESTABLISHED AND MAINTAINED

Output 1.1 Basin-wide water resources quality monitoring systems established

- Development of basin-wide water (resources) quality guidelines and monitoring systems.
- Periodic water resources quality monitoring and data sharing carried out, water resources quality year books, benchmarking of respective agencies in the basin.
- Identification and prioritisation of hotspots, pilot interventions on pollution control measures in basin states.

water resources quality is an all-embracing description of the water resource's quality through a combination of all its physical, chemical, biological and ecological characteristics. It is important to recognise that no single monitoring regime can lead to a comprehensive expression of water resources quality. It is thus necessary to implement and maintain different monitoring systems to provide information on different aspects of water resources quality.

A user-centric approach will be used in this project for the design of the water resources quality monitoring regime. The purpose of monitoring is defined as delivering the management information about water resources quality to water resource managers, planners and other stakeholders. Much effort should thus go into ensuring that the monitoring regime will deliver on the information requirements of its users.

In the design of a water resources quality monitoring regime for the Orange–Senqu River basin, it can pragmatically be assumed that the Orange–Senqu River basin monitoring regime will make use of data collected by basin states from their existing operational monitoring networks. The Orange–Senqu monitoring regime should thus largely be designed around the current monitoring sites and data that are currently collected. However, the sampling sites that will be selected and the water resources quality constituents that will be used will largely be determined by the interests of the end users.

The primary users and other decision-makers will be consulted in order to decide whether their needs can be better served by using a monitoring regime based on the reporting of water resources quality problems (e.g. salinity, eutrophication, microbial contamination as in the National Programmes of the South African Directorate Resource Quality Services), or by using a monitoring regime based on the reporting of specific water resources quality constituents (e.g. electrical conductivity, phosphorous, *Escherichia coli*). This decision has significant implications for the design of the monitoring network and also for the development of the water resources quality guidelines.

Basin-wide water resources quality guidelines will be produced that cater for all aspects of the water resources quality that have been incorporated in the monitoring regime. The guidelines will describe the effect on users of increasing degrees of water quality degradation.

Output 1.2 Environmental observation networks refurbished and maintained

- Assessment of monitoring networks and identification of key gaps to be addressed.
- Refurbishment of exiting priority stations in basin states (hydrometeorological and water quality), with particular focus on stations relevant for climate-change and transboundary water quality issues.

The environmental monitoring and observation networks (meteorological, hydrometeorological, geohydrological and others) have seen an overall decline in large parts of the basin over the recent decades. Consequently, monitoring data relevant for water resources and other natural resources management in the basin is no longer available to the desired or even required degree. There is an urgent need to refurbish the relevant monitoring and observation networks (stations) and maintain them at an appropriate level, based on an assessment of key gaps in the monitoring networks.

OUTCOME 2: TECHNICAL GUIDELINES FOR DATA EXCHANGE AND SHARING DEVELOPED

Any environmental monitoring system for the basin will make use primarily of data generated by the basin states for their own monitoring purposes. It is necessary to formalise arrangements for making the data available for basin-wide information sharing through ORASECOM.

In order to ensure that basin states accept and trust the data in the data base, it is necessary that the basin states agree on quality assurance/ quality control protocols regarding the sampling procedures, sample transport, preservation, analyses and data storage. It is also advisable that an inter-laboratory comparative testing scheme be introduced.

Procedures for content managers from donor organisations, ORASECOM and riparian states will be developed outlining the process and the minimum metadata that should be provided when contributing information to the WIS. Descriptions of typical metadata will also be provided.

Aspects of metadata standards, quality assurance procedures, etc. also need to be considered in the development of the data sharing protocol.

OUTCOME 3: ORASECOM WATER INFORMATION SYSTEM ENLARGED AND MAINTAINED

Output 3.1 ORASECOM WIS maintained and further enhanced

- Development of new functionalities, profiling of third party data custodians, grey literature archive, data wiki (a platform for general public to share their environmental observations, i.e. hydrometeorological, mini South African scoring system (miniSASS), etc.).

Although the WIS has been developed to be – as far as possible – a self-driven information repository, it is inevitable that the system will have to be maintained to ensure benefit to the users. A business case for the ongoing maintenance of the system will be developed. Also, the ongoing tasks for maintenance of the system will be identified and costs will be calculated both in terms of content management and technical maintenance of the site.

- The WIS and IT infrastructure's annual maintenance costs as well as the benefits of these assets will be assessed.
- Possible options for long-term sustainable support to the systems will be identified, e.g. prerequisite support for the WIS prescribed by ORASECOM to any donor organisations.
- The system and its role and benefits will be promoted to the ORASECOM Secretariat, member states and other affected parties.

Short-term updates to WIS functionality and population with key sourced data set will be carried out. Prioritised improvements to the WIS and key data sets will be identified. This activity will involve the following:

- key stakeholder interactions that will identify prioritised new functionality of the WIS, key data sets that need to be shared and issues with current content;
- maintenance and updating of the initial developed WIS system's according to user priority;
- obtaining and populating the system with user prioritised data sets; and
- costing of other functionality that was not seen as first priority for future consideration.

Output 3.2 Basin-wide environmental monitoring systems integrated into WIS

- Integration of environmental monitoring systems at the basin-level (water quantity and quality, biota, habitats), with particular focus on transboundary issues.

Procedural methods and guidelines for content managers from donor organisations, ORASECOM and riparian states.
This activity involves the development of procedures for content managers from donor organisations, ORASECOM and riparian states, outlining the process and the minimum metadata that should be provided when contributing information to the WIS. Descriptions of typical metadata will also be provided.

Determine user requirements and design an optimal monitoring network for operational, management and planning activities.
The activity will involve obtaining the following from riparian state stakeholders:

- Processes that require overarching reporting of monitoring information, such as planning and operational analyses. This will include water quality, water quantity (including use), flood and biological monitoring.
- Determine the critical parameters and sites which are required for effective future analyses in the Orange–Senqu basin.
- Determine the status of current hydrometrological and environmental monitoring that are taking place for the Orange–Senqu basin by the riparian states.
- Identify and prioritise the gaps in monitoring.
- Determine typical reporting for monitored information that could support annual report of the resources in the Orange–Senqu River basin.
- Design optimal monitoring network and determine status of data and access to the data.
- Make recommendations on how to improve the network by adding new stations and by making the data more accessible.

Implement interstate reporting of monitored data for optimal network.
This activity will involve the designing and implementation of functionality for the WIS that will provide an integrated view of monitored data from all the riparian states that contribute to the optimal network for the Orange–Senqu River basin. The functionality will be in the form of several thematic monitoring data overviews and display of the historic and current data for the sites. There will also be historic and current annual summaries of the data to provide an overview of the basin's resource status.

This activity will involve:

- designing monitoring data and reporting functionality for the specified optimal network;
- implementing the functionality;
- obtaining feedback from client and riparian stakeholders;
- finalising the functionality; and
- testing the functionality.

Output 3.2 is closely linked to Outcomes 1 and 2 in that it provides the platform and required procedures and systems for the integration of the various monitoring efforts at basin level.

OUTCOME 4: ORASECOM RECOMMENDATIONS FOR TRANSBOUNDARY ENVIRONMENTAL ASSESSMENT APPLIED BY BASIN STATES

Output 4.1 ORASECOM Secretariat supported in facilitating the consultation process on tb-EAs

Transboundary environmental assessment (tb-EA) guidelines have recently been developed under the auspices of ORASECOM. The project will support the ORASECOM Secretariat in facilitating the consultation process for the acceptance of the ORASECOM tb-EA guidelines by member states and the integration of the tb-EA guidelines into national legislation/regulations and their application in practice.

Output 4.2 Technical support to tb-EA guideline application

The project will assist ORASECOM and the member states with technical support (in the form of short studies or expert advice, etc.) on particular issues relevant for the practical application of the tb-EA guidelines.

OUTCOME 5: CAPACITY DEVELOPMENT FOR WATER RESOURCES PRACTITIONERS

Output 5.1 Regional exchanges between universities and polytechnics supported

The project will support regional exchanges between universities and polytechnics with an emphasis on skills development in environmental monitoring, data and knowledge management and the integration of the two. The support will build on existing regional networks where applicable and support the establishment of new partnerships where required and suitable.

Output 5.2 Technical capacity developed for mid-career water resources management and environment professionals

Training and capacity-building will be provided for water resource management and other environment professionals on environmental management, data and knowledge management and the integration of the two.

Assumptions and risks	The assumption is made that basin states will be willing to release their data for use by ORASECOM and that they will be willing to be subjected to the quality assurance and control measures that have been proposed to ensure confidence in the quality of the data in the data base.
IMPLEMENTATION	
Project duration	Four years
Project cost	USD1,000,000
Proposed funding sources	To be secured
Implementation mechanism	To be determined

PROJECT CONCEPT NOTE 2: GROUNDWATER MANAGEMENT AND USE

CORE DATA	
Project number	SAP PCN 2
Project title	Groundwater management and use
SAP priority area	Increasing water demand
Short description	The project seeks to promote the coordinated management of groundwater resources throughout the Orange–Senqu basin. Currently, management of these resources is split between four countries, each with its own agenda to suit its own needs. The project will promote a consistent protocol for groundwater monitoring and measuring along with guidance for interpretation, including groundwater flow-system conceptualisation and numerical modelling. It will seek to coordinate the interests of all stakeholders with the vision of a unified management and regulatory structure being agreed and made operational throughout the basin.
PROJECT RATIONALE	
Background	The Orange–Senqu basin comprises a large part of South Africa, Botswana, Namibia and Lesotho and includes the Orange and Vaal river basins and the Fish River in Namibia. Climate ranges from arid in the south-west, through semi-arid in the central part of the basin to a higher rainfall regime in the Lesotho Highlands. Rainfall is strongly seasonal and erratic year on year within the arid and semi-arid areas of the basin. Groundwater is important in the dryer lands to sustain large and small communities and industry, such as mining. Groundwater is available in the ancient crystalline basement rocks, where small yields are suitable for hand pumps, in the Karoo sediments, where substantial sustainable yields are forthcoming, and in the Quaternary sediments of the Kalahari and valley fill alluvium. Droughts and floods are common. Given the diverse range in environments within the basin, it is necessary to adopt a common approach to the management of the available groundwater resources and a common protocol for data gathering, rather than a locally focused approach. Currently, these functions are split between the four nations and there is little commonality even within similar environmental zones. Primary issues for the region are food security and the management of the groundwater resources to a common goal to promote optimum use of the resource for the benefit of all. Climate change is likely to exacerbate shortages as storm activity increases with a corresponding adverse impact on infiltration to groundwater reserves. Groundwater is under threat from a number of different directions: • Demography is a major stress factor which reflects increasing demand from a finite and variably renewable resource. • Pollution, both at sub-catchment level by mining, industry and intensive farming, and at a local and community level by point sources, such as mine-spoil heaps, waste facilities and even pit latrines, is a major cause for concern. • Land-use change, particularly in marginal dry-land areas, tends to work in favour of runoff at the expense of infiltration as vegetation is denuded. • Competition for water between different user interests tends to encourage over-abstraction and groundwater 'mining'. This is pertinent in the case of transboundary aquifers, such as those between Namibia, Botswana and South Africa and between Lesotho and South Africa, although none of these aquifers contain significant resources.
Project objectives	1 Identify the threats to and issues relating to groundwater resources that need to be alleviated by basin-wide management. 2 Identify and agree on a uniform groundwater resources management system including physical measurement, analysis and interpretation, as well as governance and regulation that will alleviate the identified threats. 3 Move towards implementation of shared governance of the groundwater resources within the basin.
Integration with relevant ongoing projects/ initiatives	The project runs in parallel with a number of other initiatives, each focusing on different aspects of the management of the surface and groundwater available within the Orange–Senqu basin. Although there is some overlap, the projects will contribute to an overall management system being devised for all water resources in the basin.
Project outcomes	1 Understanding of groundwater resources in the basin enhanced. 2 Groundwater governance and management in the basin improved.

Overgrazing and trampling reduces the water-regulating properties of the grasslands in Lesotho.

Technical approach	**OUTCOME 1: UNDERSTANDING OF GROUNDWATER RESOURCES IN THE BASIN ENHANCED** **Output 1.1 Data and knowledge of groundwater resources developed** • Conduct detailed hydrogeological studies to better understand the complex aquifer and groundwater systems that prevail in the basin. • Evaluate recharge potential within the various overall rainfall regimes and aquifer types. This also needs to be carried out with regard to climate change scenarios. • Conduct detailed assessment of groundwater storage in each aquifer unit. This will require drilling and geophysics to support data gathering for the characterisation of the different aquifers. • Assess the hydrological–hydrogeological interaction. • Gather groundwater hydrograph data and other time series information, such as water quality. • Collect drilling and new borehole commissioning data, archiving and data access. • Improve monitoring networks and data-gathering protocols to better understand the groundwater flow regimes. **OUTCOME 2: GROUNDWATER GOVERNANCE AND MANAGEMENT IMPROVED** **Output 2.1 National legislation related to groundwater management reviewed** • Strengthen national regulations designed to ensure the measurement and collation of basic hydrogeological parameters with which to evaluate groundwater resource capacities. • Review legislative controls on pollution; a move towards a uniform management system with regard to pollution is required across the whole basin. • Formulate and agree on a set of policies and strategies that will tighten governmental control over pollution and clean-up activities. **Output 2.2: Collaboration and sharing of knowledge between basin states improved** The key to the future management of the Orange–Senqu basin lies in international collaboration, sharing and ongoing dialogue between the four neighbouring states that occupy the basin. This is perhaps the hardest of the activities that will be needed to ensure best practice in the basin, but is nevertheless fundamental to success. • Promote dialogue between governments and between other stakeholders within the basin. • Set up dialogue avenues towards standardisation of data sets and uniform groundwater governance throughout the basin. • Develop drought management strategy to reduce the impact of dry climate cycle periods.
Assumptions and risks	The key assumption is that the organisations currently responsible for groundwater management in each of the four countries within the Orange–Senqu basin will work towards a common goal. There are no risks, as the project inevitably works for the benefit of all stakeholders.
IMPLEMENTATION	
Project duration	Four years
Project cost	USD1,000,000
Proposed funding sources	To be secured
Implementation mechanism	To be determined

Ephemeral pans rapidly dry up after the rainy season in Botswana.

PROJECT CONCEPT NOTE 3: BASIN-WIDE ENVIRONMENTAL FLOWS REGIME

CORE DATA	
Project number	SAP PCN 3
Project title	Basin-wide environmental flows (e-flows) regime
SAP priority area	Changes to the hydrological regime
Short description	Environmental flows assessments for most parts of the basin have been carried out. There is now sufficient information to set up and implement a basin-wide e-flows regime. The project aims at integrating and harmonising all relevant e-flows assessments to ensure comparability of results. Based on the existing work, agreement on the implementation of a basin-wide e-flows regime will be sought through a consultative process. Implementation and compliance monitoring will be supported.
PROJECT RATIONALE	
Background	The provision of water for the protection of the riverine and estuarine ecosystems, and the control of unwanted consequences of degradation, has long been recognised as a key factor in the management of the Orange–Senqu River basin. To date, individual e-flows assessments and related hydrological modelling have been done for all major river reaches in the Orange–Senqu River basin and for the estuary, but at different times and using different methods. There is thus a need to integrate the results of these assessments and to implement a harmonised, basin-wide e-flows regime.
Project objectives	1 Integrate and harmonise existing e-flows assessments carried out for various parts of the basin. 2 Facilitate a consultative process to set up a basin-wide e-flows regime. 3 Support the implementation and monitoring of compliance and effectiveness of an agreed basin-wide e-flows regime.
Integration with relevant ongoing projects/ initiatives	This project will align (as appropriate) with the ongoing e-flows work in the member states as well as with e-flows-related work carried out as part of the implementation of the Orange–Senqu Basin IWRM Plan.
Transboundary benefits	• Ensuring maintenance of a minimal flow regime to meet the demands of the human population and sustain aquatic ecosystems and the services they provide. • Monitoring and sharing knowledge about environmental conditions. • Improved quality of life of the inhabitants and the ecosystems.
Project outcomes	1 Existing e-flows work harmonised and integrated. 2 Basin-wide e-flows regime agreed on through consultative process. 3 Set up, implementation and compliance monitoring of basin-wide e-flows regime supported.

Gauging station at /Ai–/Ais on the ephemeral Fish River, Namibia

Technical approach	**OUTCOME 1: EXISTING E-FLOWS WORK HARMONISED AND INTEGRATED** The technical work encompasses the preparatory phase of integrating the existing information on the hydrology and ecosystems needed to assess options and make decisions, and the legal and administrative provisions that need to be in place before a basin-wide e-flows regime can be implemented. The hydrological and ecosystem work required is complete, but needs to be harmonised in order to ensure comparability of findings. **Output 1.1: Existing e-flows work harmonised** • Legal and administrative information harmonised. • Information on hydrology and water use harmonised. • Information on ecosystem and resource use harmonised. **OUTCOME 2: BASIN-WIDE E-FLOWS REGIME AGREED THROUGH CONSULTATIVE PROCESS** Based on the harmonised existing e-flows work, a suite of basin-wide development scenarios will be developed, covering a range of socio-economic development options and showcasing the resulting ecosystem protection levels. The scenarios will be presented to the basin states and agreement on a basin-wide e-flows regime for implementation will be facilitated through a consultative process. **Output 2.1: E-flows scenarios developed** • Shortlist of basin-wide development/protection scenarios for evaluation by basin states developed. **Output 2.2: Basin-wide e-flows regime determined and agreed** • Basin-wide consultation process conducted for determination of e-flows regime for the scenarios shortlisted. • E-flows regime jointly agreed by basin states. **OUTCOME 3: SET UP, IMPLEMENTATION AND COMPLIANCE MONITORING OF BASIN-WIDE E-FLOWS REGIME SUPPORTED** Following the adoption of an agreed basin-wide e-flows regime, the basin states will be supported in setting up the necessary implementation and compliance monitoring systems required for effective implementation. Particular emphasis is placed on the coordination of national-level activities in order to ensure that a coherent and harmonised basin-wide e-flows regime is implemented in practice. **Output 3.1: Legal and administrative regimes implemented** • Mechanisms for e-flows implemented. • Monitoring and compliance programmes implemented. • Adaptive management programme implemented. **Output 3.2: Hydrology and water use regime implemented** • Flows and abstractions monitored and compliance assessed. • Adaptive management programme implemented. **Output 3.3: Ecosystem and resource use regime implemented** • Efficacy of e-flows regime in maintaining target ecosystem conditions monitored and assessed. • Adaptive management programme implemented.
Assumptions and risks	The main assumption is that there will be a political investment in implementing the provisions of the Water Acts in each of the basin countries. The main risks to the success of the project are: (i) lack of political will to implement the legislation in the basin countries; (ii) unwillingness to integrate e-flows into administrative procedures, such as licensing; and (iii) non-compliance.
IMPLEMENTATION	
Project duration	Five years
Project cost	USD1,000,000
Proposed funding sources	To be secured
Implementation mechanism	To be determined

Oanob Dam is a double-curvature arch dam on the Oanob River, Namibia, that supplies the town of Rehoboth via a four-kilometre pipeline.

PROJECT CONCEPT NOTE 4: ORANGE–SENQU RIVER MOUTH MANAGEMENT

CORE DATA	
Project number	SAP PCN 4
Project title	Orange–Senqu River mouth management
SAP priority area	Changes to the hydrological regime
Short description	This project concentrates on priority interventions for the effective management of the Orange–Senqu River Mouth. The main focus of this project will be on local interventions that: (i) improve the condition of the Orange–Senqu River mouth salt marshes; (ii) enhance the estuary nursery function to improve the stock status of collapsed/over-exploited fish species; and (iii) improve the water quality of the river flowing into the system. The project will require a range of practical interventions, which range from management interventions, to restoration actions and the provision of critical supporting information.
PROJECT RATIONALE	
Background	The South African section of the Orange–Senqu River mouth (Ramsar site) was placed on the Montreux Record in 1995 following the severe degradation of the salt marsh habitat, a particularly important area for birds. An assessment of the present ecological state of the Orange–Senqu River estuary indicated that it was in a largely modified state (Category D) as a result of large-dam development (reduction in floods and increase in winter low-flows) and a range of local non-flow related activities.* The study also concluded that the estuary's present condition can be significantly improved through mitigation of non-flow related activities.
Project objectives	1 Condition of the lower Orange–Senqu River mouth salt marshes improved. 2 Estuary nursery function enhanced. 3 Nutrient input into the catchment (downstream of Vioolsdrift) reduced.
Integration with relevant ongoing projects/ initiatives	The two main projects of the above intervention can feed into: • The UNDP–GEF Orange–Senqu Strategic Action Programme research project on e-flow requirements of the Fish River and the Orange–Senqu River Mouth Atlas Project ID 71598. • The strategic management plan for the Orange River Mouth Ramsar site being jointly developed by South Africa and Namibia.
Transboundary benefits	• Provision of critical environmental requirements for species and functional condition of a habitat. • Provision of continuity and future options by protecting the health of the ecosystems.

* This concept note relies strongly on work done as part of the UNDP–GEF Orange–Senqu Strategic Action Programme, Research Project on Environmental Flow Requirements of the Fish River and the Orange–Senqu River Mouth Atlas Project ID 71598.

Flamingoes feeding in the Orange River estuary, one of five Ramsar sites in the basin.

Project outcomes	1 Natural flood-plain function and marked improvement in estuarine habitat condition restored. 2 Status of over-exploited/collapsed species through implementation and enforcement of fishing regulations on both South African and Namibian sides of the estuary improved. 3 Nutrient input from agricultural area(s) below Vioolsdrift through implementation of agricultural best practices targeted at specific hotspot(s) reduced.
Technical approach	**OUTCOME 1: NATURAL FLOODPLAIN FUNCTION AND MARKED IMPROVEMENT IN ESTUARINE HABITAT CONDITION RESTORED** **Output 1.1: Restorative measures implemented to improve condition of floodplain function** • Remove the remnant causeway that still transects the salt marshes. Control alien invasive plants in the floodplain. • Remove the old earth-moving equipment buried in the sand berm near the mouth of the Orange–Senqu River. • Control wind-blown dust and wastewater from mining activities. • Conduct a Lidar survey of the Orange River mouth to assist with identifying elevated areas that obstruct tidal intrusion and drainage of floodplains after high flow events. • Rationalise the existing dirt-road network crossing the Orange River mouth floodplain to limit impact on estuarine habitat. • Formalise a mouth management plan (i.e. artificial breaching protocol) to provide guidelines for when and how the estuary mouth may be breached. **OUTCOME 2: STATUS OF OVER-EXPLOITED/COLLAPSED ESTUARY SPECIES IMPROVED** **Output: 2.1: Over-exploitation of species prevented** • Enforce the prohibition of gillnetting in the estuary. Curtail illegal dog hunting and predation by feral dogs on the floodplain and islands. **Output 2.2: Joint zonation scheme to manage activities within the Ramsar sites and/or protected area(s) reviewed and developed** • Revisit the boundaries of the site and formal protected areas as well as the planning schemes for Alexander Bay and Oranjemund. • Improve management of livestock grazing within the protected sites. **OUTCOME 3: NUTRIENT INPUT FROM AGRICULTURAL AREA(S) BELOW VIOOLSDRIFT REDUCED** **Output 1.1: agricultural best practices targeted at specific hotspot(s) implemented** • Quantify nutrient input as a result of agricultural areas around Vioolsdrift. • Identify and implement best agricultural practices targeted at the hotspots.
Assumptions and risks	The main risks that the above proposed projects pose are related to river mouth closure. They include: • Inundation of developments/infrastructure (e.g. golf course) and farm land on the floodplain during the closed phase. • Fish recruitment failure if estuary mouth remains closed during spring and summer recruitment peak whilst acknowledging that this happens under natural conditions as well. • Increased aquatic macrophyte blooms under low-flow conditions before mouth closure.
IMPLEMENTATION	
Project duration	Between three and five years
Project cost	USD1,000,000
Proposed funding sources	To be secured
Implementation mechanism	To be determined

The state-owned diamond mine, Alexkor, in Alexander Bay, Northern Cape, South Africa

PROJECT CONCEPT NOTE 5: CONTROL OF ALIEN INVASIVE SPECIES

CORE DATA	
Project number	SAP PCN 5
Project title	Control of alien invasive species
SAP priority area	Land degradation
Short description	This concept note proposes a two-pronged approach to initiate long-term basin-wide alien invasive plant control programme for the Orange–Senqu River basin. Based on a preparatory mapping and cost–benefit analysis, clearing of alien invasive vegetation will be carried out in priority areas in all four basin states.
PROJECT RATIONALE	
Background	The Orange–Senqu River basin is one of the largest catchments in southern Africa including Lesotho, stretching through South Africa into Botswana and Namibia. The river is regulated by several large dams, as well as inter-basin water transfers and is heavily utilised for urban, industrial and agricultural purposes to the extent that the current river flow is approximately half of its natural flow. Ecological flow requirements of the river as well as continued developmental pressures in the catchment require that further efficiency improvements in water uses are achieved and wastage reduced. The constraints on available surface and groundwater resources are exacerbated by the spread of alien invasive plants along the river. Invasive plant species often have a higher evapotranspiration rate than indigenous vegetation. In addition, they create monospecific stands, thereby reducing local biodiversity. In case of dense invasions, they also render land unusable for farming. Species of particular concern are wattles, eucalypts, poplars and willows (throughout the central areas of South Africa), and *Prosopis* species in the more arid parts of the South African, Botswana and Namibian catchment. The eradication of invasives in key areas would increase water yield, potentially improve water quality yield, and protect biodiversity and other ecosystem services (e.g. grazing opportunities). The size of the catchment and the extent of the invasions across all countries make it difficult to prioritise eradication areas. A two-pronged approach is proposed in order to set up a basin-wide control programme for alien invasive plants.
Project objectives	1 Develop a basin-map to quantify the density and distribution of key alien invasive plant species within the Orange–Senqu River basin. 2 Determine a cost-estimate analysis of the current and predicted impact of invasive plants, their impact on ecosystem services and the benefits people obtain from clearing. 3 Clear alien invasive species in key priority areas, as identified in the previous steps.
Integration with relevant ongoing projects/ initiatives	**South Africa:** • Working for Water Programme initiatives: Active projects ongoing in Gauteng and the Free State (eucalypts, wattle, willows and poplars) and the Northern Cape (*Prosopis*). • Agricultural Research Council (ARC): Existing data sets and mapping projects for *Prosopis* in the Northern Cape, as well as 2007 data for the wetter regions of South Africa. **Namibia:** • Orange–Fish Basin *Prosopis* Working Group: Group of interested stakeholders regarding the control of *Prosopis*. • Polytechnic of Namibia: The outcome of this mapping exercise could precipitate student involvement during clearing activities.
Transboundary benefits	• Avoided habitat degradation and biodiversity loss. • Collaborated response to common environmental problems. • Established collaborative procedures towards environmentally sensitive concerns.
Project outcomes	1 Priority areas identified and selected. 2 Alien vegetation cleared in selected priority areas.
Technical approach	**OUTCOME 1: PRIORITY AREAS IDENTIFIED AND SELECTED** **Output 1.1: Alien plant invasion comprehensively mapped** The following species are very common along the Orange–Senqu River and are likely to be included in clearing plans: • Wattle (*Acacia dealbata*) in high altitude areas of Lesotho. • Wattle (*A. mearnsii*), willow (*Salix babylonica*), poplar (*Populus canescens, P. deltoides*) and eucalypts (*Eucalyptus camaldulensis*) in the higher rainfall areas of central South Africa. • *Prosopis* species in the arid catchment parts that include Botswana, Namibia and the Northern Cape of South Africa. The mapping of invasive plants in the Orange–Senqu basin would build on a wide variety of existing data sets. Useful existing data sets that will be considered for this project are the ARC mapping data, especially for the higher rainfall areas, as well as existing work on *Prosopis* mapping in the Northern Cape. Kotzé et al. (2010) mapped invasion data for the rivers of South Africa and the dryland and riparian invasions in the higher rainfall areas of the basin. As Namibia and Botswana were not included in their mapping, the primary focus of this project component will be on mapping invasions in these two countries. The Northern Cape work by Van den Berg (2010) will provide the methodological backbone for the remote sensing work that will be required for the mapping of *Prosopis* in Namibia and Botswana. **Output 1.2: Cost–benefit analysis model designed** • Design an economic model for the cost–benefit analysis of clearing efforts. An economic model for the cost–benefit analysis of clearing efforts will be designed based on the approach developed by Wise et al. (2012). This involved determining the effects of *Prosopis* invasions in riparian and dryland settings on key ecosystem services (primarily groundwater supplies and grazing), and using this information to model the potential impact on the economic benefits derived from the land. It is proposed to use such a model and represent the outputs spatially so that the areas where invasions have the greatest impact can be identified. **Output 1.3: Priority clearing areas defined** The Centre for Scientific and Industrial Research has undertaken a number of studies aimed at prioritising the clearing of invasive alien plants species both nationally and within the nine South African provinces for the country's Working for Water Programme.* A multi-criteria decision-making approach was used which incorporated criteria relating to ecosystem services (e.g. water supplies, grazing), conservation priorities, employment benefits and the importance and difficulty of controlling particular alien plant species. It is proposed to adapt the modelling approach developed for South Africa to target the whole basin, so that key invaded areas are clearly identified and can be targeted for clearing efforts. **OUTCOME 2: ALIEN VEGETATION CLEARED IN PRIORITISED AREAS** **Output 1.1 Alien vegetation cleared** • Undertake clearing alien vegetation in all prioritised areas in the basin.

* Forsyth, GG, Le Maitre, DC, O'Farrell, P and van Wilgen, BW, 2012. The prioritisation of invasive alien plant projects using a multi-criteria decision model informed by stakeholder input and spatial data. *Journal of Environmental Management*, 103: 51–57.

Assumptions and risks	The clearing of alien invasive plants for a basin as big as the Orange–Senqu is a challenge. It needs to be understood that 'eradication' is not possible, given the level and extent of the invasions. On-going control is realistic – and therefore clearing is not a once-off effort. It will require continued attention. The first challenge is to obtain the required political commitment – which cannot be guaranteed when faced with a basin that spans four countries. The value of clearing (e.g. in terms of job creation, poverty alleviation, improved biodiversity and other ecosystem services) needs to be very strategically communicated. The second challenge is financial commitment. Developing countries face a myriad of challenges and in order to ensure any long-term funding it is crucial to express the value of clearing in terms of the needs and goals of developing nations. Financial self-sufficiency of clearing efforts is another option that needs to be strongly motivated in the trial clearing period. However, whether or not this succeeds depends on many local issues that can only be grappled with in a trial phase. The third challenge is joint decision-making at a basin scale, given four different legal systems and their corresponding documentation. SADC agreements and the Regional Biodiversity Action Plan could be used as starting points. In terms of scientific data, South Africa is currently at a disproportionate advantage to the other three basin state members, although its investments have benefited Lesotho. However, much of the data can be extended and used at a basin scale (e.g. information on specific species) and a mapping, cost–benefit and prioritisation process, as suggested in this concept note, would build on existing work to ultimately benefit all member states equally.
IMPLEMENTATION	
Project duration	Three years
Project cost	Estimated USD2,000,000
Proposed funding sources	To be secured
Implementation mechanism	To be determined

A dense thicket of *Prosopis* trees chokes the ephemeral Nossob River in Namibia, outcompeting indigenous riparian species and reducing groundwater recharge.