



Republic of Botswana

Botswana Integrated Water Resources Management & Water Efficiency Plan



*Empowered lives.
Resilient nations.*

Volume 2:
Appendices, May, 2013

Botswana Integrated Water Resources Management & Water Efficiency Plan

May 2013

Volume 2: Appendices

Prepared for: Ministry of Mineral, Energy and Water Resources
Department of Water Affairs
Private Bag 0029
Gaborone, Botswana
Tel: +267 395 2241
Fax: +267 390 3508

Prepared by: Centre for Applied Research and Aurecon Botswana

Citation: Department of Water Affairs - Ministry of Minerals, Energy & Water Resources. (2013). *Botswana Integrated Water Resources Management & Water Efficiency Plan*. (L. Dikobe, Ed.) Gaborone, Botswana: Government of Botswana.

TABLE OF CONTENTS

LIST OF TABLES	VII
LIST OF FIGURES.....	VIII
ABBREVIATIONS.....	IX
1.0. APPENDIX A: SUMMARY OF IWRM-WE PLAN CONSULTATION	1
1.1. Sector Consultation	1
1.1.1. Environment Sector	1
1.1.2. Agricultural sector	3
1.1.3. Mining Sector.....	6
1.1.4. Tourism sector	9
1.2. District consultations.....	11
1.2.1. South and south western consultations (held in Kang).....	11
1.2.2. Northern –North East consultations	17
1.2.3. East consultations (Palapye).....	21
1.3. Participants in Consultations.....	28
2.0. APPENDIX B SUMMARY OF SELECTED SADC WATER POLICY DOCUMENTS.....	31
2.1. SADC Water Policy and Strategy	31
2.2. Other SADC policy notes.....	34
3.0. APPENDIX C: REVIEW OF TRANSBOUNDARY RIVER BASINS IN SADC.....	35
3.1. Introduction.....	35
3.2. International Watercourses: Policy and Conventions	35
3.3. International Legislation.....	37
3.3.1. UN Convention on the Law of the Non-navigational Uses of International Watercourses	37
3.3.1.1. Part I: Introduction	38
3.3.1.2. Part II: General Principles	38
3.3.1.3. Part III: Planned Measures.....	39
3.3.1.4. Part VI: Protection, Preservation & Management	39
3.3.1.5. Part V: Harmful Conditions & Emergency Situations	40

3.3.1.6.	Part VI: Miscellaneous Provisions.....	40
3.3.1.7.	Part VII: Final Clauses	40
3.3.2.	Draft articles on the Law of Transboundary Aquifers	40
3.3.3.	UN Convention to Combat Desertification.....	43
3.3.3.1.	Convention Provisions and Priorities.....	43
3.3.4.	Convention on Wetlands of International Importance (Ramsar).....	54
3.4.	REGIONAL LEGISLATION	55
3.4.1.	Revised Protocol on Shared Watercourses in SADC (2000)	55
3.5.	Zambezi River Basin	56
3.5.1.	Institutional Review (Pietersen and Beekman)	57
3.5.1.1.	Organizational Structure	58
3.5.1.2.	Functions and Mandate.....	58
3.5.1.3.	Rules on Decision-making & Procedure for Dispute Resolution	59
3.5.1.4.	RBO programmes and capacity building processes.....	59
3.5.1.5.	Comments	60
3.5.2.	Zambezi IWRM Strategy and Implementation Plan	61
3.5.2.1.	Challenges and Development Issues	61
3.5.3.	Zambezi IWRM Strategies	64
3.5.3.1.	Strategic Options Analysis	64
3.5.3.2.	Strategies.....	65
3.5.4.	Zambezi IWRM Implementation Plan.....	77
3.5.4.1.	Implementation Plan	77
3.5.4.2.	Financing Strategy Implementation	77
3.5.4.3.	Coordination and Monitoring.....	78
3.5.4.4.	Key Follow-up Steps	79
3.5.5.	Recommendations and Actions.....	79
3.6.	Cubango-Okavango River Basin.....	80
3.6.1.	Institutional Review (Pietersen and Beekman)	80
3.6.2.	Comments	83
3.6.3.	Botswana National Action Plan for the Okavango	85
3.6.3.1.	Driving factors	86

3.6.3.2.	Priority Areas of Concern	87
3.6.4.	Management Interventions – Botswana Specific Thematic Areas.....	94
3.6.5.	NAP Implementation	98
3.6.5.1.	Institutional set up for NAP coordination	98
3.6.5.2.	Monitoring and Evaluation Mechanisms.....	102
3.6.5.3.	Required resources and possible funding	103
3.6.6.	Recommendations and Actions.....	114
3.6.6.1.	Botswana National Action Plan for the Zambezi	114
3.6.6.2.	Funding	114
3.7.	Orange-Senqu River Basin	114
3.7.1.	Institutional Review (Pietersen and Beekman)	115
3.7.2.	Comments	119
3.7.3.	Orange-Senqu IWRM Plan	123
3.7.4.	The Interests of Botswana (Heyns, 2004).....	124
3.7.5.	Development of Water Quality Monitoring Programme and Data Management Framework (2011)	125
3.7.6.	Data Management.....	128
3.7.7.	Recommendations.....	132
3.7.8.	Environmental Flows	133
3.7.9.	IWRMP Recommendations and Actions.....	142
3.8.	Limpopo River Basin	145
3.8.1.	Institutional Review.....	146
3.8.2.	Joint Limpopo River Basin - Scoping Report (SADC 2010)	147
3.8.3.	Limpopo IWRM Plan	151
3.9.	Conclusion	151
3.9.1.	Challenges of linking R/LBOs with national governments.....	151
3.9.1.1.	Political support and commitment.....	151
3.9.1.2.	Awareness Creation for National Governments and Other Stakeholders	152
3.9.1.3.	Financial viability of R/LBOs	153
3.9.1.4.	International Agreements	153
3.9.1.5.	Information Sharing.....	153

4.0. APPENDIX D: REVIEW OF INTERNATIONAL IWRM-WE PLANS.....	155
4.1. Malawi (Shorter version of the plan)	155
4.2. Zambia	158
4.3. Namibia.....	162
4.4. Kenya	170
4.4.1. Strategic area: trans-boundary water resources.....	172
4.4.2. Strategic area: Closing the gap between water demand and supply	172
4.5. Jordan	173
4.5.1. 2004 National Water Master Plan	174
4.5.2. Water for Life: Jordan’s Water Strategy 2008-2022	176
4.6. Spain	183
4.7. Kazakhstan.....	184
4.8. Israel	187
5.0. APPENDIX E: CONSULTANCY TO REVIEW, DEVELOP TRAINING MATERIALS AND PILOT THE LIQUID WASTE MANAGEMENT GUIDELINES IN NGAMILAND DISTRICT (OKAVANGO DELTA RAMSAR SITE)	190
5.1. Introduction.....	191
5.1.1. Background.....	191
5.1.2. Consultancy tasks and deliverables.....	191
5.2. LITERATURE REVIEW.....	192
5.2.1. Introduction.....	192
5.2.2. Background Information to Liquid Waste Management Systems in the ODRS	193
5.2.3. Wastewater Management in the ODRS	193
5.2.4. Hazardous Wastes	194
5.2.5. Technological options for wastewater management and selection criteria.....	195
5.2.6. Normal site conditions	195
5.2.7. Difficult Site Conditions	197
5.2.8. Adverse site conditions	199
5.2.9. Performance of Wastewater Management Systems in ODRS	201
5.2.10. Hazardous Substances Handling, Transportation, Storage and Disposal Protocols	201
5.2.11. Contingencies for Fuel Spills.....	202
5.2.12. Risk assessment for fuel storage facilities	203

5.2.13.	A review of institutional set-up for the wastewater subsector as proposed by water sector reforms	205
5.2.14.	A critique of the guidelines under review	206
5.2.15.	Technology selection	206
5.2.16.	Regulatory proposals.....	207
5.2.17.	Institutional responsibilities	208
5.2.18.	Guidelines on Hazardous Waste.....	209
5.3.	STAKEHOLDER CONSULTATION	209
5.3.1.	Outcomes from stakeholder consultations	209
5.3.2.	SYNTHESIS AND CONCLUSION	211
5.4.	LIQUID WASTE MANAGEMENT GUIDELINES	211
5.4.1.	Guidelines for Assessing Pollution Risk	213
5.4.2.	Guidelines for technology selection	213
5.5.	Guidelines for Licensing of Liquid Waste Management Facilities	216
5.5.1.	Components of a License Application Report	216
5.5.2.	System Design Considerations	216
5.5.3.	Procedure for License Application to Competent Authority and its Response.....	217
5.5.4.	License Conditions.....	217
5.6.	Monitoring of Liquid Waste Management Systems.....	218
5.6.1.	Components of a Monitoring Plan	218
5.6.2.	Self-monitoring Procedure of Existing Establishments	218
5.7.	Sludge Management.....	219
5.7.1.	Components of the Sludge Management Plan.....	220
5.7.2.	System Operation and Maintenance.....	221
5.7.3.	On-land Mobile Operator Camping Grounds and Houseboats	221
5.7.4.	Decommissioning and Rehabilitation.....	222
5.7.5.	Institutional Responsibilities	222
5.8.	Hazardous Liquid Waste Management and Guidelines	223
5.8.1.	Contingencies for fuel spills.....	224
5.8.2.	Risk assessment for fuel storage facilities	225
5.9.	BIBLIOGRAPHY	228

6.0. APPENDIX F: PROJECT PROPOSAL NOTE ON CLIMATE CHANGE, VARIABILITY AND THE WATER SECTOR IN BOTSWANA	239
6.1. Climate Change and Variability (CC&V) and the Water Sector and Resources in Southern Africa	239
6.2. Climate Change and Variability (CC&V) and the Water Sector and Resources in Botswana	240
6.3. The proposed project	242
6.4. Planned Activities	243
6.4.1. Water Infrastructure & Storage.....	243
6.4.2. Treated Effluent.....	243
6.4.3. Food Security	243
6.4.4. Water Demand Management.....	243
6.4.5. Major Ecosystems.....	244
6.4.6. Improved Understanding of CC&V Impacts	244
6.5. Funding sources.....	244
6.6. 4 Institutional set up and further proposal development.....	244
7.0. APPENDIX E: REFERENCES.....	246

LIST OF TABLES

Table 1: RWS policy areas and interventions.....	31
Table 2 Botswana National Action Plan to Combat Desertification	47
Table 3 Zambezi IWRM Strategic Framework.....	68
Table 4 Zambezi IWRM Implementation Plan	73
Table 5 Funding Modalities.....	78
Table 6 Summary of changes in availability of communal land overtime	90
Table 7 Thematic areas, identified priority concerns and the driving forces	94
Table 8 Okavango - Botswana National Action Plan 2011-2016.....	104
Table 9 Orange-Senqu sampling points.	126
Table 10 Minimum and Recommended Sampling Frequency	128
Table 11: Results of Inter Laboratory Benchmarking	130
Table 12 Comparison of Laboratory Results to the SABS Spike Sample	131
Table 13 Trigger Values for sampling points 6 to 12	132
Table 14 Conservation Areas in the Molopo River Basin.....	133
Table 15 Major environmental aspects within the different countries of the Orange River Basin.....	140
Table 16: Present water use by sector for Limpopo member States (Mm ³ /a).....	148
Table 17: Principles and steps to follow when developing a funding strategy for an IWRM plan	168
Table 18: Challenges, goals and strategies for Jordan's water sector	178
Table 19: Water consumption by sector and source (2010; Mm ³).....	189
Table 5-1: Prevalence of wastewater management systems	194
Table 5-2: Quantities of fuel by mode by of transportation	195
Table 5-3: Basic requirements of disposal sites falling into three major groups.....	195
Table 5-4: Guidelines for design of septic tank.....	196
Table 5-5: Applicability of alternative on-site wastewater treatment systems for difficult conditions 198	
Table 5-6: Comparative analysis of on-site wastewater treatment systems.....	198
Table 5-7: Removal efficiency ranges from different systems.....	201
Table 5-8: Risk-ranking framework for hazardous substances	204
Table 5-9: Recommendations on Risk Control Measures	204
Table 5-10: Site conditions classification	207
Table 5-11: Pollution risk based on quantity of liquid waste generated and site classification.....	213
Table 5-12: Risk-ranking framework for hazardous substances	227
Table 5-13: Recommendations on Risk Control Measures	228

LIST OF FIGURES

Figure 1: Botswana and its participating transboundary river basins.	36
Figure 2: Map of African Shared Groundwater Resources	42
Figure 3 Zambezi River Basin (UNEP 2008).....	57
Figure 4 Cubango-Okavango River Basin (UNEP 2008).....	80
Figure 5 OKACOM Organizational structure.	81
Figure 6 Botswana NAP Implementation Structure.....	101
Figure 7 Orange-Senqu River Basin (UNEP 2008)	115
Figure 8 ORASECOM Organizational structure.	117
Figure 9 Proposed Revised ORASECOM Structure. (<i>Tompkins, 2007</i>).....	122
Figure 10 Location of sampling points.	127
Figure 11 Proposed Data Management Structure	129
Figure 12 Conservation Areas, Cultural Heritage Sites and Ecological Sensitive Areas in the Molopo Basin	134
Figure 13: Gravel road to be upgraded in Molopo River Valley at Hoekrans.	135
Figure 14 Typical habitat drivers and biological response for rivers.	138
Figure 15 Limpopo River Basin (Source: www.limcom.org)	146
Figure 16: Map of aridity index defines mean annual precipitation divided by the potential evapotranspiration (CSIR, 2003).	148
Figure 17: Diagrammatic illustration of the key components of Namibia’s IWRM Plan	163
Figure 19: Flow of M&E information among stakeholders.....	167
Figure 5-1: Typical 2-compartment septic tank	197
Figure 5-2: Typical cross-section of soakaway	197
Figure 5-3: Typical waste holding tank.....	199
Figure 5-4: Typical cross-section of evaporation lagoon	200
Figure 5-5: A typical composting toilet	200
Figure 5-6: Conceptual framework of the reviewed guidelines.....	212
Figure 5-7: Flow diagram for technology selection for medium to high pollution risk	215
Figure 5-8: Botswana sludge classification system	220

ABBREVIATIONS AND ACRONYMS

AFU.....	Automatic Flush Urinal
ANSI.....	Adjusted Net Savings Index
ART.....	Anti-retroviral Therapy
BALA.....	Botswana Association of Local Authorities
BHDR.....	Botswana Human Development Report
BIUST.....	Botswana International University of Science & Technology
BN IWRM-WEP.....	Botswana National Integrated Water Resources and Water Efficiency Plan
BoBS.....	Botswana Bureau of Standards
BoCCIM.....	Botswana Confederation Commerce Industry and Manpower
BoCoNGO.....	Botswana Council of Non-Governmental Organisations
BOTEC.....	Botswana Technology Centre
BoWELS.....	Botswana Water Efficiency Label System
BTO.....	Botswana Tourism Organisation
BWF.....	Basin Wide Forum
CAR.....	Centre for Applied Research
CBNRM.....	Community Based Natural Resource Management
CBO.....	Community Based Organisation
CC.....	Climate Change
CCA.....	Climate Change Adaptation
CCD.....	Convention to Combat Desertification (short title)
CoP.....	Conference of Parties
DBES.....	Department of Building and Engineering Services
DWA.....	Department of Water Affairs
EFR.....	Environmental Flow Requirements
EIA.....	Environmental Impact Assessment
EWR.....	Ecological Water Requirements
GEF.....	Global Environment Facility
GoB.....	Government of Botswana
GW.....	Ground Water
GWP.....	Global Water Partnership
GWP-SA.....	Global water Partnership (Southern Africa)
HATAB.....	Hospitality and Tourism Association of Botswana

HIES	Household Income and Expenditure Survey
HOORC	Harry Oppenheimer Okavango Research Centre
IC	International Consultant
ILC:.....	International Law Commission
IRBM:.....	Integrated River Basin Management
IWRM	Integrated Water Resource Management
IWRM-WE:.....	Integrated Water Resources Management and Water Efficiency
IWSD.....	Institute of Water and Sanitation Development
IZS.....	Interim ZAMCOM Secretariat
KCS	Kalahari Conservation Society
LBPTC	Limpopo Basin Permanent Technical Committee
LEA	Local Enterprise Authority
LIMCOM:	Limpopo River Basin Commission
LIMID	Livestock Management and Infrastructure Development
M&E	Monitoring and Evaluation
MCM	Million Cubic Metres
MDG	Millennium Development Goal
MFDP.....	Ministry of Finance and Development Planning
MMEWR	Ministry of Minerals, Energy and Water Resources
MP	Member of Parliament
NAMPAADD.....	National Master Plan for Arable Agriculture and Dairy Development
NAP:	Botswana National Action Plan (Okavango, 2011)
NAPs	National Action Plans
NC.....	National Consultant
NCSA.....	National Conservation Strategy Coordinating Agency
NGOs	Non Governmental Organisations
NMPSWW	National Master Plan for Sanitation and Wastewater
NPFW	Non-Potable Fresh Water
NRW	Non Revenue Water
NSC.....	North South Carrier
NWMP.....	National Water Master Plan
NWMPR.....	National Water Master Plan Review
OBSC.....	Okavango Basin Steering Committee
ODMP	Okavango Delta Management Plan

OKACOM	Okavango River Basin Commission
ORASE.....	ORASECOM Secretariat
ORASECOM	Orange-Senqu River Basin Commission
PDL	Poverty Datum Line
PEI	Poverty and Environment Initiative
PET	Potential Evapotranspiration
PMTCT	Prevention of Mother to Child Transmission
PMU	Project Management Unit
PR	Public Relations
PSC	Project Steering Committee
R/LBO	River / Lake Basin Organisation
RBOs.....	River Basin Organisations
RSAP	Regional Strategic Action Plan I – III (SADC)
RWP.....	Regional Water Policy (SADC)
RWS.....	Regional Water Strategy (SADC)
SADC.....	Southern African Development Community
SAP:	Strategic Action Programme (Okavango)
SAPs.....	Strategic Action Programmes
SD	Sustainable Development
SW	Surface water
T.b.a.	To be assessed
TAC	Technical Advisory Committee
TAG.....	Technical Advisory Group for Botswana IWRM-WE project
TAG.....	Transitional Advisory Group for LIMCOM
TBNRM:	Transboundary National Resources Management
TDA:.....	Transboundary Diagnostic Assessment (Okavango, 2011)
TIWRMP	Transboundary Integrated Water Resources Management Plan
ToR	Terms of Reference
TWW	Treated WasteWater
UNAIDS.....	United Nations Programme on HIV/AIDS
UNCED.....	United Nations Conference on Environment and Development
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
WA.....	Water Accounting

WAVES.....	Wealth Accounting and Valuation of Ecosystem Services
WB.....	World Bank
WCED	World Commission on Environment and Development
WCU	Water Conservation Unit
WDM	Water Demand Management
WE	Water Efficiency
WI	Water Initiative
WMA:	Wildlife Management Area
WRB.....	Water Resources Board
WSR	Water Sector Reform
WUC	Water Utilities Corporation
ZACPLAN.....	Zambezi Action Plan
ZACPRO	Zambezi Action Projects
ZAMCOM.....	Zambezi River Basin Commission
ZOP	Zambezi Operationalisation Plan
ZRA:	Zambezi River Authority

1.0. Appendix A: Summary of IWRM-WE Plan consultation

The consultative meetings were jointly facilitated by Mr. B. Thamuku (Department of Water Affairs), Mr. M. Ramaano (IWRM/WE Project Manager), Ms. T. Setlhogile and Dr. J. Arntzen (Centre for Applied Research). The purpose of the meetings was to identify and discuss water issues for sectors that were represented and also get feedback on the direction that the National IWRM/WE plan should take. The summary is divided into two sections: i) sectors and ii) district meetings. The list of all participants is attached at the end of the summary.

1.1. Sector Consultation

1.1.1. Environment Sector

Situation analysis

Rising water demands of economic sectors and domestic users puts increasing pressure on water resources. This can easily lead to a situation where ecological water requirements (EWR) are no longer met and ecological degradation and loss of biodiversity occur. The risks are highest in the Limpopo Basin (eastern Botswana), which is already heavily used. EWR may not be met in future in the Okavango, Zambezi-Chobe and Kwando Linyanti Basin because of expected major abstractions. A shortfall of EWR is more likely in the absence of policy and legal framework that recognise and prioritise EWR (as is currently the case in Botswana). The IWRM-WE Strategy needs to fully incorporate EWR to prevent this from happening.

IWRM and cross cutting issues

Climate change is the most relevant cross cutting issue for EWR as it is likely to lead to higher evaporation, greater variability in rainfall (droughts and floods) and changes in run-off and recharge.

EWR and EFR

EWR is described as the water requirements for maintenance of existing ecosystems in an acceptable state (ecosystems are inherently dynamic). It refers to water resources in perennial rivers (all are transboundary), ephemeral rivers and groundwater. With respect to rivers, EWR represent the required river flow to maintain the ecosystem of the catchment area. With respect to groundwater, EWR refers to keeping the groundwater level such that the vegetation can regenerate. While groundwater mining is well known and documented, the ecological impacts have not been studied. Both water quantity and quality are important for EWR.

Environmental flow requirements (EFR) refer to the required flow of rivers/wetlands to meet existing environmental and human requirements. Usually, EFR are estimated for river to ensure continued human and environmental activities.

Some environmental flow studies have been done in Botswana: Okavango (part of EPSMO), new dam studies (Thune, Lotsane, Dikgathong) and some other rivers (Moseitse, Tati and Ntimbale). No EWR studies have been carried out. NWMP2 (2006) has some findings regarding ecological requirements. No EFR studies have been done for existing dams. The EWR are determined by the characteristics of the catchment area in terms of size, slope, rainfall, soil, vegetation and wildlife. Moreover, EWR vary greatly in time (intra- and inter annual) and in space.

WUC has prepared two dam water release strategies (Ntimbale and Letsibogo). This is part of their corporate IWRM & WDM strategy. WUC will monitor and evaluate the impact of water releases. From an EWR perspective, water releases should mimic natural rainfall variations (e.g. drought and wet conditions). This is in conflict with downstream users' wishes to release water during droughts.

Data, Capacity and Methodologies

While data are inadequate, estimates of EWR and EFR can be made. DWA has hydrological data on surface water and groundwater (bi-annual reports on well fields). Wildlife estimates are also available as well as water requirements by species (based on literature). DGS has data on observation boreholes. WUC has data on production boreholes. Moreover, RS & GIS data are available that can be used to estimate EWR. The data constraints were observed:

- Poor monitoring data at DWA since 1996.
- Out-dated vegetation map
- Mixed data quality of DWA data (especially in recent years)
- No information on DWNP boreholes (running non-stop and wasting water)

In terms of capacity, adequate human resources and capacity are available. Institutions may experience capacity constraints. Its new mandate of resource management makes DWA responsible for estimating and protecting EWR (with specialised inputs of other departments). The new structure should find a suitable location for this task within DWA.

Data: as part of its new mandate, DWA will collect water data from all users and stakeholders. There is need for sector specific monitoring (mining, livestock, etc.) and a general monitoring system (DWA has developed a system of ten monitoring stations throughout the country). Collaboration between Met Services and DWA is increasing but it needs to be formalised. There is an urgent need for DWA to improve its data collection & processing systems and efforts. Compared to 1980s and 1990s, the data collection (quantity and quality) is inadequate and the quality has deteriorated significantly, harming resource management efforts.

Methodologies: a number of methodologies can be used, but there is no need to specify these in the IWRM-WE Plan. The methodology should be site or catchment area specific. In other words, decentralised water management is essential.

EWR/IWRM Mainstreaming & Prioritisation

Currently, EWR is hardly mainstreamed and certainly not prioritised. Several ways of mainstreaming were identified:

Explicit reference to EWR in water policy and legislation. In Namibia and South Africa, water uses have been prioritised as follows: basic domestic needs, EWR, productive uses. The draft Botswana Water Policy has the same prioritisation. This needs to be retained and supported in a new Water Act.

- Incorporation of EWR in EIAs and Strategic Environmental Assessment (SEA).
- Establishment & implementation of IWRM-WDM corporate strategies (e.g. WUC & DWA);
- Expansion and updating of water accounts (DWA) using SADC and UNSO methods, which include EWR.

EWR and policy environment

A new Water Policy and Act are imperative. Wetland policy and EIA/SEA Act should also be covered in the IWRM-WE Plan. The meeting expressed a strong preference for a decentralised, catchment area management approach as it can deal optimally with EWR and competing water uses.

Monitoring, Evaluation & Research

M & E is DWA's responsibility and needs to be integral part of the IWRM-WE plan. Research topics that emerged during the discussions:

- Assessment of EWRs of different ecosystems and catchment areas;
- Assessment of impact of groundwater mining on vegetation and ecosystem;
- Environmental flow assessment of major rivers and basins.

Brief conclusion:

EWR needs to be prioritised in IWRM-WE Plan to prevent major future problems. It can be done and should be seen as part of the resource management mandate of DWA.

1.1.2. Agricultural sector

Situation Analysis

Irrigation is a small, but growing sector in Botswana. It is estimated that at present some 3 500 ha are under irrigation. Detailed production figures are not known. Generally, the horticultural sector now produces around 60% of domestic consumption. The key problem for horticulture is marketing.

The Ministry of Agriculture (MoA) has two irrigation clusters at Glenn valley (using treated wastewater) and Dikabeya (using dam water). Agriculture also expects water from new dams such as Thune and Lotsane. Dikabeya water consumption is not metered or monitored. Glenn Valley is metered but not monitored.

Irrigation is concentrated in the Tuliblock (especially Talana Farms, groundwater at maximum 12 m deep), around Francistown (groundwater and in Chobe area (from Chobe; very limited groundwater availability).

Agricultural water resources concerns include:

- Limited water availability for irrigation and poor water quality (often high pH). This forced some farmers in Glen Valley (e.g. Fabulous Flowers) to have their own water treatment infrastructure, which is expensive and proved to be unsustainable. Treatment at source (i.e. WWTW) is cheaper than treatment by individual; farmers due to economies of scale.
- Lack of understanding about water requirements for irrigated crops among farmers in terms of required supply reliability and water quality;
- Institutional issues. MoA is involved in supplying bulk irrigation water whilst this should be the mandate of Water Utilities Corporation (WUC);
- Inadequate reuse of treated effluent due to sectoral planning (e.g. no suitable arable land available close to wastewater treatment works or WWTW);
- Virtually no monitoring of agricultural water consumption and dam yields; this makes it difficult to properly plan irrigation schemes;
- No management of agricultural dams leading to siltation, collapse of fences and inappropriate use (e.g. for livestock);
- Livestock ranches allocated without due consideration of groundwater availability. This often leads to drilling blanks and high costs to farmers;
- There are many unused water rights for agriculture and at the same time irrigation ventures without appropriate water (and land) rights;
- There is no accountability for water consumption by irrigation farmers as they do not pay for water.

IWRM and Cross-cutting Issues

Climate change (CC) is the most relevant cross cutting issue for agriculture, especially irrigation. CC will lead to more frequent and intense extremes (e.g. floods, droughts, frost, hail), damaging crops. Water requirements of crops will rise due to higher temperatures and evapo-transpiration. There will be need to adapt cropping plans and agricultural management adaptations, plant drought and disease tolerant crops, provide farmers with education, water storage and modified designs of irrigation schemes.

Poverty and food security are closely interrelated important cross cutting issues too. Back yard gardening was considered mostly as a food security programme but may have a poverty reduction potential. There will be need to be creative in terms of water sources (e.g. rainwater harvesting) and crops grown.

IWRM & WDM in Agriculture

The main opportunities refer to increased use of treated wastewater and excess mine water as well as in increasing water use efficiency based on economically viable water saving irrigation technologies. Opportunities exist to make better use of treated wastewater (new water) and a feasibility study will be done into the potential to utilise excess mining water for irrigation (e.g. BCL). Hot water from BCL could also be used for aquaculture (reducing the production costs).

Non-conventional water use opportunities in agriculture should be identified through existing EIA procedures (e.g. for mines and wastewater treatment works). No WWTW should be constructed without an accompanying reuse scheme/ plant.

Aquaculture was mentioned as an opportunity to reuse treated effluent.

Key Elements of the Plan

The presented draft observations regarding Vision, goals and targets were discussed with the following observations.

- The Vision should make reference to adequate water for food security. Moreover, a holistic coordinated approach towards WRM is essential (part of mission?).
- The goals should make reference to the development of a sustainable water sector with a sustainable agricultural sector which can deliver food security.

Suggested additional targets include:

- Establish effective management systems for agricultural dams and reduce the water losses from seepage and evaporation;
- Increase the water use efficiency of the irrigation sector. Clear targets (and requirements) need to be developed to be met not later than by 2020;
- Maximise the (re-)use of treated wastewater subject to appropriate water quality and develop supporting infrastructure near WWTW;
- Increase the use of rainwater harvesting (including storm water) and saline water for irrigation by offering incentives.

Water-use Allocation and Prioritisation

Water allocation should be based on demand prioritisation and afterwards a number of criteria, including value added/m³, jobs/m³, food security/m³ and livelihood increase/m³. Basic needs and environmental requirements need to be given priority 1 and 2. Subsequent uses need to be determined based on the above criteria (if there

is resource competition). Transboundary resources need to be allocated based on the SADC Shared Water Courses Protocol and the above criteria.

Water quality issues also need to be considered when allocating water within the irrigation sector. The water quality influences the choice of crops and irrigation technology.

Water Charges and Finances

Irrigation farmers currently do not pay for water. Glenn Valley farmers should in fact pay as they are metered. Payment for water is necessary (based on user pays principle) as it assist farmers to account for water and provides incentives for water savings. However, this should be based on a supplier-farmers contract that stipulates the required services and payments.

Funding could be sourced from general tax collections, private funders and water users (through the user and polluter pays-principle). Once WUC is on top of its mandate, a combined potable water and water treatment charge¹ is likely to be developed.

Data, Capacity and Methodologies

Bulk water for irrigation should be supplied by WUC. It is uncertain whether WUC possesses the capacity to do that given their hugely expanded mandate. It remained unclear whether the WSRP had filled in the details as to who is responsible for the infrastructure, O&M and water supply for irrigation water.

District water use plans could assist to develop district capacities and ensuring a holistic, coordinated approach towards water and land management at decentralised levels.

Monitoring, Evaluation & Research

M & E is currently virtually absent. Self monitoring by water users and the WRB were considered the main M&E instruments.

Proposed research topics include:

- Feasibility of use of mining water for irrigation;
- Technologies to reduce evaporation from surface water sources (e.g. dams);
- Integrated land and water use planning around WWTW.

1.1.3. Mining Sector

Situation Analysis

Mining often occurs in remote areas without access to existing well fields or dams. Therefore mines often source their own water (so-called self providers) and in

¹ Currently part of the council service levy charged to property owners.

remote areas mining operations often depend on groundwater. The main resource concerns include:

- Water demand of the mining sector will increase due to growth of the sector. In the next few years, 4-5 new mines will start operation (Bosetu, Boteti, Hanna Gope and Lerala). Morupule coal mine is tripling its production (current water consumption around 60 000 m³ p.a.) and will be connected to the NSC. It is likely that A-Cap will start uranium mining in 2013/4 (estimated water consumption of over 110million m³ p.a.).
- Required water quality and competition with other economic sectors. Botswana does not have industrial water quality well fields. Use of water with salinity in excess of 1000 TDS would limit the resource competition for potable water and livestock water. This poses corrosion and maintenance challenges to the mining sector;
- Current groundwater mining occurs around some mines. Use of non-potable water would reduce the adverse impacts on other sectors;
- Connection with NSC. This would alleviate water shortages concerns but leads to competition with other sectors and may provide a disincentive for increasing water use efficiency in the mining sector.
- Opportunities for reclaiming water from tailing dams.

WUC does not consider supply of mines as its mandate (even though some mines receive water from Shashe Dam). The situation is somewhat confusing.

The main issue is to pre-empt possible future water shortages for the mining sector that could impair future growth of the sector (similar to current energy shortages). Water is an acute problem of Lerala mine as it operates without a license to abstract water from the Limpopo River.

IWRM and cross cutting issues

Climate change is the most relevant cross cutting issue for the mineral sector, particularly where it affects surface water resources such as dams. Moreover, heavy downpours and floods may lead to in-pit problems, especially in northern diamonds mines. Reference was made to the submission to COP17 by the International Council of Mining and Metals.

IWRM & WDM in Mining

Examples were given of reuse of water within the existing mines and the construction of the storm water dam in Orapa. Figures on the water losses (UfW) in the sector varied from very low (around 3%) to around 15-20%. These figures need further verification. Debswana managed to reduce water consumption by 33% in the period 2003-2008 (target was 50%). It is increasingly difficult to achieve further water

consumption gains as the 'easiest and most rewarding' interventions have already been made.

Key Elements of the Plan

The presented draft observations regarding Vision, goals and targets were generally supported with the following observations. First, the mining sector already reached close to 100% re use of treated effluent. Botswana at large should meet the NMPWWS target of 96% earlier than in 2030! Second, the mining sector should commit itself to priority use of water of qualities unsuitable for domestic and livestock use. Only where such resources are not available, fresh water should be used. Thirdly, the IWRM-WE plan should particularly target new mines to ensure that they fully embrace IWRM and WDM. For example, mining rights could be made conditional on full IWRM/WDM plans for each mine. The current EIA/SEA procedures can be used but are not sufficient at present. The IWRM-WE plan should ensure that IWRM-WDM guidelines are used in the preparation of EIAs. Fourthly, emphasis should also be on development and utilisation of water efficient technologies in the mining sector. Finally, the IWRM-WE should use the cluster analysis and reports, which indicate where the largest water challenges are likely to occur.

Lessons from the mining sector for other sectors and the IWRM-WE plan:

- The importance of water must be fully appreciated (this is obvious for mines);
- Appreciation of the high costs of water stimulates water conservation.

Water-use Allocation and Prioritisation

The meeting supported the prioritisation of water requirements for basic domestic use and for environmental requirements. Where large scale supply opportunities still exist (e.g. Zambezi Chobe), water allocation should be carefully considered and prioritised, including domestic, industrial, agricultural and mining needs. Mining should use as much as possible water that does not compete with domestic, other potable and livestock uses. Where mines are located close to Wastewater Treatment Works (e.g. Francistown), mines could reuse treated effluent.

Data, Capacity and Methodologies

Sufficient capacity exists within the mining enterprises. Debswana now has sustainability managers for each mine. Government capacity is limited and therefore mining enterprises should facilitate data collection and analysis for government. The main problems are that mines sometimes exceed their water quota and that only a few mines submit regular water abstraction reports (e.g. Debswana and BPC).

Monitoring, Evaluation & Research

M & E is DWA's responsibility and needs to be integral part of the IWRM-WE plan. The plan is that the hydrology parts of DGS will be merged with DWA, but it is unclear when this will happen. Research topics that emerged during the discussions:

- Technologies to reduce evaporation from surface water sources (e.g. dams);
- Potential of mine shafts and pits to store water;
- Potential of water as by-product from coal bed methane production.
- Reclamation of water from tailings dams (and water quality concerns);

1.1.4. Tourism sector

Situation analysis

Three types of tourism activities can be distinguished:

- Tourism activities in settlements with water reticulation systems;
- Tourism activities outside settlements in water rich areas (e.g. delta)
- Tourism activities outside settlements in water scarce areas (e.g. CKGR and Gemsbok Transfrontier Park)

For category 1, water is currently supplied by WUC, DWA and District Councils. In future all water will be supplied by WUC. For categories 2 and 3, companies and individuals have to develop and maintain their own water supplies (subject to water abstraction rights).

The following water concerns emerged during the meeting:

- Water shortages affect tourism in Maun due to flooding of the well field and inadequacies in the infrastructure. For private operators, (waste) water infrastructure development can be very expensive.
- Water quality concerns due to salinity and effluent disposal. People differed as to how problematic water quality concerns are at present. There was agreement that methods of waste disposal might lead to pollution in the future and this must be avoided.
- Lack of data and monitoring of water consumption, effluent disposal etc. There is no institution that systematically collects such data. In addition, there is no analysis and interpretation of existing data. There is no monitoring of actual water consumption of water rights (which have a daily abstraction ceiling based on the expected requirements)
- Sectoral approaches towards resource & development planning. Land and water use planning need to be fully integrated
- Water competition with other sectors such as agriculture, particularly in WMAs. This is mostly due to agricultural expansion and water use in villages for livestock.

Information sources: BTO has water saving guidelines in their ecotourism standards. Aqualogic study on water consumption in tourism camps in the delta; EPSMO (OKACOM TDA reports) study on tourism impacts of changes in water in the delta;

BiOkavango reports on water and tourism; BOBS water standards and DWA Water Quality Monitoring project.

IWRM and Cross-cutting Issues

Poverty eradication and climate change (CC) are the most relevant cross cutting issue. Poverty eradication is a driver of pro poor tourism and CBNRM. Climate change will alter water resource availability and change tourism opportunities. The example of NG 23, Duba Plains (a shrinking island) was discussed. This may be due to long term cycles within the delta and/or to CC.

IWRM & WDM

Most issues were discussed above. Tourism companies implement IWRM & WDM to different extents. BTO will provide examples of CBOs, camps or lodges (mostly camps which have attained Ecotourism Certification) with best water conservation practices that can be included in the IWRM-WE Strategy. Water charges are helpful to conserve water and recover water supply costs. Payment for ecosystem services and a water use charge on volumes for self-providers are currently being considered. Affordability needs to be kept in mind. Water resources are an economic good with a value & price but its public good nature must also be kept in mind. The case of CBO water charges for the rights of passage through water in their area was discussed.

Metering of water production and consumption is important to identify the location and nature of resource wastage (e.g. tourists, workers or facility operations) and to design proper interventions.

Key Elements of the Plan

The presented draft observations regarding vision, goals and targets were discussed with the following observations. Education and awareness raising must be added as a goal. Technical solutions are insufficient if people do not understand their purpose and how they should be implemented. The targets are too specific and need to be rephrased to ensure that take into account specific conditions (e.g. water tanks do not work with thatched roofs). Generally, the tourism sector should implement water saving technologies and reuse/ recycle treated effluent.

Water use allocation and prioritisation

Water rights and conservation should be included in the lease conditions. WAB should grant water rights ceilings based on water savings technologies and real needs. Education about the value and scarcity of water among workers and tourists is essential to increased efficiency. BTO has a water saving paragraph in its ecotourism standards, which can be used as an efficiency model for tourism outfits.

IWRM and land use

IWRM must be fully integrated in all aspects of land use and development planning (especially EIA/SEA, NDP/DDP and CBNRM). Various land uses impact on the river flow, water quality and sedimentation patterns, changing the ecosystems and related

eco-tourism (e.g. river sand digging, changes of water flows, overgrazing and irrigation).

Given its new mandate of water resource management (WRM), DWA needs to ensure integration of WRM into land use and development planning (to make it IWRM).

IWRM capacity

Knowledge about IWRM and WDM is still limited, particularly at district level. For these to work in the tourism sector, the business case must be made for their implementation. Staffing is also very limited (e.g. 2 persons to deal with wastewater and pollution control in Ngamiland) and often equipment is broken down. There is therefore need for training and maintenance of equipment.

Data collection (e.g. monitoring) can be expensive thus effective and efficient methods need to be identified/ used. Subsidies should be introduced on water efficient instruments to promote their usage.

Monitoring, evaluation & research

M & E is DWA's responsibility and needs to be integral part of the IWRM-WE plan. Indicators are needed to guide data collection. The collected data need to be analysed and interpreted (often forgotten). The WAB registry of water rights needs to be computerised and utilised for IWRM (e.g. annual analysis). A discussion about the pros and cons of wildlife boreholes evolved, leading to the conclusion that interventions must be based on proper analysis of the consequences (costs and benefits). Metering of tourism operations will provide valuable M & E data.

1.2. District consultations

1.2.1. South and south western consultations (held in Kang)

Situation assessment

The major source of water in the Kgalagadi/Ghanzi area is groundwater particularly in the form of boreholes. There is no surface water in the area and thus dependency on boreholes is high. Water is used for various purposes including (in order of importance): household use, livestock, wildlife and limited crop production. Game farmers have their own boreholes and use float switches. For wildlife in protected areas, solar powered boreholes are used to provide water for the animals. However, the wildlife species in the area do not consume much water as they are not water dependant.

Water challenges

Water quality is a major problem in the south-western part of the country. The water is often saline and requires adequate treatment for it to be used sufficiently. However, treatment is costly and some cannot afford it. In most cases, consumers do not have access to information as to how they can address salinity issues. While saline water is usually not a major problem for wildlife, for livestock it is a constraint therefore

livestock farmers are often compelled to travel long distances in search of good quality water. Since the introduction of the backyard gardens' scheme, a few households are engaged in this activity. However, saline water blocks the drippers of the irrigation system. Unfortunately, this requires the use of filters and chemicals in-order to tackle the problem and thus has cost implications.

The available water resources are limited in terms of quantity. Borehole water level is declining and yields are very low. In some instances, for example, in game parks, animals have to use one water point because the other ones do not have adequate water. Groundwater recharge is poor largely due to overutilization, over-pumping and lack of monitoring of water levels.

There is indiscriminate use of water especially around communal standpipes. Some community members do bowse public water to their cattle posts thus violating the law for intended use of the water source. In addition, livestock is kept in residential areas thus consume water from the local sources.

With regards to livestock farmers, most of the farmers still employ traditional methods of farming. Overstocking is very common thus excessive water abstraction is carried out. Some boreholes are shared among farmers (syndicates, family members/relatives, etc) and this puts pressure on the water resources. Water constraints are exacerbated by the aridness of the climatic conditions in this area. As such, evaporation rates are also high due to high temperatures thus exerting more pressure on the available water resources. Ideally, consumers should apply for water rights from the Water Apportionment Board. However, some water users exploit water resources without attaining water rights from the board.

The newly introduced backyard gardens concept is well received by communities but there is fear that more water will be used for the crops. Therefore it will be costly to water the gardens because of the high water charges incurred by the users.

There is an outcry that facilities and infrastructures are not maintained by the relevant stakeholders. These include government departments and schools where there is excessive abstraction of water. People's attitudes need to change so as to enhance sustainable development and sound water resources management.

Alternative sources of water

Use of non-conventional water sources is limited. Grey water reuse is not practiced mainly because of lack of awareness and information on the benefits of undertaking such an activity. However, some tourism facilities such as Nkisi lodge in Kang have a greywater reuse system in place where the returned water is mostly used to water the vegetable garden and wash bed linen. Rainwater harvesting is limited although most government institutional houses are installed with rainwater tanks. There is poor maintenance of the institutional houses and the rainwater harvesting tanks hence people do not use them. It seems people have not grasped the idea of harvesting rainwater regardless of the current water situation in the area.

Water conservation and management measures

Current practices

At Hide-out game farm, there are over 300 game animals and water is provided for by three boreholes and five water points. One borehole is used at a time and pumps 40 000m³ /hour. Pumping is done in a sustainable manner and water levels are monitored. Water abstraction is kept at bay and the farmer only pumps what is needed. This is also done to reduce evaporation.

For livestock farmers, they usually pump water from the boreholes at night so as to fill the reservoirs. This water is used during the day for livestock drinking. This is a form of management strategy as in this case, the water is not pumped all throughout the day. Department of Water Affairs encourages farmers to implement water management measures. However, most of them do not comply with instructions and do not adopt water management strategies.

The participants were not aware of guidelines that encourage sectors to manage water.

Proposed management practices

- There is need to introduce water measuring devices (metres) in boreholes which are used to measure how much water is available, how much can be pumped and consequently how much should be left in the borehole. This instrument will thus monitor the water levels and inform the user on the amounts they are using;
- Practice under-pumping as opposed to over pumping – use the right equipment;
- Effect efforts to purify water and this should consider affordability of consumers;
- Utilise rainwater as a way of blending saline water;
- Collect rainwater for use in other activities such as gardening and to solve connection problems that is currently the case. There is fear that WUC will disconnect water reticulation pipes.
- Construction of small dams or small water points in order to tackle loss of water due to evaporation. Water points (game parks and farms) could be lined as well. However this should be done in an ecologically sensitive manner.
- There is need for guidelines on water resources management specifically for farmers (livestock and game) and this should be stipulated in the law. Farming practices should be in compliance with water resources management. Water laws should be enforced.

For these to work, there should be extensive training and awareness campaigns to sensitize users on the importance of managing water. Although this has been done a number of times, efforts should still be made with practical demonstrations. In

particular, priority should be on promoting alternative uses of water. In addition, water should be afforded its true value and this should be reflected in its price and limited subsidies to be promoted.

Results of EIAs and SEAs should be mainstreamed into water resources management. In a number of cases EIA reports are just shelved and not implemented thus defeating the intended purposes of addressing natural resources management. Furthermore, those that are undertaken mostly fail to pick up a number of important issues thus hampering sustainable use and management of resources.

Sustainable Water Management and IWRM

Institutions

Capacity

Most stakeholders do not have sufficient capacity in terms of efficient water use and water resources management. In the Agricultural sector (departments), those who deal with water and irrigation issues are more concerned with water management as they address the issues on a daily basis. Therefore, in other divisions whose mandate is not explicitly concerned with water management, they often sideline water issues.

The Department of Wildlife and National Parks alluded that they are guided by the NWMP (1991 and 2006) when addressing water issues and development of water resources, in this case, boreholes for wildlife water consumption. However, most of the time, construction of boreholes is tendered out to companies and when the job is done, they leave. In many cases, DWNP officers do not have the skills and knowledge as to how to monitor water levels of boreholes, recharge, yields, water quality, etc. Lack of capacity in such aspects thus limits the officers to fully manage the resources hence they end up being depleted and some not even looked after.

Schools are the highest water users but water management is not adequately practiced in these facilities. They get bulk water and teachers often do not incur the costs of water use and where they pay, the charge is minimal. In addition, maintenance of the facilities is poor and the Councils as the overall authority for schools incur all the costs. In this sense, the users are not obliged to use and manage water efficiently. To address this issue, there should be separate water meters for schools and teachers' houses such that teachers pay for their water consumption.

Water Sector Reform

Since the implementation of the reform where WUC is the sole water supplier, there has been a widespread shortage of water. The participants alluded that WUC takeover was done haphazardly, preparation was done poorly and the public has not been adequately consulted. WUC does not have sufficient capacity to provide water services and in some areas there is no infrastructure. In other areas, WUC has disconnected water reticulation pipes and this has affected social structures among the communities as people are forced to lock their water taps thus hampering communal sharing of water which has been the case for some time. The service provider needs to determine how DWA and district councils were operating in availing water to the public and

review the instruments they were using. WUC was charged mainly with operating surface water and reservoirs and now they face challenges of operating boreholes. Operation of boreholes and dams is different and the challenges vary as well. Therefore WUC's capacity to operate and manage the former is questioned. They still require the services of DWA to help with the takeover because more problems will incur in the future.

It is anticipated that poverty will increase with the implementation of the reform process. Those who cannot afford water will be worse off and those who were in the queue for connections, it will even take longer for them to be connected. However, one of the positive expectations of the reform process is that there will be timely and informative water bills for the consumers. Before, some people could wait as long as six months before they could pay for water because of no bills and where available, the bills only indicate how much one has to pay. In some areas, there are no water metres and therefore consumption charges can be wrong because it is not known as to how much one has consumed.

Water as a social and economic good

In order to keep water affordable and available to all, water demand management measures should be implemented to enhance efficiency. This could be done through the following:

- Water conservation at schools as a mainstream subject. It should thus be in the curriculum at all levels.
- The polluter pays principles should be implemented and those who waste water should be charged as well.
- Water reticulation facilities should be maintained on a regular basis to reduce water losses and unaccounted for water².
- The building control Act should be amended to provide for water saving measures in all building developments.
- Implementation of policies and enforcement of water conservation laws.
- Livestock watering in residential areas should be prohibited and the culprits should be charged.
- There should be proper monitoring of water consumption through meter readings and keeping daily records to pick up gaps and demand patterns especially in institutions (A model similar to MOMS used in wildlife management areas).
- There should be designated people in institutions who will deal with water issues and utility expenditures. This could be administration officers.

With regards to the needs of the poor and vulnerable groups, it was indicated that social nets be used to cater for their water needs. However, these safety nets should

² WUC uses the term non revenue water to cover both water losses and unaccounted for water. In this report, the terms are used interchangeably.

be tightened to ensure that the poor graduate from the programme and become self sufficient to provide for themselves and reduce dependency on government.

In-order to ensure that WUC avails adequate water in small and remote settlements, new boreholes should be drilled informed by an adequate water survey. In addition, WSR should be reviewed to ensure that WUC is well placed to carry out its mandate.

In terms of water allocation, the existing policies worsen the water situation as allocation is skewed towards human consumption leaving behind other uses. This is exacerbated by the land allocation regime. Therefore there is need for a review and updating of water and land related policies and should also be harmonised to provide for integration.

Policies and laws

Our policies are old, fragmented and often overlap. In many cases, Batswana do not have adequate understanding of these policies and the relevant officers who are responsible for their implementation, often lack their basic knowledge as well. There if therefore need to raise awareness and educate the public and civil servants on policies and how they link with policies from other sectors such as land. This will reduce conflicts that are often incurred during implementation.

Gender issues

This area is not clearly understood but the participants highlighted the need for women to be champions of water management as they are most affected by water challenges such as travelling long distances in search of water. There is need for sensitising the public and water users at large on the importance of a gender sensitive water sector.

Issues for the IWRM/WE Plan

Participation

In order to enhance participation, the consultation process should stem from the grassroots level by including the traditional authorities (chiefs) as they are the representatives of the people. However, this could be done through 'Ntlo ya Dikgosi' to afford them to be involved in decision making on IWRM planning and implementation.

The planning process has to target groups such as the borehole owner and irrigation farmers to raise awareness and educate them on water use efficiency and management of water resources. Water users committees could be formed at district level and will be charged with implementing water management and monitoring activities at the local level.

There should also be an umbrella advisory body at district level that will deal with water issues and advise other stakeholders on water management practices (almost similar to DLUPU). This body should also be part of implementation of IWRM plan and monitoring of activities and interventions recommended by the plan. It was mentioned

that this structure should be institutionalised and the secretariat would be DWA while the District Commissioner of a particular district would be the chair of such a body. All relevant institutions/sectors would be represented in this structure including civil society and private companies.

Funding and financial needs of the plan

It is expected that the plan would be funded from the government's coffers. Different government ministries and departments should budget for the interventions of the plan through their annual budgets so that the interventions are not left out during planning. In this way, progress towards attaining the objectives would then be monitored and evaluated accordingly by the relevant department. For transboundary water issues and activities, river basin organisations and authorities should be responsible for sourcing funding of the recommendations of the plan. Other potential funding mechanisms identified include donor agencies and in-kind resources through education and training institutions. Such institutions could be approached for capacity building purposes. It was highlighted that it is however important that the correct people be trained as opposed to training only those who are responsible for decision making and those who are likely to retire in the near future before implementing the plan. It is therefore important to undertake a needs assessment to determine where and who needs capacity in IWRM.

1.2.2. Northern -North East consultations

Situational Analysis

The major sources of water in the Northern part of the country are surface and ground water sources. Most of the water that is used for most social and economic activities is supplied through the big dams in the area being Shashe and Ntimbale Dams.

Overview of the Orapa Mine water situation

The Orapa Mine requires 17 Mm³ of water per year and it gets this water from the two major sources being;

- Wellfield: The mine has 200 production boreholes which produce 12 Mm³ per year. These boreholes all have water rights and results are submitted to the Water Apportionment Board on a yearly basis;
- Debswana has a Water Policy and Strategy which guide water use and management;
- Mine ground water control: the mine is engaged in the dewatering of pits around the kimberlite pipes. The dewatering produces about 5million m³ per year;
- The mine also has a storm water dam which is able to provide 1 MCM per year and therefore has been instrumental in water harvesting;

- There is 100% reuse and recycling of water used in the operations of the mine.

In addition to the above, the mine has several observation boreholes which give an overview of the dewatering levels and are currently installing a telemetry system which will be able to give water levels every hour.

In general, stakeholders do not have knowledge as to how much water they consume and there is lack of monitoring. Farmers usually exceed the carrying capacity of the rangeland where there are limited water resources. This exerts pressure on the resource and eventually leads to depletion. There is also no monitoring to ensure that the individual farmers adhere to the allowed abstractable quantity of water.

Cross cutting issues (Poverty and Climate Change)

Poverty

In order for the poverty eradication initiatives to be successful these have to be able to respond to the village dynamics as opposed to having one initiative and hoping that it will work throughout the country. Interventions have to be different and the water sector should have different approaches in order to ensure that water is made available to the poor and the needy.

Well-developed villages should have in place systems that are different from the least developed ones. In well developed areas, private water connections are the norm and the poor should be provided with their own private water connections. In less developed villages, water infrastructure is not usually in place hence communal standpipes that use tokens should be erected to cater for the poor. This will help improve access to safe drinking water for the poor and the needy.

Climate Change

In order to address problems/challenges associated with climate change, the water authorities have to devise ways of trapping both storm water and rainwater. Rainwater harvesting should be encouraged at household level and awareness created on the benefits of such a system. Towns like Gaborone and Francistown which are paved should have storm water dams that can be used for a variety of purposes depending on the water quality. The storm water can be directed to such dams using the available network of storm drainage systems.

The agricultural sector has to also come up with interventions that will show how they are adapting to the changing rainfall patterns. For example, they should promote the planting of crops that mature quickly and within the shortened rainfall season of November to early April.

Since the country is now mining a lot of the underground water resources, the option of artificially recharging the aquifers should be explored. The aquifers can be recharged using treated waste water or rainwater during wetter than average periods.

Sustainable Water Management

Issues raised and proposed solutions are outlined below;

- Government institutions such as schools, BDF, Botswana Prisons were identified as the major institutions that waste water and do not really account for their water usage. The water wastage is due to a number of factors such as dilapidated infrastructure, lack of awareness and the lack of accountability since water is paid for through a centralised system. There is also lack of ownership, as a result of them not paying for the usage as mentioned above. There is no surcharge for those who misuse.

It was proposed that;

- The institutions have to be given a quota/threshold that they are to utilise in a given period for effective water management. The quota should be estimated based on the number of people in the institution as is currently done when a budget is developed for feeding in schools and prisons. Funds availability should not be used to determine the volume of water to be used as this perpetuates the problem of water wastage.
 - To improve accountability for water usage, the payment for water bills should be decentralised to the user institutions. The budget should be based on quota developed above.
 - Maintenance of institutional infrastructure should be prioritised to bring down the percentage of unaccounted for water. DBES should be given funds to carry out maintenance in government owned institutions.
 - Extensive capacity building and awareness creation should be carried out to ensure that all stakeholders are able to practise water conservation and implement IWRM.
- Stakeholders are not involved in water management issues hence there is no meaningful participation and this has promoted sectoral planning.

It was proposed that the plan should promote the formation of Regional/District Water Balances Forums. These forums will be mandated to report issues related to water management, challenges experienced and be able to account for water used and how anomalies will be addressed. The Forum will be expected to have a thorough understanding of the water resources in the region.

Government and major water users should create a post for a Services Accountant (for water and electricity) within the departments. The officer should be able to audit the department in terms of water usage, IWRM planning and remedial actions to be carried out.

- There are currently no monitoring tools for private boreholes within the country. Most boreholes do not have water rights and if they do, these are normally used for the wrong purpose such as guaranteeing loans with

financial institutions. Pumping tests are rarely done on the boreholes and if they are done this is not interactive often leading to the over mining of the resource. The lack of interactive modelling has also led to the unsustainable practice of having a relief borehole which leads to over pumping. Once a farmer has been granted rights, they continue withdrawing that amount regardless of whether the yield goes down therefore monitoring of the resources is lacking.

As way forward the following were proposed;

- The WRB should develop standards that will be followed by all borehole owners. This should include the installation of water meters for purposes of measuring the amount of water pumped on a yearly basis.
- Interactive models of ground water should be used so as to be able to monitor the impacts that boreholes have on each other as well as to use the information when water rights are granted.
- The WRB should do away with relief boreholes as this leads to unsustainable water pumping.
- The WAB was shown to have failed in its monitoring duties of the water resources. As such a call was made that the anticipated WRB should be given more powers in order for it to be able to enforce water laws. Enforcement has failed in the past because government departments have always been left to do as they please resulting in unsustainable water resource management.

The WRB should decentralise its operations and have centres throughout the country and each centre should facilitate the work of the Regional/District Water Balances Forums proposed above. The centres should also have a fully-fledged monitoring arm which will monitor the performance of wellfields; quality and quantity of water as well do interactive modelling for the wellfields. Monitoring should be the mandate of the WRB and not individuals as is currently the case.

The WRB should also put in place incentivised positions so that they are able to attract professionals to these centres. Thus the centres have to be headed by senior officials who will be able to influence/change course of district developments.

- The legislation for managing water should be revised and made in such a way that it does not give absolute power to a politically elected official but rather to an institution/professional that can be held accountable. The power given to politicians by the policies and acts have worked against the principles of

sustainable management of the water resources as in most cases professional principles and best practices are overruled by the Minister.

Water Sector Reform Process

A number of recommendations were made with regards to how Water Utilities Corporation is currently discharging its mandate.

Since the country has run out of dam sites, a robust Water Demand Management (WDM) strategy should be implemented and this should be visible even in the estimated future water needs of the country. Currently optimization of the water resources is done inclusive of the water that is wasted. At 22% this is a significant amount that can be used for the development of the country. Thus WUC should strive to bring this down in phases to as low as possible.

WUC and DWA should be involved in the land planning process at the district level to ensure that land allocation/use does not have impact on the water resources. Currently a lot of water is being polluted as has been seen in the cases of Ramotswa, Ghanzi and Serowe wellfields. These institutions should also attend meetings of the District Land Use Planning Unit.

- In order to maximise the economic benefits of dams, WUC should encourage the principle of Multi Use Dams. However this should not be done to the detriment of the water resources. WUC does not have capacity to monitor and optimize the other uses of the dams hence it has to work with other government ministries.
- WUC/DWA/WRB has to put in place a process of issuing excavation certificates in order to avoid damage to their water network of pipes as this is a costly and time consuming to the institution. If there is an institution already issuing these certificates, then there has to be a section where they will authorise.

1.2.3. East consultations (Palapye)

Situational Assessment

Water characteristics

The region is characterised by mostly surface water sources and boreholes. The North-South Water Carrier is a 400km pipeline that transfers water from Letsibogo dam in Mmadinare to the south eastern part of the country. This also provides water to the central region. In addition, construction of several dams is almost complete (Dikgatlhong, Thune and Lotsane dams) and these are said to be the last available sites for major dams in the country. Although limited, groundwater resources are also significant. Some are government owned while some are privately owned by farmers and mines. Water is used for various purposes including domestic, livestock, industry,

wildlife and the environment. For wildlife, water is mostly availed through natural water points while in some protected areas, there are solar powered boreholes.

Water sector challenges

There are several issues pertaining the availability and use of water resources in the Central district. The major issue identified is sector planning where sectors plan individually without consulting each other and these results in misuse of resources and misinformed infrastructure developments. In addition, developments and strategies are often implemented before planning. There is therefore a strong need for integrated planning and IWRM promotes such efforts hence the importance of developing an IWRM -WE plan that communicates with all sectors.

With regard to *Water Utilities Corporation (WUC)*, there is limited monitoring of aquifers and this results in low water levels in the boreholes. There is misuse of water resources and over pumping largely because of increasing demand and lack of water conservation efforts. It has been observed that some users pump for as much as 24hours as opposed to the required 8 hours of pumping. This exerts pressure on the available water resource. Where available, public standpipes are misused by local communities because of continued abstraction and no charges for water abstraction. In such areas, some consumers can bowse water in large water containers for other uses other than domestic purposes. Livestock water consumption from standpipes is common as well.

In the case of *schools*, there is water wastage in school facilities (toilets and taps) despite the daily environmental conservation messages that are relayed to pupils. It was indicated that most of the time, teachers do not have adequate capacity to stringently tackle water conservation issues and apply management measures. In addition, they do not have the motivation to save water because they do not incur the costs of paying for utilising the resource. As with most government institutions, government pays the water bills for schools.

In the *livestock* sector, there is over pumping of boreholes and limited monitoring of abstraction levels. Farmers still employ the traditional methods of farming where in many cases, there is overstocking despite the unavailability of water. Moreover, some farmers share boreholes also not considerate of the number of animals that utilise that particular resource. Therefore, carrying capacity is exceeded and there is pressure on the water resource.

Regarding *mining*, there is a concern that intensified mining explorations exerts pressure on the available water resources.

During the dry season, wildlife tends to migrate in search of water and they concentrate on one water point in large numbers. This causes deforestation and transmission of diseases such as anthrax. Furthermore, in the Boteti area, there have

been cases of elephants intruding people's property in search of water. This is a form of human wildlife conflict that exists in relation to water resources.

The wastewater treatment works in the region use the pond system and therefore are mostly designed to discharge into the environment hence the resource is not immediately available for other purposes. In addition, downstream, communities use the resource for domestic and agricultural purposes and therefore the quality of the effluent that is released and later utilised downstream is questioned as well as overall inadequate treatment of wastewater for reuse and recycling.

There is also a concern that most of the major rivers have been dammed without due consideration of environmental flow requirements. Environmental flow assessments would thus assist in determining the quantity and quality of river flows required to sustain the freshwater, aquatic and surrounding ecosystems as well as the livelihoods that depend on these ecosystems. It is therefore important that efforts be made towards undertaking these assessments for most of the rivers and dams.

Water management and conservation measures

WUC

- Prepaid standpipes – these require use of a token and for consumers to attain a token, they need a land certificate which shows that indeed they reside in a particular area.
- WUC encourages consumers to connect water in their yards;
- Water tariffs – however, some consumers can use water beyond what they need because they can afford to pay high tariffs for consumption. Therefore in some cases, tariffs are not good instruments for water management;
- Education and awareness campaigns on water conservation.

Primary schools

- Environmental education is integrated in the curriculum;
- Installation and use of water storage tanks. Water from the kitchens is sometimes used in the school gardens.

DEA/Environment

- Environmental impact assessment of dams, mines so as to assess potential impacts on the environment and water resources. Environmental management plans are also prepared as well as environmental auditing. However, often auditing often takes time because of limited capacity within DEA;
- Participation in annual environmental day commemorations;
- Education and awareness – e.g. newsletters, talk shows and dialogues to engage the public and interested parties in discussing environmental and water issues.

Physical planning

- Encourage people to use conservancy tanks as opposed to pit latrines;
- 6km by 6km rule for distance between boreholes;

Households

- Educate children on sustainable use of water and water conservation measures.

Cross cutting issues

Poverty

- The impoverished should be connected with water;
- The poor are among the major water polluters as they utilise pit latrines which are sometimes located near water resources hence affects the quality of that particular water resources;
- Abolishment of standpipes will increase poverty. Councils will have the responsibility to assist people with yard connections and this will hence burden the council budget.
- Backyard gardening is an important scheme that helps generate cash income, food production, promotes healthy nutrition as people include vegetables in their diets and leads to food security. Although the objective is to eradicate poverty, it was indicated that the scheme might not be able to achieve this objective because some farmers cannot afford to pay for water.

Gender

Water use and management greatly affects women and children as they have to travel long distances in search of water and sometimes the distance travelled is more than 1km. The Department of Women's Affairs empowers women to develop businesses so as to generate cash for and this may be utilised for water connections.

Climate change

Climate change is a long-term shift in the climatic conditions of a particular location. These changes can be natural or human based through inappropriate use of environmental resources, inefficient use of the land and emission of green house gases among others. The impacts are significant and water resources will be largely affected. This will be in the form of water stress where the available water resources would not be able to cater for increasing demands and given the case of Botswana where already water scarcity is a challenge, climate change will have significant impacts on the resource. Evaporation from dams and surface water will increase due to rising temperatures thus will affect the quantity of the resource. Furthermore, there will be less recharge of groundwater resources. For instance, currently the yields of boreholes in the Tswapong area are significantly low and it is anticipated that they will be adversely affected by changes in climatic conditions. Water consumption will also increase hence putting pressure on the water authority to devise means and strategies of meeting the demand and this will have cost implications.

Addressing climate change challenges should be a collective responsibility by all stakeholders. Measures could include:

- Aforestation should be encouraged particularly indigenous plants which do not require significant amount of water for survival.
- Artificial recharge of aquifers should be assessed (economic, social and environmental impacts should be taken into consideration).
- Sound and effective EIAs and environmental monitoring.
- Stringent education and awareness on climate change issues and measures to implement so as to address these challenges.
- Storm water harvesting.

Sustainable water management and IWRM

Water supply costs and water losses

Generally, the costs of water supply are enormous (capital, operation and maintenance) and WUC therefore seeks to recover these costs through its water provision service to various consumers. WUC charges for water use and recovers some of the costs through tariffs. It was indicated that the current tariffs are not sustainable and need to be reviewed.

Costs could also be minimised through integrated planning. When planning to develop water infrastructure in a particular area, the water authority should consult the land use planning department to assess issues around landscapes and get an indication of village expansion and layout. This will avoid unnecessary construction of costly pipelines where they are not needed. Sedimentation of major dams may also reduce costs of water supply. In addition, water authorities should reduce the non-revenue water by maintaining the water supply systems and infrastructure and timely rehabilitation of water networks.

Treated wastewater use

The resource is mostly utilised in the construction sector. The rest of the effluent is discharged into the environment and not utilised for other purposes. Some of the impeding factors include: limited technologies for treatment (currently only ponds); expensive infrastructure for transporting the resource (households); negative attitude and perception of wastewater as well as cultural and social acceptance of using the resource. This therefore requires more efforts towards promoting reuse and recycling among consumers.

Rainwater harvesting

Rainwater tanks have been installed in most institutional houses but the water is hardly utilised. It may sometimes be used when there is a shortage or when the quality of the available water is not up-to standard. Some consumers associate rainwater with poverty and low class while some regard it as dirty water hence its limited utilisation.

Institutional sustainability

There is inadequate understanding of water resources management among stakeholders including the public at large. This results in lack of ownership of resources and leads to negligence as evidenced by water misuse of public standpipes in some areas and water wastage in government institutions.

In order to enhance water management:

- There should be a decentralised billing system where there is accountability by all players;
- Punitive measures should be enforced and be clearly supported by policy and legislation. This should be in relation to those who exceed a certain amount of water for consumption where beyond this rate, they more. The water use ceilings should be agreed upon by the water authorities and the envisaged water regulator;
- Increase capacity among stakeholders to be better placed to implement IWRM.

Water sector reform (WSR)

The reform process has resulted in mixed views among stakeholders. These are summarised as follows:

- Loss of jobs and idling workers because of the restructuring process. WUC has not been able to absorb all employees from DWA and district councils. As a result, some have been left without jobs while some do not know what the future holds for them.
- There is monitoring and accountability for water use by stakeholders such as the councils.
- Consumers are prompted to pay their water bills on time to avoid being disconnected. Before, consumers in the villages could take more than four months without paying for water consumption, not because they could not afford to pay but also because they never received their bills on time.
- Water metering in most households and institutions. In some areas, water meters have not been installed therefore there is no monitoring of water consumption.
- With time the tariffs will increase and communities will be expected to pay more for water consumption.
- There is fear that it may take a long time for consumers to realise the intentions of WUC and the situation is also influenced by the lack of political buy-in especially from MPs and councillors. WUC might be forced to lower their standards because of pressure from politicians.

Participation and communication

To enhance participation and communicate on water management and the recent WSR, WUC organises breakfast shows and kgotla meetings in various villages. Information is also disseminated through bills and there is a toll free number that consumers can call to enquire, complain and report leaks to WUC. WUC is also using existing institutions at village level to disseminate information. Such institutions include sub-district councils and district development committees. It has been encouraged that with time, WUC should form part of these committees. There is need for continual education and awareness raising among consumers because current

efforts are inadequate. Therefore this could be addressed through identifying an existing committee (regional level) that could enhance IWRM (maybe the TACs).

Mainstreaming IWRM in development planning requires adequate capacity among planners such that they prioritise water issues and projects. In the Boteti area, a management plan for Makgadikgadi could be an entry point into IWRM implementation as it has identified water related activities that could be implemented by several institutions.

1.3. Participants in Consultations

Ecological Water Requirements

Name	Organisation
B. Sethebe	Department of Biology-UB
P. Kenabatho	Department of Environmental Science-UB
J. Manga	Department of Environmental Affairs
M. Dipotso	Department of Wildlife and National Parks
O. Dikgomo	Department of Water Affairs
M. Masie	Water Resources Consultants
K. Dikgola	Department of Water Affairs
J. Monngae	Geo Sciences Consultants
W. Masamba	Okavango Research Institute
K. Gaboiphiwe	Department of Water Affairs
M. Magowe	Water Utilities Corporation

Agricultural Sector

Name	Organisation
R. Orman	Agriculture Hub
J. Van der Nat	Fresh Produce industry- independent
W. Kapele	Ministry of Agriculture - NAMPAAD
M. Obakeng	Ministry of Agriculture- irrigation
B. Mathangwane	Department of Water Affairs

Mining Sector

Name	Organisation
O. Lekgowe	Department of Geological Surveys
M. Brook	Debswana
M. Tautsagae	Department of Environmental Affairs
A. Kgomotso	Department of Waste Management and Pollution Control
C. Siwawa	Botswana Chamber of Mines

Tourism Sector

Name	Organisation
B. Mosepele	SAREP/USAID
M. Maboga	Okavango Community Trust
O.N. Dikgang	Department of Environmental Affairs

K.C. Sebeke	Department of Waste Management and pollution Control
S. Motsumi	Department of Environmental Affairs
B. Thamuko	Department of water Affairs
J. Nyamurundira	Okavango Community Trust
T.K. Segaetsho	Botswana Tourism Organisation
J. Jacob	Department of Water Affairs
L.C Van Neel	The Ngami Times
G.Phunyuka	Department of Forestry and Range Resources
K. Nkile	Department of Wildlife and National Parks
M. Mpho	SELF
L. Bankgotsi – Lian	Botshelo guest house
T.C. Bibang	OKMCT
M. Masole	Maduo lodge
O. Ketshogile	Department of Tourism
K. C. Rathipana	Department of Wildlife and National Parks
I.M Mosiapitso	XDT

Palapye

Name	Organisation
N. Toitoi	Boteti Sub-District Council
D. Motlhabane	Water Utilities Corporation
P. Mafavuneh	Water Utilities Corporation
M.P. Ramosu	Water Utilities Corporation
T. Rapitsenyane	Primary Education
G. Ramabe	Water Utilities Corporation
M. Kgomo	Department of Wildlife and National Parks
O. Kgotla	Department of Wildlife and National Parks
B.B Nduma	Department of Environmental Affairs
K. Mafoko	Ministry of Agriculture
E.K. Dineo	Women's Affairs
B. David	District Administration
B. Gaotingwe	Central district Council
K.DGarogwe	Boteti Sub District Council
A.K. Bogosi	Department of Wildlife and National Parks

Francistown

Name	Organisation
J. Motlhaleemang	Department of Water Affairs, Francistown
M. Keakantse	Economic Planning, Tonota District Council
B. Thero	Physical Planning, Tonota District Council
S. Direkileng	Department of Tourism, Francistown

Name	Organisation
M.A Matenge	Tonota Sub LandBoard
G.S Maswabi	Botswana Meat Commission, Francistown
R. Matsebe	Department of Youth, Francistown
T.B. Rahube	Debswana, Orapa

Kang

Name	Organisation
K. Kgaponyane	Education – Hukuntsi
K. Motlogelwa	Department of Wildlife and National Parks, Ghanzi
G. Ramoshibidu	Department of Water Affairs - Ghanzi
M. Moetsabatho	Department of Wildlife and National Parks- Ghanzi
G. Albert	Hide Out Club game ranch
S.M. Mangope	Department of Agric Research
M. Mosarwa	Department of Crop Production

2.0. Appendix B Summary of selected SADC water policy documents

2.1. SADC Water Policy and Strategy

SADC has developed the 2006 SADC Regional Water Policy (RWP) with nine thematic areas to address the water resources management issues and challenges: a. Regional cooperation in water resources management; b. Water for development and poverty reduction; c. Water for environmental sustainability; d. Security from water-related disasters; e. Water resources information and management; f. Water resources development and management; g. Regional water resources institutional framework; h. Stakeholder participation and capacity building; and i. Financing IWRM in the region.

The Regional Water Policy (RWP) is implemented through the 2007 Regional Water Strategy (RWS) and the Third Regional Strategic Action Plan (RSAP) on IWRM (2011-15; SADC, 2010). The successful implementation requires well functioning RBOs, sound legislation, provision for stakeholder involvement and adoption of IWRM principles. Important features of the RWP include:

- Integration of regional issues water issues and challenges in national water management.
- Coordination of RWP implementation with sectoral policies, particularly, those for the major water use sectors such as trade, agriculture, mining, energy and environment;
- Recognition of ecological water requirements as a legitimate user of water;
- Securing adequate and sustainable financial resources for national and regional projects for water resources;
- Recovery of water management costs through user fees, least cost designs and planning;
- Water demand management can be an important cost saving measures;
- Development of partnership between government, donor agencies and private sector to generate financial support for IWRM in the SADC region.

The main policy areas and intervention areas of the RWP and RWS are summarised in Table 1.

Table 1: RWS policy areas and interventions

Policy area	Policy Statement	RWP 2006	RWS 2007
Regional cooperation in water resources	Water for economic integration & water for peace	Integrated WRD and M based on balance, equity and mutual benefits Southern African vision as point of departure	Promote integrated development of shared water courses based on IWRM for economic integration Effective RBOs

Policy area	Policy Statement	RWP 2006	RWS 2007
management		Implementation of SADC protocol Intersectoral cooperation Harmonisation of national policies and legislation Conflict management Water for international cooperation	Implementation of Shared Water Courses Protocol Develop common data base and experience sharing for shared water courses Promote harmonisation of national laws Capacity building in dispute resolution
Water for development and poverty reduction	Water for socio-economic development, sanitation and hygiene, food security, energy development, industrial development and sports and leisure		Water accounting, equitable and sustainable allocation of shared water Promote sharing of benefits rather than resource allocations Promote water use efficiency in Cooling towers of thermal power stations Regional guidelines for water sports and recreation Promote multi-purpose uses (e.g. tourism and abstractive use)
Water for environmental sustainability	Water and environment & water quality management	Water requirements of environment recognised Sufficient water allocations for environment Minimum standards for shared water courses Pollution prevention Import restrictions EIA requirements Control of alien species to reduce water consumption	Environmental flow requirement guidelines Use of EIAs and SEAs Harmonisation of min. Water quality standards Dealing with non-economical alien invasive species
Security from water related disasters	People's protection from floods and droughts Disaster prediction, planning and mitigation	Commitment to human life protection SADC to coordinate disaster management at shared waters and regional level Capacity building disaster predictions Integrated and coordinated RBO plans and procedures Notification duty of impending disasters	Joint efforts to minimise disasters Coordinate optimal resource allocation and use Coordinated strategic infrastructure development Coordinated early warning systems Sharing of information
Water resources information and management	Information sharing	Water resource data management systems Compatible systems Sharing Public access Regular dissemination	Hydro meteorological data systems and networks Guidelines for water resources assessment Awareness programmes Harmonisation of national data bases Prioritise water resources research
Water resources development and management	RBO	RBO approach and plans Water allocation and utilisation based on equitable and reasonable mechanisms through negotiations	Facilitate river basin approaches based on IWRM Develop allocative and regulatory guidelines for use of water resources Develop & promote WDM guidelines & promote WDM Improve info on alternative water sources Research into new technologies Stakeholder participation and empowerment in dam planning.
	Integrated planning	IWRM based Joint implementation	
	WDM	Utilise shared water more efficiently WDM is a fundamental requirement of IWRM	

Policy area	Policy Statement	RWP 2006	RWS 2007
	Alternative sources of water	Rainwater harvesting, desalination, treated effluent	
	Dam development and management	Integrated planning, development and management Participatory process Negotiations of operating rules Affected communities	
Regional water resources institutional framework	Shared water course institutions	Establishment of SWCI and Water course commission Consensus decision making Cooperation with NGOs and civil society groups	Strengthen SADC Water division
	Institutional arrangements at national level	National enabling environments Decentralisation of water management Increased participation of NGOs	
	SADC secretariat	Support for SWC institutions Implementation of RSAP, RWP and Protocol	
	Monitoring and evaluation		
Stakeholder participation and capacity building	Participation and capacity development	Participatory water management including NGOs	Stakeholder participation mechanisms Information sharing
	Gender mainstreaming	Implementation of principles of gender mainstreaming	
	Capacity building and training	Capacity development and sharing Water education and training	
	Research, technology development and transfer	Demand driven water sector research with a regional perspective Sharing of water technologies and info	
	Financial sustainability	National financial resources Cost recovery	
Financing IWRM	Cost reduction	Cost reduction measures	Sufficient national contributions Efficiency Sustainable financial partnerships between stakeholders
	Public-private sector partnerships		

Sources: adapted from SADC, 2006 and 2007.

The RWAP III has three strategic objectives: capacity development; climate change adaptation and social development. The RWAP focuses on three strategic areas, i.e. water governance, infrastructure development and water management. The following programmes will be implemented:

- River basin organisations: RBO development and training, guideline development for RBOs, networking and sharing of best practices and support for basin wide water forums;
- Development of regional instruments: monitoring of Protocol implementation and review, policy harmonisation, implementation of CCA Strategy for water sector and policy training;

- Support for the SADC Water division at headquarters;
- Communication and awareness raising;
- Research and education, e.g. through WaterNet, WARFSA and education;
- Stakeholder participation in transboundary water management, e.g. through support for NAWISA, SADC Water week, gender and youth mainstreaming, policy dialogues;
- Infrastructure development: guidelines for project preparation, training manual on sustainable infrastructure development, etc.
- Resource mobilisation:
- Infrastructure pilot projects: IWRM community projects and joint cross border water initiatives.

2.2. Other SADC policy notes

The SADC 'Climate Change Adaption (CCA) Strategy for the Water Sector was developed as 'climate change acts as a threat multiplier by exacerbating existing vulnerabilities' (SADC, not dated, p.4). The challenges are twofold:

- Adapting WRM to reduce vulnerability to climate change;
- Use WRM to increase countries climate resilience.

The goal of the CCA is to improve climate resilience through IWRM at regional, river basin and local levels. Countries and the region are encouraged to take appropriate measures in the following areas:

- Water governance: awareness raising and education, climate change and water research, stakeholder participation and info/data exchange, integration of IWRM in sectoral and development planning, international negotiations, reforms and financing.
- Infrastructure development: multipurpose water storage, water supply and sanitation, water efficient and more productive irrigation, groundwater development, flood protection measures, hydrogeo-meteorological monitoring.
- Water resource management: disaster management, early warning systems, vulnerability assessments, WDM optimising dam management, water quality, groundwater management and IWRM.

Regionally, the CCA strategy will be implemented through the RWAP III. Botswana should implement the CCA strategy through the development of the national CCA strategy and through the IWRM-WE Plan.

3.0. Appendix C: Review of Transboundary River Basins in SADC

3.1. Introduction

Botswana is a member State to four Transboundary River Basins, **Figure 1**. These include the Zambezi, Cubango-Okavango (“Okavango”), Orange-Senqu and Limpopo River Basins. Further, Botswana is a member of the Southern Africa Development Community (SADC), as well as a signatory to several United Nations conventions. When planning the current and future management and utilisation of Botswana’s water resources, each of these agreements must be considered. This report outlines these international agreements and their implications on the Botswana National Integrated Water Resources Management and Water Efficiency (BN IWRM-WEP) planning process.

The report outlines the International and Regional Legislation applicable to the transboundary water resources of Botswana. The report then goes on to identify the specific actions applicable to Botswana, from the four transboundary river management plans and Agreements. An institutional review of these transboundary institutions has been sourced from Pietersen, K and Beekman, H.E. (2008) *A comparative study on the linkages between River/Lake Basin Organisation and the respective National Governments in Seven Major African Basins*. GTZ. This review provides a critical analysis for three of the four Basins. Limpopo Basin has recently made progress in establishing a River Basin Organisation, and was not included in the Pietersen and Beekman (2008) review.

3.2. International Watercourses: Policy and Conventions

When states have to cooperate in the management of a shared resource, the obvious way for doing so is by concluding international agreements. According to Pietersen and Beekman (2008), this is an act of sovereignty and allows independent States to reconcile national legal and jurisdictional aspects with political and geographical reality. It will not be possible to develop an effective and comprehensive Transboundary – Integrated Water Resources Management Plan (TIWRMP) without the necessary overall plan being in place. All required legal and other arrangements can then be agreed upon to provide for the required framework, principles, powers, monitoring, compliance and institutions. It is important that the relevant National actions of any TIWRMPs are included in the National IWRM Plan of the member States.

International institutions can only do what they are empowered to do through the agreements that create them. It is important to provide them with all the required powers to be effective. The mere existence of an international organization is of formal nature only; its real powers will determine its success. This also involves domestic legislation and the exercise of state power.



Figure 1: Botswana and its participating transboundary river basins.

The incorporation of international legal norms and obligations into the municipal law of the relevant States has to be mentioned. If it is for example decided to adopt a set of uniform international norms to be implemented by the States involved, then the incorporation of such norms becomes an important aspect. Incorporation can happen in several ways. It can start with an international institution with powers to take the necessary decisions and develop detailed tasks, which the member States then have to implement. Another

possibility is to adopt an international framework and then to leave it to the member states to implement it through their own legislation. In both instances adequate national legislation, executive powers and institutions must be in place. There must also be the necessary skills and technical capacity to ensure effective domestic implementation of regional plans on joint cooperation.

Further, National constitutions often contain provisions on the approval, ratification and incorporation of international agreements³. They have to be kept in mind in order to provide for the effective, simultaneous and harmonized implementation of agreements in all the state parties.

Legal arrangements involving more than one state must be sufficiently clear and detailed in order to provide for certainty and predictability, a clear rules-based dispensation and even remedies in instances where that will be necessary. Subsequent monitoring of national activities will in all probability be required, necessitating suitable institutional arrangements.

3.3. International Legislation

When establishing these international Agreements for shared river basins, there are several pieces of international and regional legislation to consider, including *inter alia* the UN Convention on the law of the non-navigational uses of international watercourses, the draft UN convention on shared underground water, the UN Convention to combat desertification in those countries experiencing serious drought and/or desertification, in particularly in Africa, the UN Convention on wetlands of international importance (Ramsar Convention), and the revised Protocol on shared watercourses in SADC (2000). These are discussed further in this chapter.

3.3.1. UN Convention on the Law of the Non-navigational Uses of International Watercourses

The Convention on the law of the non-navigational uses of international watercourses (“the Convention”) was adopted by the General Assembly of the United Nations on 21 May 1997. It represents the codification of the rules of customary international law as regards shared watercourses. It has however not yet been ratified. Some of its provisions are binding as customary international law. The principles of the Convention are however being applied throughout the world, and once ratified it will be obligatory for countries to incorporate the principles into their legislation addressing transboundary watercourses. The Convention established three critical principles in the use of shared watercourses. They are:

The principle of equitable and reasonable utilisation according to a number of factors including social and environmental factors. This principle states that these must be considered on a case-by-case basis (Article 6);

³ See South African Constitution (1996) section 217.

The principle of obligation not to cause significant harm (Article 7), which protects downstream users of the watercourse from upstream development or utilisation. This principle introduces the possibility of compensation in the event that serious harm is caused;

- The principle of prior notification in the event of planned measures that may “have a significant adverse effect upon other watercourse states” (Article 12);
- These principles essentially obligate basin states to institute a framework for extensive cooperation, information exchange and impact assessment in their uses of international watercourses.
- The framework of the convention aims to ensure the utilisation, development, conservation, management and protection of international watercourses and the promotion of the optimal and sustainable utilisation thereof for present and future generations.
- The convention is comprised of 7 parts and 36 articles. Of particular relevance, Part I – Part V relates to the sustainable and cooperative management of the shared water resources.

3.3.1.1. Part I: Introduction

Articles 1 and 2 composed under Part I set out the scope and terminology of the Convention. Articles 3 and 4 relate to establishing watercourse agreements. In the context of Botswana’s shared watercourses, some form of Agreements have already been established on all four River Basins.

3.3.1.2. Part II: General Principles

Article 5 presents the need for equitable and reasonable utilisation and participation, recognising the right to utilise the watercourse but also the duty to cooperate in the protection and development thereof. Article 6 identified factors to be considered relevant to Article 5, including *inter alia* geographic, climatic and hydrological character, social and economic needs, population dependency, existing potential use, impacts of use of the watercourse on other watercourse states, the conservation, protection and development and economy of use of the water resources, and the availability of alternatives. Equitable utilization is not defined and therefore practical needs are to be considered and the guidelines of Article 6 have to be taken into account. Ideally the states in question should negotiate and agree on the utilization of the watercourse under discussion. In the absence of an agreement, a watercourse state must apply the relevant legal principles to demonstrate to others that it has respected the law. It is now

customary international law that other watercourse states should not be deprived of their equitable benefits of an international watercourse⁴.

Article 7 outlines the obligation not to cause significant harm, or where harm is caused the responsible States must take appropriate measures, in consultation with the affected State, to eliminate or mitigate such harm and if necessary provide compensation. No mechanism is identified to determine what is defined by “significant harm” or what method of determining/ type of compensation. Articles 8, 9 and 10 address the obligation to cooperate, facilitate regular exchange data and information and the relationship between different uses, respectively.

3.3.1.3. Part III: Planned Measures

This part and its Articles provide guidance to member States intending to carry out planned measures that will affect the condition of a shared watercourse, an example of such planned measures may include dams, diversions, contamination, flood/drought defence, etc. The Articles call for the notification of planned measures and possible adverse effects, a period to reply to the notification, obligations of the notifying State during the period of reply, reply notification, absence of reply notification, consultations and negotiations concerning planned measures, procedures in the absence of notification, and the urgent implementation of planned measures. Article 33 in Part VI and the Annex make provision for further dispute resolution and arbitration respectively.

3.3.1.4. Part VI: Protection, Preservation & Management

Article 20 calls for the protection and preservation of ecosystems of international watercourses. Article 21 sets out measures and methods to prevent reduce and control pollution of shared watercourses, including *inter alia* setting joint water quality objectives and criteria, establishing techniques and practices to address pollution from various sources, identifying harmful substances to be prohibited or limited. These measures are particularly relevant to the Botswana National IWRM Plan, to ensure that these measures are followed up and established for each of the shared watercourses (Currently only the Orange-Senqu has begun to determine these parameters). Article 22 relates to preventing the introduction of alien or new species that may be detrimental to the ecosystem of the watercourse. Article 23 calls for the protection and preservation of the marine environment, including estuaries. This Article is aimed at individual States, in cooperation with the other member States, in terms of their

⁴ See in this regard the comment by Tanzi and Acari *The United Nations Convention on the Law of International Watercourses – A Framework for Sharing*, Kluwer International Law, 2001 at 89.

management of water resources. Articles 24 and 25 relate to the management and regulation of activities on shared watercourses, while Article 26 requires the maintenance and protection of installations, facilities and other works related to international watercourses.

3.3.1.5. Part V: Harmful Conditions & Emergency Situations

Article 27 requires all member States to take all appropriate measures to prevent or mitigate conditions related to international watercourses that may be harmful to other watercourse States, either as a result of natural causes or human conduct, including *inter alia* flood or ice conditions, water-borne diseases, siltation, erosion, salt-water intrusion, drought or desertification. This requires that individual States management of water resources addresses these issues. Article 28 makes provision for emergency situations.

3.3.1.6. Part VI: Miscellaneous Provisions

The Articles in this Part make provisions for times of conflict, indirect procedures, protection of data and information vital to national defence or security, non-discrimination and the settlement of disputes. While the Articles of this Part are relevant to shared watercourses, they do not require action in terms of the Botswana National IWRM plan.

3.3.1.7. Part VII: Final Clauses

These Articles relate to the signature and ratification of the convention and its entry into force.

3.3.2. Draft articles on the Law of Transboundary Aquifers

Transboundary Aquifers apply to 96% of the planet's freshwater resources - those that are to be found in underground aquifers, most of which straddle national boundaries. **Figure 2** indicates the shared groundwater resources of Africa.

Many shared aquifers are under environmental threats caused by climate change, growing population pressure, over-exploitation, and human induced water pollution. Since they generally extend across several national boundaries, the sustainable use of African aquifers depends on agreed management mechanisms that will help prevent pollution or over-exploitation. Therefore they require integrated and coordinated management by all member States.

According to Eckstein (1995), the Convention (on non-navigational uses of international watercourses) does not acknowledge the intimate way in which water resources are interlinked. It provides for "international watercourses" (article 1), defining a "watercourse" as "a system of surface waters and groundwaters

constituting by virtue of their physical relationship a unitary whole and normally flowing to a common terminus” (article 2). However, this definition excludes:

- Related surface and groundwaters flowing in different directions. For example the Judean Mountain aquifer shared by Israel and the West Bank.
- Water resources that are indirectly related.
- Groundwaters that are unrelated to surface waters. For example, the Nubian Sandstone aquifer underlying Chad, Egypt, Libya and Sudan.
- In order to address this, a draft convention to address the sustainable utilisation and protection of transboundary aquifers is currently being drafted.

On August 5, 2008, the International Law Commission (ILC) adopted draft articles for an international framework convention on transboundary aquifers. The Commission adopted, on second reading, a preamble and a set of 19 draft articles, together with commentaries thereto, on the law of transboundary aquifers and in accordance with article 23 of its statute recommended a two-step approach consisting in the General Assembly (a) taking note of the draft articles to be annexed to its resolution and recommending that States concerned make appropriate bilateral and regional arrangements for the proper management of their transboundary aquifers on the basis of the principles enunciated in the draft articles (own emphasis); and (b) considering, at a later stage, the elaboration of a convention on the basis of the draft articles. Since there would be sometime before a decision is made on the second step, the Commission decided to refrain from formulating a draft article on the relationship between these draft articles and other international agreements and also a draft article on the settlement of disputes the formulation of which would become necessary only when the second step would be initiated.

The Draft Articles are laid out in a similar fashion and similar principles to the Convention on non-navigational uses of international water. Draft Articles 1 and 2 address the scope and definitions. Draft Article 3 refers to the sovereignty of the member States. Draft Articles 4 and 5 relate to the equitable and reasonable utilisation of groundwater and the factors relevant to this. Draft Article 6 is the obligation not to cause harm, however in the draft articles this excludes provision for compensation. Draft Article 7 and 8 refers to the general obligation to cooperate and the regular exchange of information. In particular Draft Article 8(3) must be highlighted, “If an aquifer State is requested by another aquifer State to provide data and information relating to an aquifer or aquifer system that are not readily available, it shall employ best efforts to comply with the request. The requested State may condition its compliance upon payment by the requesting State of the reasonable costs of collecting and, where appropriate, processing such data or information” (own emphasis). This may hamper initial efforts for aquifer management, especially where one State is more readily prepared than another.



Figure 2: Map of African Shared Groundwater Resources

Draft Article 9 provides for bilateral and regional Agreements. Draft Articles 10, 11 and 12 relate to the protection and preservation of ecosystems, the determining and protection of

recharge and discharge zones, and the prevention, reduction and control of pollution respectively. Draft Articles 13 and 14 provide for monitoring and management respectively. Draft Article 15 related to planned activities, which requires the submission of an EIA to member States. Draft Article 16 refers to the technical cooperation with developing States, while draft Article 17 provides for emergency situations. Draft Article 18 relates to protection in time of armed conflict. Draft Article 19 relates to protection of data or information vital to national defence or security. As the second step has not been completed, there are no Articles on coordinating with existing Agreements, dispute resolution, signature, accession or validity at this time.

It is recommended that a Task Team be established, if one hasn't already, to address the draft articles and make provision for bilateral and regional agreements for the relevant aquifers in Botswana. The Task Team should review the existing international Agreements with the option of amending existing Agreements to ensure they cater for aquifers in accordance with the draft articles. Or where these cannot be accommodated, then negotiations need to commence regarding new Agreements specific to shared aquifers and groundwater.

3.3.3. UN Convention to Combat Desertification

Desertification does not refer to the expansion of existing deserts. It occurs because dryland ecosystems, which cover over one third of the world's land area, are extremely vulnerable to over-exploitation and inappropriate land use. Poverty, political instability, deforestation, overgrazing and bad irrigation practices can all undermine the productivity of the land. Most of the endangered dryland regions lie near the world's five main desert areas, including the Kalahari Desert in southern Africa.

3.3.3.1. Convention Provisions and Priorities

The United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification (CCD), Particularly in Africa, the Convention's full name, was adopted on 17 June 1994 and opened for signature in Paris in October 1994. It entered into force on 26 December 1996.

The stated objective of the CCD is "to combat desertification and mitigate the effects of drought in countries experiencing serious drought and/or desertification, particularly in Africa" To achieve this goal, the CCD calls for action involving international cooperation and a partnership approach. It focuses on improving land productivity, rehabilitation of land, conservation and sustainable management of land and water resources. Such action should also prevent the long-term consequences of desertification, including mass migration, species loss, climate change and the need for emergency assistance to populations in crisis.

The CCD establishes a framework for national, sub regional and regional programmes to counter the degradation of drylands, including semi-arid grasslands and deserts. It calls on developed countries to:

- Actively support the efforts of affected developing country parties to the CCD;
- Provide "substantial financial resources" to assist affected developing country parties;
- Promote the mobilization of adequate, timely and predictable financial resources from all official and private sources; and
- Promote and facilitate access to appropriate technology, knowledge and know-how.
- Desertification-affected countries are obliged to:
 - Give priority to combating desertification and drought by allocating adequate resources in accordance with capabilities;
 - Establish strategies to combat desertification and drought;
 - Address the underlying causes of the problem and pay special attention to relevant socio-economic factors;
 - Promote awareness and the participation of local population in action to combat desertification and drought; and
 - Provide an enabling environment through appropriate laws, policies and action programmes.

The CCD also aims to improve the efficiency of desertification aid to developing countries by coordinating donors' efforts and encouraging affected countries to set up national action plans to combat desertification with grass-roots participation, particularly with people who live off the land. CCD framers believed that local people, who are often poor, know more than anyone else about the fragile ecosystems in which they live and work and are thus in the best position to contribute to the fight against desertification. Therefore the CCD stresses a "bottom-up" approach to action. A significant component of this approach is the protection, promotion and use of relevant traditional and local technology, knowledge, know-how and practices. It has become evident that desertification cannot be effectively addressed unless the people most affected are fully involved and committed. It specifically underlines the important role played by women. It also stresses the special role of non-governmental organizations, particularly in ensuring implementation. Of course, governments remain responsible for creating this enabling environment. They must make politically sensitive changes, such as decentralizing authority, improving land tenure systems, and empowering women, farmers and pastoralists.

Under the CCD national action programmes are required to identify the causes of desertification and practical measures necessary to combat it and mitigate the effects of drought. These programmes must also:

- Specify the roles of government, local communities and land users and identify available resources;
- Incorporate long-term strategies;
- Suggest preventive measures;
- Allow for modifications in the face of changing circumstances;
- Enhance national climatological, meteorological and hydrological capacities;
- Promote policies and strengthen institutional frameworks for cooperation and coordination and facilitate access by local people to appropriate information and technology;
- Provide for effective participation at local, national and regional levels; and
- Require regular review and progress reports on implementation.

To mitigate the effects of drought, national action programmes may also include the following:

- Establishment or strengthening of early warning systems and mechanisms for assisting environmentally displaced persons;
- Strengthening of drought preparedness and management, including contingency plans;
- Establishment and strengthening of food security systems; and
- Development of sustainable irrigation programmes for both crops and livestock.

In contrast to many past efforts, these action programmes are to be fully integrated into other national policies for sustainable development. They should be flexible and adapted to changed circumstances.

The CCD also provides guidelines for: implementation and coordination of action programmes; information collection, analysis and exchange; research and development; technology transfer and development; capacity-building, education and public awareness; mobilizing financial resources and establishing financial mechanisms.

Four annexes outline how the agreement will be implemented by region: in Africa, Asia, Latin America and the Caribbean, and the northern Mediterranean, respectively.

Articles of the CCD established a Conference of the Parties (COP) to regularly review the implementation of the CCD and the functioning of its institutions. All parties are to provide reports to the COP on what they have done to implement the Convention. The COP also establishes and guides subsidiary bodies as needed, considers and adopts CCD amendments, and promotes and facilitates information exchange on measures adopted by the Parties.

Table 2 Botswana National Action Plan to Combat Desertification

Objective	Activity	Output	Indicators	Lead Agency	Partners
1. To mobilize resources to implement the National Action Program	1.1. Identify and seek sources of funding from international organizations and the private sector.	Sources of funding identified and sought	At least 6 projects funded by 2009	Department of Environmental Affairs (DEA)	Department of Forestry and Range Resources (DFFR)
	1.2 Establish national desertification fund for the specific needs not catered for by existing funding mechanisms.	Established funding scheme for all desertification projects	National Desertification Fund established by September 2009	DEA	Ministry of Finance and Development Planning (MFDP); DFFR
	1.3 Promote the utilization of existing national funding mechanisms through the dissemination of information.	Improved access and knowledge of funding sources.	At least 30% of existing funds accessed / distributed by 2009	DEA	DFFR; Ministry of Agriculture (MoA); Civil Society Organizations
2. To undertake research on processes of drought and desertification	2.1 Develop collaboration and partnership mechanisms between national, regional and international research institutions.	Joint research programs developed	At least 5 joint research programs undertaken by 2009	DEA	DFFR; Botswana Technology Centre (BOTEC), Rural Industries Innovation Centre (RIIC); Okavango Research Institute (ORI); Botswana College of Agriculture (BCA); Department of Research, Science and Technology (DRST); Energy Affairs Division (EAD)
	2.2 Promote stakeholder participation.	Stakeholder participation in research increased	At least 3 research projects undertaken in collaboration with stakeholders by 2009.	DFFR	DFFR; BOTEC; RIIC; ORI/BCA; DRST; EAD
	2.3 Conduct studies on areas vulnerable to desertification and identify appropriate methods of combating desertification.	Information on desertification	Four studies conducted by 2008		6. Civil society organisations

Objective	Activity	Output	Indicators	Lead Agency	Partners
3. To facilitate capacity building for stakeholders involved in combating desertification and mitigating effects of drought	2.4 Identify needs and problems of local populations, and document best practices on indigenous knowledge systems (IKS) as well modern scientific knowledge.	produced Needs, indigenous knowledge systems (IKS) and modern scientific knowledge (MSK) documented	IKS incorporated in pamphlets / manuals for combating desertification Tool kit developed by 2009		DEA; Civil society organisations
	2.5 Promote research on issues/problems Exacerbating land degradation and develop tool kit.	Causes identified and tool kit developed		DFRR	
	3.1 Train stakeholders on participatory approaches for the conservation and sustainable utilization of natural resources.	Stakeholders trained in participatory approaches	At least 50% of stakeholders identified (Table 4), trained in participatory approaches throughout the country by 2009.	DEA	DFRR; EAD; Civil society Organizations; BOTEK; MoA; Dept. Wildlife and National Parks (DWNP); Dept. Meteorological Services
	3.2 Develop and support training programmes to facilitate the participation of the youth, women and disadvantaged groups.	Increased participation of women, youth and disadvantaged groups.	Women, youth and Disadvantaged groups undertaking NAP projects in all the districts by 2009.	DEA	Women's Affairs Dept.; Dept. Culture and Youth; DFRR; Civil Society Organisations
	3.3 Build capacity of communities to help combat desertification	Communities trained	6 desertification projects implemented by 2009	DFRR	Women's Affairs Dept.; Dept. Culture and Youth; DFRR; Civil Society Organisations
3.4 Build capacity of local authorities and policy makers	Local authorities and policy makers trained	Desertification incorporated in local authority and policy	DFRR	Ministry of Education (MoE); DEA; Ministry of Agriculture (MoA)	
3.5 Provide information on	Information provided				

Objective	Activity	Output	Indicators	Lead Agency	Partners
	desertification and drought to formal, non-formal and informal sectors of education	to all sectors of education	makers' agenda by 2009 Number of awareness workshops / seminars on desertification and drought conducted by 2009 Number of visits by extension workers by 2009 Number of toolkits, and other material disseminated by 2009		
4. To facilitate establishment of alternative livelihoods projects particularly for people living in marginal and degraded areas	4.1 Identify alternative livelihood projects	Alternative livelihoods projects identified	Six alternative livelihoods projects implemented by 2009	DFRR	MoA; Youth and Culture; Women's Affairs; Civil Society Organisations
	4.2 Disseminate information on alternative livelihoods projects /programmes	Increased awareness on alternative livelihoods projects	40% of the rural population made aware of alternative livelihoods projects by 2009	DFRR	DEA; Department of Wildlife and National Parks (DWNP); Civil Society Organizations; BCA; MoA; Rural Development Coordination Division (RDCCD); EAD
5. To create awareness on the causes and effects of desertification and drought	5.1 Undertake desertification awareness campaigns	Increased awareness on causes and effects of desertification and drought	Percentage of population that is aware of causes and effects of desertification increased by 10% in 2009	DFRR	MoA; Dept. of Meteorological Services (DMS); DEA; EAD

Objective	Activity	Output	Indicators	Lead Agency	Partners
	5.2 Develop educational and public awareness material.	Public awareness material available for distribution to the public.	All targeted awareness material produced and distributed to the public by 2009.	DEA	MoE; EAD; DFRR; MoA; Civil Society Organisations
	5.3 Provide resource centres with information on desertification and drought to ensure public access to relevant information.	Resource centres provided with information on drought and desertification	All resource centres supplied with information by 2009.	DEA	MoE; EAD; DFRR; MoA; Civil Society Organizations; BNLS; UB
6. To coordinate interventions and approaches on desertification and drought among different stakeholders	6.1 Establish national committee for coordinating Multilateral Environmental Agreements (MEAs)	MEAs Committee established	MEAs Committee operational by 2007	DEA	All stakeholders
	6.2 Establish UNCCD implementation steering committee	UNCCD steering committee established	UNCCD implementation steering committee operational by end 2006.	DEA	All stakeholders
	6.3 Promote integration of CCD related activities into existing national programs and projects	CCD related activities integrated into existing programs and projects	Integration done by 2009	DEA	All stakeholders
7. To improve drought preparedness and management at local and national	7.1 Incorporate drought preparedness strategies in local and national planning instruments.	Drought preparedness strategies incorporated in local and national planning instruments	Drought preparedness strategies incorporated in all local and national planning instruments by 2009.	MFDP	MoA; Ministry of Environment, Wildlife and Tourism (MEWT)

Objective	Activity	Output	Indicators	Lead Agency	Partners
levels	7.2 Strengthen early warning systems facilities and ensure that the information reaches all stakeholders in a user-friendly format.	User friendly drought information provided to stakeholders	Timely dissemination of early warning drought information to stakeholders	MFD	Early warning technical committee; Inter-ministerial drought committee; MEWT; . MoA; Ministry of Local Government (MLG); Ministry of Minerals, Energy and Water Resources (MMEWR); Civil Society Organisations
8. To ensure effective participation of all stakeholders particularly women, in decision making processes and implementation of the National Action Programme	8.1 Create effective partnerships with all stakeholders, particularly women.	Stakeholder partnerships created for implementing NAP	Five stakeholder partnerships created for implementing NAP by 2009.	DEA	All stakeholders
	8.2 Review roles / functions of stakeholders regularly and incorporate emerging issues in the consultative framework	Roles / functions of stakeholders reviewed and emerging issues included in the consultative framework	Roles / functions of stakeholders reviewed and emerging issues incorporated by 2009	DEA	UNCCD Steering Committee
	8.3 Provide information to all stakeholders to facilitate their effective participation in national action programmes	Information provided to all stakeholders.	Workshops / seminars conducted and publications distributed by 2009	DEA	DFRR; MoA; Civil Society Organisations (CSOs)
9. To control and prevent land degradation	9.1 Lobby to develop legislation to regulate dual grazing rights.	Legislation that regulates dual grazing rights formulated.	Legislation to regulate dual grazing rights approved by 2009.	CSOs	UNCCD Steering Committee; Livestock producers; Attorney General's Chambers
	9.2 Facilitate enforcement of all environmental legislation aimed at minimizing land degradation.	Environmental legislation enforced	Defaulters complying with environmental legislation by 2009	DFRR	DEA; CSOs

Objective	Activity	Output	Indicators	Lead Agency	Partners
	9.3 Promote appropriate cultivation practices.	Sustainable cultivation practices adopted.	At least 30 farmers in each district practicing appropriate cultivation by 2009	MoA	Land Boards
	9.4 Rehabilitate degraded land areas.	Degraded land rehabilitated	At least 2 rehabilitation projects implemented by 2009.	DFRR	MoA; Dept of Mines
	9.5 Promote participatory land use planning.	Communities participating in land use planning.	Five community driven land use plans produced by 2009.	ML&H	MoA; MEWT; Communities
	9.6 Empower local communities to manage natural resources in their areas.	Communities empowered to effectively manage natural resources	Five community driven natural resources management plans produced by 2009.	DFRR	DWNP; Civil Society Organisations
	9.7 Promote efficient management of livestock production.	Improved livestock production management systems	10% of farmers practicing efficient livestock management by 2009.	MoA	CSOs; Land boards; Botswana Agricultural Union; DFRR
	9.8 Promote use of alternative energy sources particularly in Government institutions.	Increased use of alternative energy sources.	75% of government institutions using fuel wood switch to alternative energy sources by 2009.	Energy Affairs Division	DFRR; MoE; MEWT; Ministry of Labour and Home Affairs (MLHA); Botswana Defence Force (BDF); CSOs

Objective	Activity	Output	Indicators	Lead Agency	Partners
	9.9 Promote research to develop affordable alternative energy sources	Affordable alternative energy technologies developed	Acceptable products developed by 2009	Energy Affairs Division	BOTEC; RIIC; DFRR

Article 24 of the CCD establishes a Committee on Science and Technology as a subsidiary body of the COP to provide it with information and advice on scientific and technological matters related to desertification and drought. It is intended that the Committee be open to participation by all Convention parties and that it meet in conjunction with normal COP sessions. Under COP supervision, the Committee is expected to arrange for surveying and evaluating existing scientific networks and institutions willing to become part of a new network to support the CCD's implementation. Scientists worldwide will be encouraged to contribute their know-how and research results to this international effort.

Article 21 of the CCD provides for a Global Mechanism to promote action leading to the mobilization and channelling of substantial financial resources, including the transfer of technology, on grant or concessional terms, to developing countries for action to implement the CCD. The mechanism is to operate under the guidance and authority of the COP.

Botswana's National Action Programme (2006) will culminate in a national forum process to discuss arrangements for its implementation. The Strategic Objectives of the National Action Plan are indicated in **Table 1**. Many of the actions identified in the plan were expected to be completed by 2009. It is recommended that a review of this Action take place and all applicable outstanding activities be catered for in the Botswana National IWRM-WE Plan.

3.3.4. Convention on Wetlands of International Importance (Ramsar)

The Convention on Wetlands of International Importance, called the Ramsar Convention, is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. Adopted in the Iranian city of Ramsar in 1971, the Convention is the only global environmental treaty that deals with a particular ecosystem.

The Convention's mission is "the conservation and wise use of all wetlands through local and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world". The wise use of wetlands is defined as "the maintenance of their ecological character, achieved through the implementation of ecosystem approaches, within the context of sustainable development". "Wise use" therefore has at its heart the conservation and sustainable use of wetlands and their resources, for the benefit of humankind. The Convention uses a broad definition of the types of wetlands covered in its mission, including lakes and rivers, swamps and marshes, wet grasslands and peatlands, oases, estuaries, deltas and tidal flats, near-shore marine areas, mangroves and coral reefs, and human-made sites such as fish ponds, rice paddies, reservoirs, and salt pans.

Article 1 provides definitions. Article 2 sets out the principles of "the List" of wetlands to be protected. Article 3 relates to formulating plans for the conservation of and any changes to the listed wetlands. Article 4 relates to the managing of the wetland areas, and proposes providing additional habitat to compensate for loss of habitat. Article 5 calls of integrated management by member States where wetlands

are transboundary. Articles 6 and 7 establish the Conference of Contracting Parties for the implementation and management of the convention, and identify necessary scientific representation at the conference meetings. Article 8 identifies the IUCN as the agent for carrying out the bureau duties. Articles 9, 10 and 10bis relate to the signing of the Convention and any amendments. Articles 11 and 12 relate to the validity and accession of the Convention.

Botswana acceded to the Convention in December 1996, and it entered into force in April 1997. Botswana has 1 listed wetland, the Okavango Delta System. The wetland is 5,537,400 ha in size. The site borders Namibia and is the only inland delta in sub-Saharan Africa. Set in a semi-arid region and subject to large fluctuations in flooded area, the site includes permanent and seasonal swamp, riverine floodplains and a seasonal freshwater lake. The floodplains form critical habitat for many species of birds and wildlife at their southern limits of distribution in the region. The diverse flora and fauna includes 1060 different plant species, 32 large mammal species, over 650 species of birds, 68 species of fish, and a highly diverse insect population, all of which include rare, endangered and endemic species. Human activities include recreation, tourism, subsistence farming, fishing, and livestock grazing. The present area figure has been recalculated downward in 2006, with no change of site boundaries.

The Botswana National IWRM-WE Plan should ensure that activities to ensure the sustainable management and protection of this wetland system are adequately implemented.

3.4. REGIONAL LEGISLATION

3.4.1. Revised Protocol on Shared Watercourses in SADC (2000)

The Revised Protocol on Shared Watercourses in the Southern African Development Community (SADC) (2000), here on referred to as “the Protocol”, is premised on the UN Convention for non-navigational uses of international watercourses. The original 1995 Protocol was revised to bring its provision in line with the UN Convention and to strengthen the principle of integrated management of shared watercourses, with specific provisions regarding equitable utilisation, planned measures, no significant harm, and emergency situations. The Protocol also makes provision for the establishment of “shared watercourse institutions” (Article 5(3)) and “joint management mechanisms” (Article 4(3)).

The 1995 Protocol was for all practical purposes based on the Helsinki Rules while the present one reflects the UN Convention of 1997, which has taken the development of international water law substantially further and has refined many of the principles. The SADC Revised Protocol came into force in October 2004 following ratification by two-thirds of the signatory states⁵.

⁵ Clever Mafuta “SADC Aligns Water Protocol with International Law” REDI News Features,

The entry into force of the Revised Protocol also means that the previous SADC Protocol has been repealed.⁶ The Revised Protocol is the source of applicable treaty law for Botswana and the member states of the four transboundary River Basins.

The SADC Revised Protocol follows a particular pattern. It starts with a definitional clause and defines a watercourse as “a system of surface waters and ground waters constituting by virtue of their physical relationship a unitary whole normally flowing into a common terminus such as the sea, lake or aquifer.” A watercourse state is a state “in whose territory part of the watercourse is situated.”

The overall objective, Article 2, is to foster closer cooperation for judicious, sustainable and coordinated management, protection and utilization of shared watercourses and to advance the SADC Agenda of regional integration and poverty alleviation. Then it contains general principles in Article 3, specific provisions in Article 4, a detailed institutional framework for implementation in Article 5, provisions on shared watercourse agreements in Article 6 and a provision on dispute settlement in Article 7. In particular, the Protocol aims to promote the establishment of shared watercourse agreements and institutions, to advance sustainable, equitable and reasonable utilization, sound environmental management, harmonization and monitoring of legislation of the states involved and the promotion of research, technology development, information exchange and capacity building.

The duty “to harmonise the water uses in the shared watercourses” as contained in Article 3(1) is provided for in Article 6, which is in its totality devoted to different aspects of “Shared Watercourse Agreements.” Article 6(3) reads: “Watercourse States may enter into agreements, which apply the provisions of this Protocol to the characteristics and uses of a particular shared watercourse or part thereof.” To such agreements can be added the “Shared Watercourse Institutions” provided for in Article 5(3) and the “joint management mechanisms” of Article 4(3).

Articles 8, 9, 10 and 11 address the signature, ratification, entry into force and accession of the Protocol; while Articles 12, 13, 14 and 15 addresses the matters of amendment, withdrawal, termination and depositary. The final Article, Article 16 addresses the repealing of the 1998 protocol.

Further to the SADC Protocol are the SADC Regional Water Policy, the SADC Regional Water Strategy and the SADC Regional Strategic Action Plan (RSAP). These documents have already been discussed in the Botswana IWRM-WE Scoping Report (2010) and will not be discussed further here.

3.5. Zambezi River Basin

The Zambezi River Basin is located between latitude 9-20° South and longitude 18-36° East in Southern Africa, **Figure 3**. The Zambezi River, together with its tributaries, forms the fourth

redi@sardc.net.

⁶ Article 16, Revised Protocol.

largest river Basin in Africa and is the largest river Basin in SADC. The Zambezi River is the main river in the basin; it originates in the Angolan Highlands and drains into the Indian Ocean in the east. The major tributaries are the Shire, Luangwa, Kafue, Kabompo, Luena and Cuando/Chobe Rivers. The Zambezi River Basin has a catchment area of ~1 390 000 km² and includes parts of Angola (18%), Botswana (1%), Malawi (8%), Mozambique (12%), Namibia (1%), Tanzania (2%), Zambia (42%) and Zimbabwe (16%). Over 30 large dams have been built in the Basin with an estimated total capacity of 221 000 Mm³. There are about 40 million people living in the Zambezi Basin.

Applicable International agreements

- 1987: Zambezi River Authority (ZRA) established by Zambia and Zimbabwe
- 2004: ZAMCOM agreement signed by all riparian states (Angola, Botswana, Malawi, Mozambique, Namibia, Tanzania, Zambia and Zimbabwe).

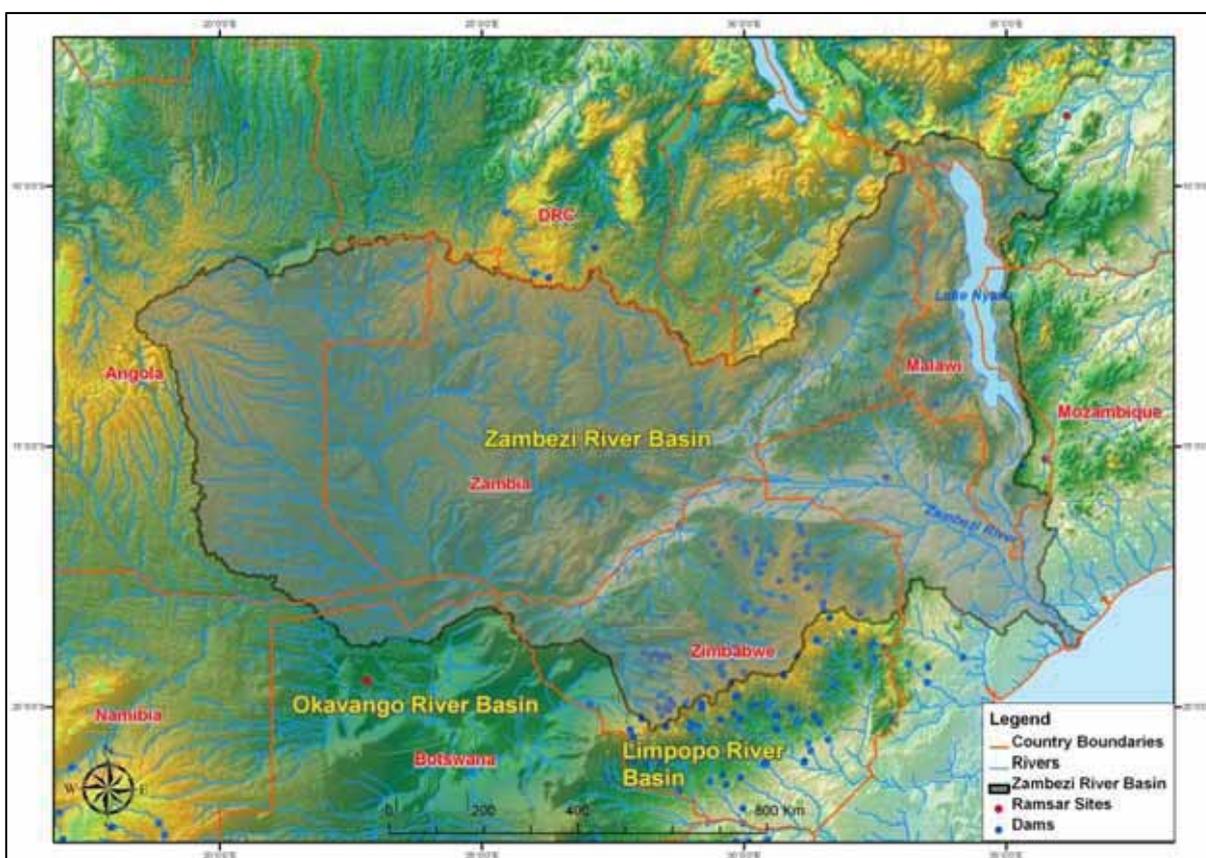


Figure 3 Zambezi River Basin (UNEP 2008).

3.5.1. Institutional Review (Pietersen and Beekman)

Plans to establish a river basin organization have existed since the 1980s, but no serious progress was made towards institutionalization of a basin-wide cooperation. In 1987, the governments of the riparian countries adopted the Action Plan for the Environmentally Sound Management of the Common Zambezi River System (ZACPLAN). Angola, Namibia, and Malawi joined these efforts in 1990. ZACPLAN consists of 19 projects, the so-called Zambezi Action Projects (ZACPRO). In 2002 the SADC Secretariat headed several rounds of negotiations until finally on 13 July 2004 the Agreement for establishing the Zambezi Watercourse Commission (ZAMCOM) was signed. SADC's role as facilitator during the negotiations towards the ZAMCOM

Agreement was fundamental to the conciliation of interests and the procurement of funding.

ZAMCOM is an international organisation, with legal personality and capacity and power to enter into contract, acquire, own or dispose of movable or immovable property and to sue and be sued. In the territory of each Member State, the Commission has such legal capacity as is necessary for the proper exercise of its functions.

3.5.1.1. Organizational Structure

ZAMCOM has similar subsidiary structures as ORASECOM in the Orange River Basin, and consists of a council of Ministers, Technical Committees and a Secretariat. The Council comprises one delegate (Minister responsible for water resources management and development) from the Government of each member state. The Chairperson and Vice-Chairperson are elected by the Council on the basis of rotation. The Technical Committees are made up of three representatives from each member state. The Secretariat is headed by an Executive Secretary and consists of technical and administrative staff.

3.5.1.2. Functions and Mandate

ZAMCOM advises the member states on the planning, management, utilization, development, protection, and conservation of the Zambezi River Basin. The Commission also advises on measures necessary to avoid disputes between the member states and assists in the resolution of conflicts. ZAMCOM will collect, evaluate, and disseminate information and data relevant to the implementation of the agreements and foster greater awareness for the efficient and sustainable management and development of the Zambezi among the population. The main objective of ZAMCOM is to promote the equitable and reasonable utilization of the water resources of the Zambezi watercourse, and their efficient management and sustainable development.

In particular,

The Council of Ministers have the overall function to adopt policies and decisions and provide guidance on matters pertaining to the efficient management, sustainable development, reasonable and equitable utilization of the water resources. It also includes the approval and supervision of implementation of the plans, programmes and projects and the approval of the annual budget of the Commission (Hollingworth, 2007);

The Technical Committees are primarily responsible for implementing the Council's policies and decisions, for the development of the Strategic Plan for the Zambezi Watercourse, for the development of rules of application to facilitate the equitable and reasonable utilization principle in the basin and

for the formulation of recommendations on matters for decision by the Council; and

The Secretariat is responsible for the technical and administrative support of the Council under the Technical Committee's supervision.

3.5.1.3. Rules on Decision-making & Procedure for Dispute Resolution

Decisions will be taken unanimously, with two thirds of the member states forming a quorum. In case of a dispute the member states are required to enter into consultations and negotiations. The Council of Ministers may give recommendations. If a dispute cannot be settled, it can be referred to the SADC Tribunal. Disputes between a member state and ZAMCOM can also be brought before the Tribunal.

3.5.1.4. RBO programmes and capacity building processes

All member states are obliged to inform ZAMCOM of any program, project or activity with regard to the Zambezi watercourse. If one of the other member states opposes planned measures or activities, they are required to start consultations and negotiations and reach a solution. The project is to be postponed during these negotiations. The Commission can conduct a fact-finding study to support the negotiation process.

The Zambezi River Authority (ZRA) through ZACPRO 6.2 is currently working on the development of an Integrated Water Management Plan for the Zambezi River System, a project already initiated in the 1990s as part of the Action Plan for the Environmentally Sound Management of the Common Zambezi River System (ZACPLAN). ZAMCOM is expected to take over the responsibility from the bi-national ZRA. A detailed Integrated Water Resources Management Strategy for the Zambezi River Basin was recently developed (Euroconsult Mott MacDonald, 2008) outlining issues, strategies and main actions to be taken. With it comes the Zambezi Water Information System (ZAMWIS) which is expected to give the riparian countries an opportunity to share information in an efficient and effective manner.

Challenges ahead for ZAMCOM include:

- Capacitating and operationalizing the Commission;
- Capacitating individual basin regime countries;
- Completion of ZACPLAN projects;
- Developing a holistic approach to basin wide development and management;
- Developing effective stakeholder participation mechanisms in water resources planning, development and management; and

- Strengthening data collection, information management system and information dissemination.

The following International Cooperating Partners (ICPs) currently provide direct and indirect support and capacity building to transboundary water management in the Zambezi River Basin, through tailor-made backing of the SADC-RSAP2 program (SADC, 2005; Beekman and Pietersen, 2008):

- Multi-lateral: AfDB, UN, UNDP, UNEP, UNESCO, EU, FAO and WB
- Bi-lateral: Danida, DGIS, GTZ (and DFID), InWent, KfW and Sida

High level political commitment is central. The ZACPLAN process (through the ZRA) has suffered from not being able to establish ZAMCOM to guide the process on the basin level.

3.5.1.5. Comments

R/LBO specific

ZAMCOM has now been established as seven of the eight required member states have ratified the Agreement. ZAMCOM is expected to take over the responsibility from the ZRA. The ZRA through the ZACPRO 6.2 Program currently receives support from several International Cooperating Partners (ICPs) through tailor-made backing of the SADC-RSAP2 program on the development of an IWRM Plan for the Zambezi River System, strengthening the institutional framework for water resource management, various fields of capacity building, and strengthening stakeholder involvement.

R/LBO - National Government linkages

Key governmental institutions are national ministries for water resources and/or environment

Recently, an Integrated Water Resources Management Strategy for the Zambezi river basin has been finalized which provides direction for ZAMCOM in the context of its functions and interrelationships with existing key actors in the water sector of the riparian countries of the Zambezi River Basin (Euroconsult Mott MacDonald 2008).

At present the capacity of national water management institutions to perform river basin management tasks is limited. Riparian countries are faced with an acute shortage of both the material and personnel to be used within the basin.

Public participation and empowerment

Stakeholder participation in water resources management in the Zambezi Basin is not yet well established. There are a number of issues, including national and regional legislation that do not support institutions for facilitating stakeholder participation. Ineffective stakeholder participation in

water resources planning, development and management is leaving most stakeholders „ignorant“ of projects and activities implemented in the basin.

Through the ZACPRO 6.2 Program with donor support, measures are being undertaken to strengthen stakeholder involvement (e.g. through the Zambezi Has its People Project).

Information management

There is inadequate knowledge on the state of water resources in the Zambezi River Basin, inadequate data harmonisation and verification and insufficient information sharing. There is also lack of common methodologies for assessments and standardised procedures for data collection and reporting. A Zambezi Water Information System (ZAMWIS) is under development which is expected to give the riparian countries an opportunity to share information in an efficient and effective manner. There is presently only a ZRA web-site.

Financial aspects

The budget of the future Commission will be drawn from annual cash contributions by Member States; donations, grants and loans from bilateral and multilateral organizations; monies raised internally; and other sources of funding agreed to by the Council.

3.5.2. Zambezi IWRM Strategy and Implementation Plan

The Euroconsult Mott McDonald (2008) Zambezi IWRM Strategy and Implementation Plan identified four key challenges: integrated and coordinated water resources development, environmental management and sustainable development, adaptation to climate variability and climate change, and basin-wide cooperation and integration. These key challenges have an individual set of strategies and actions contained in the Implementation Plan. These are presented in this section.

3.5.2.1. Challenges and Development Issues

Challenges and Opportunities

In spite of the economic growth evidenced over the last 5 to 10 years, and the abundant water and other natural resources, poverty in the Zambezi Basin is still a major challenge. The majority of the people in the Basin have low access to water supply and sanitation, particularly in the rural areas. There are periodic food deficits caused by combination of factors including failure of the rain season (most food production is rain-fed), poor supply of agricultural inputs, inadequate road network and poor management. The majority of the population has no access to electricity and depends on fuel wood and charcoal for cooking and heating. The more arid parts of the Basin (in Namibia, Botswana, and western Zimbabwe) are experiencing challenges meeting their water needs for domestic and industrial water supply.

The Zambezi Basin is rich in resources, but low in population. The Basin has considerable potential for development in agriculture, tourism, hydropower and mining. As the global economies develop, this creates considerable opportunities for the Zambezi Basin. Water resources development and management will be a key factor in the socio-economic development of the SADC region as a whole and the Zambezi Basin in particular. The key issues with respect to water development and management are discussed under four classes, namely:

- Integrated and Coordinated Water Resources Development;
- Environmental Management and Sustainable Development;
- Adaptation to Climate Variability and Change;
- Basin-wide Cooperation and Integration.

Integrated and Coordinated Water Resources Development

In the Zambezi Basin, ensuring water security is a major challenge in an area characterised by high variability in available water resources. As the Zambezi Basin countries improve their economies to meet the demands for higher social, health and economic well-being – to eradicate poverty, and meet MDGs - there will be need to increase the infrastructure necessary to harness and manage the water resources of the region, upon which the envisaged development depends. More storage dams will be needed (for hydropower, irrigation, water supply and river regulation); other hydraulic structures will equally be needed. The existing dams have been built to serve a single purpose. These dams will need to be operated conjunctively to optimize multiple benefits including power, irrigation and flood control. Future development of water infrastructure would call for integrated development and operation for multi-purposes including safeguarding the integrity of aquatic eco-systems most prevalent in the Basin. These aspects will call for real Basin-wide cooperation and improved coordination. Funding of water resources development and management will need greater support from governments of the riparian states. Access to water supply and sanitation is relatively low among the majority of riparian states, and this impacts negatively on health of communities, educational advancement of children (particularly girls), poverty eradication, and sustainability of economic development in general. Water resources management has to address this particular need for improved access to sustainable water supply and sanitation among the Basin states.

Environmental Management and Sustainable Development

The Zambezi Basin is an area of considerable environmental value – as is clear from the extensive wetlands (many whom, including the Barotse Floodplain, Kafue Flats, and the Zambezi Delta are Ramsar sites), natural and man-made lakes (including Lake Malawi/Nyasa/Niassa, and Lake Kariba) and numerous national parks. What is more, economic growth in the Basin will

depend to a large extent on the sustainable use of natural resources. Wetlands are potentially among the most productive ecosystems in the river Basin, providing a wide range of goods and services of local, national and international importance. However, wetlands are also among the most environmentally sensitive areas of the Basin and are often widely degraded. Thus environmental management and sustainable development of the aquatic environment will be a major challenge in the Zambezi Basin. Water quality in the Basin is also at risk because of increasing discharges from urban, mining and manufacturing centres. Increasing pollution from urban and mining activities is already evident in Upper Kafue Basin (copper mining area of Zambia), and urban and industrial complex in the swathe of territory running from Bulawayo to Harare in Zimbabwe. The invasion of aquatic weeds (water hyacinth, hippo-grass, red water fern, and mimosa pigra) is already a problem in a number of sub-Basins including the Kafue, Shire, Kariba, Zambezi delta. Although large parts of the Basin are sparsely populated, the watershed suffers from deforestation and soil degradation because of a high level of dependency on fuel wood and charcoal for cooking, heating, brick and tobacco curing. Overgrazing by livestock and wild animals is reported in a number of areas.

Adaptation to Climate Variability and Change

Climate variability, though an established characteristic over the Basin, has taken greater importance lately. There is now compelling evidence of a shift towards a new climate state, characterized by higher temperatures, extremes of rainfall, including shifts in the onset and duration of the rain season, apparent frequency of alternating droughts and flooding. Floods are probably the most pressing transboundary water management issue for the population living in the Zambezi river Basin. The Lower Zambezi, with a number of unregulated tributaries has suffered from severe floods almost on an annual basis. Flood management is a shared responsibility by a number of national institutions. There is need for improved coordination, reporting, and disaster management plans. There are a number of challenges in dealing with droughts, including: poor data networks of climatic and hydrological variables (including water supply); poor information sharing and exchange among Basin states; lack of integrated physical and socio-economic indicators that would facilitate a comprehensive understanding of the magnitude, spatial extent and impacts of droughts; and lack of sound drought management plan, and bureaucratic obstacles to efficient implementation

Basin-wide Cooperation and Integration

Regional cooperation in water resources management has been improving, though more slowly than may be desirable to deal with the evident development challenges in the Basin. River Basin management framework is established through the SADC Protocol on Shared Watercourses. ZAMCOM needs to be operationalized and the institutional frameworks at national

level enhanced to facilitate greater cooperation. In addition, the institutional capacity of the water management institutions, both at national level as well as at the regional level, require strengthening as there are deficiencies in terms of funding, skills for integrated water resources management, including hydro-meteorological monitoring, multi-sectoral planning, and environmental management. Furthermore, there is paucity of data and information on which to base sound water resources planning and management across the Basin; data collection networks are declining and poorly maintained throughout the Basin states, there is inadequate funding of data collection and processing, particularly for water quality and groundwater. Equally important is the lack of effective stakeholder participation in water resources development and management, an issue engendered by a number of factors including inadequate policy and legal framework, poor funding by governments, mistrust between various stakeholders, and lack of awareness of the benefits of stakeholder involvement in the management of natural resources such as water.

3.5.3. Zambezi IWRM Strategies

3.5.3.1. Strategic Options Analysis

A Strategy is essentially the set of options determined to be the best measures for addressing the issues affecting water resources development and management in the Zambezi Basin. Thus strategy formulation provides the occasion and opportunity to analyse strategic options for the Zambezi Basin. Options analysis was a logical step following identification of issues. For a number of issues (as discussed in the previous section) there is hardly any choice or discussion of optimum option; there is only one way to address the issue, and the question is not so much whether but when and in which sequence to implement the solution. The strategic option therefore is reduced simply to project design, determining scope of development, the timing, and the associated costs.

Options analysis was a key component of the consultative workshops conducted in the riparian states with stakeholders at national level (the National Steering Committees) and at regional level (through the Zambezi Basin Forum Meeting and the Regional Expert Meeting). While the options analyses were primarily subjective (group discussions), the results present synthesis of collective knowledge, experience and expertise; hence greater weightage was given to the outputs of these consultative meetings.

For hydropower development the options analysis relied on previous analyses carried out by the Southern African Power Pool (SAPP) to choose a development scenario most appropriate to meet the energy needs of SADC region. Thus future water use for hydropower was based on the SAPP hydropower development plan. For expansion of agriculture, two

development scenarios were used to assess the future water requirements, and it was concluded that a modest (50%) expansion of irrigated agriculture seems more likely than the maximum expansion envisaged under the riparian states' development plans.

3.5.3.2. Strategies

The formulated strategies address the above challenges and issues in the Zambezi Basin. The overall development objective is "Equitable sustainable utilization of water for social and environmental justice, regional integration and economic benefit for present and future generations."

The strategies are formulated within the four key challenges: integrated and coordinated water resources development, environmental management and sustainable development, adaptation to climate variability and climate change, and basin-wide cooperation and integration.

Strategy 1: Integrated and coordinated water resources development

Water resources development and management should serve many purposes – hydropower and irrigation, but also fishery, aquatic weed control, flood plain agriculture, flood control and the sustenance of environmental flows – and benefits and costs should be shared among the riparian states. The Strategic Objective under the Challenge of Integrated and Coordinated Water Resources Development and Management is to "Develop and manage water resources so as to serve social and economic development in the Basin".

This Strategic Objective translates into a number of strategies that are presented below. These strategies should be read in close conjunction with other strategies, in particular in the field of mainstreaming of environment and adaptation to current and future climate variability. The strategies to achieve integrated and coordinated water resources development are:

- Address the high demand for new water infrastructure to meet regional energy security.
- Address the demand for water in agricultural development and regional food security.
- Improve operation of existing and new major dams in the Basin to take into account and optimise multiple functions of water.
- Increase funding for water resources development and management.
- Improve access to sustainable Water Supply and Sanitation

Strategy 2: Environmental management and sustainable development

All countries in the Basin have ambitious and optimistic economic growth scenarios to ensure better living and reduced poverty. In a global context the

Basin countries will derive the larger part of their growth from natural resources use – mining, fishery, agriculture, forestry and in nature tourism. This places environmental management and natural resources governance in the core of development in the Zambezi Basin. The strategic objective of this challenge is therefore to *“Mainstream environment in the development and management of water resources in the Basin”*.

There are six strategies that are particularly important for sustainable development in the Zambezi Basin:

- Adequately manage the ecological and economic functions of wetlands and sustain their viability.
- Control water pollution from point sources – especially from urban centres and mining areas.
- Control invasive aquatic weeds and prevent new outbreaks.
- Promote sustainable fishery management as a contribution to regional food security.
- Ensure water resource development and management does not harm tourism potential.
- Prepare and implement strategic environmental plans and procedures including the development of protected area networks and valuable eco-systems.

Strategy 3: Adaptation to climate variability and climate change

Climate change is expected to materialize through changes in extreme events such as droughts and floods, affecting agricultural crop and livestock production as well as wildlife population. Rising temperature furthermore is expected to affect the fish production from the major lakes and reservoirs, to cause higher evaporation from these main water bodies and reduce the yield of main agricultural crops (especially cereal crops). The ecosystems of the wetlands will be affected because run-off patterns will change. Precise assessments of climate change in Africa are not yet complete and are often limited to mean temperature and precipitation, with relatively little known on changes in extremes.

The Strategic Objective under the Challenge of Adaptation to Climate Variability and Climate Change is to *“Adapt water resources management to current and future climate variability”*. This translates into four strategies as follows:

- Improve the knowledge base on climate variability and climate change and their impacts on water resources.
- Improve flood management and mitigation mechanisms at national and regional scale.

- Improve regional and national drought management.
- Develop regional capacity to adapt to climate change and make use of the development opportunities associated with global climate change mitigation.

Strategy 4: Basin-wide cooperation and integration

The challenges of integrated and coordinated water resources development, environmental management and sustainable development, and climate change adaptations, and the strategies required to address these challenges underline the need for stronger regional cooperation and closer integration in the field of water management. Clearly integrated water resource development and management is at the heart of economic development and social well-being in the Zambezi Basin.

At present there are several activities undertaken to support water management in the Zambezi Basin. These activities, though worthwhile, do not add up, as there is no single focal point. There is pressing need to further strengthen Basin-wide cooperation and to formalize the cooperative framework. The strategic objective for this challenge is to: “Operationalize the institutional frameworks in support of Basin-wide water resources development and management.” This requires four strategies:

- Operationalize the institutional frameworks in support of Basin-wide water resources development and management and discuss issues of inter-Basin transfer.
- Strengthen organisational, financial and human resource capacities of water management institutions at regional, national and local levels.
- Improve and expand Basin-wide water resources data collection, processing and information transfer systems.
- Promote broad-based stakeholder participation in water resources development and management.

Table 2 presents the Strategic Framework for the Zambezi IWRM Strategy. For each Challenge the Strategic Objective has been defined, and for each objective the key issues have been summarized; this is followed by the strategies to address those issues and the main actions in support of the proposed strategy. The framework also indicates the close relationship between the strategies. This is the basis of IWRM as it calls for coordinated and integrated development of water resources in the entire river Basin to address the socio-economic development of the Basin in particular but with benefits beyond the Basin and into the SADC region as a whole.

Strategic Framework

Table 3 Zambezi IWRM Strategic Framework

Overall Objective				Equitable sustainable utilisation of water for social and environmental justice, regional integration and economic benefit for present and future generations			
Challenge	Integrated and Coordinated Water Resources Development and Management (1)	Environmental Management and Sustainable Development (2)	Adaptation to Climate Variability and Climate Change (3)	Basin-wide Cooperation and Integration (4)			
Strategic Objective	Develop and manage water resources so as to serve social and economic development in the Basin	Mainstream environment in the development and management of water resources in the Basin	Adapt water resources management to current and future climate variability and change	Operationalize the institutional frameworks in support of basin-wide water resources development and management			
ISSUES	<ul style="list-style-type: none"> Inadequate water infrastructure for achieving regional energy security (1.1) Insufficient water infrastructure for agricultural development to achieve regional food security (1.2) Major dams in the Basin were constructed for a single purpose and their operation is not optimised for multiple uses (1.3) Inadequate financing of water resources development and management (1.4) Low access to Water Supply and Sanitation (1.5) 	<ul style="list-style-type: none"> Inadequate protection and sustainable development and use of wetland (2.1) Deterioration of water quality due to point pollution from mining, industrial and urban centres (2.2) Proliferation of invasive aquatic weeds (2.3) Unsustainable and low-productivity fisheries management (2.4) Tourism development is threatened by degradation of the aquatic environment (2.5) High-value and unique ecosystems and related ecological and economic functions in the Basin may be threatened and fragmented by accelerated development (2.6) 	<ul style="list-style-type: none"> Extreme variability and uneven distribution of rainfall is likely to be amplified by climate change (3.1) Lack of integrated flood management in development planning (3.2) Poor drought management and integration in development planning (3.3) Inadequate coping mechanisms for climate change (3.4) 	<ul style="list-style-type: none"> Absence of a river basin organisation for the whole Zambezi Basin (Zambezi River Basin Organisation not yet established and operational) (4.1) Weak capacity of national water management institutions to perform river basin management tasks (4.2) Inadequate water resources knowledge base for Basin-wide development and management (4.3) Inadequate effective stakeholder participation in water resources planning, development and management (4.4) 			
STRATEGIES	<ul style="list-style-type: none"> Address the high demand 	<ul style="list-style-type: none"> Adequately manage the 	<ul style="list-style-type: none"> Improve the knowledge 	<ul style="list-style-type: none"> Operationalize the 			

<p>for new water infrastructure to meet regional energy security (1.1)</p> <ul style="list-style-type: none"> Address the demand for water in agricultural development and regional food security (1.2) Improve operation of existing and new major dams in the Basin to take into account and optimise multiple functions of water (1.3) Increase funding for water resources development and management (1.4) Improve access to sustainable Water Supply and Sanitation (1.5) <p>ecological and economic functions of wetlands and sustain their viability (2.1)</p> <ul style="list-style-type: none"> Control water pollution from point sources – especially from urban centres and mining areas (2.2) Control invasive aquatic weeds and prevent new outbreaks (2.3) Promote sustainable fishery management as a contribution to regional food security (2.4) Ensure water resource development and management does not harm tourism potential (2.5) Prepare and implement strategic environmental plans and procedures including the development of area networks (2.6) <p>base on climate variability and climate change and their impacts on water resources (3.1)</p> <ul style="list-style-type: none"> Improve flood management and mitigation mechanisms at national and regional scale (3.2) Improve regional and national drought management (3.3) Develop regional capacity to adapt to climate change and make use of the development opportunities associated with global climate change mitigation (3.4) <p>institutional frameworks in support of basin-wide water resources development and management and discuss issues of inter-basin transfer (4.1)</p> <ul style="list-style-type: none"> Strengthen organisational, financial and human resource capacities of water management institutions at regional, national and local levels (4.2) Improve and expand Basin-wide water resources data collection, processing and information transfer systems (4.3) Promote broad-based stakeholder participation in water resources development and management (4.4) 	<p>MAIN ACTIONS</p> <p>(1.1)</p> <ul style="list-style-type: none"> Joint development of feasible package of major hydropower sites, taking into account multiple functions in coordination with SAPP Identify and promote options for small scale hydropower development <p>(2.1)</p> <ul style="list-style-type: none"> Improve the wetland related regulation and management between riparian countries Assess and maintain environmental flows appropriate to each river section Develop management plans for all the major wetlands in the Basin taking into account the different wetland functions Develop and implement special initiatives for environmental management <p>(3.1)</p> <ul style="list-style-type: none"> Carry out comprehensive assessment of the vulnerability of basin water resources to climate variability and climate change <p>(4.1)</p> <ul style="list-style-type: none"> Encourage signing and ratification of the ZAMCOM Agreement and establish and operationalize ZAMCOM – through promotion of targeted measures to raise awareness of benefits of basin-wide management of water resources, Establish Interim ZAMCOM Secretariat Develop public information function of Interim Secretariat and later ZAMCOM Secretariat Strengthen coordination with
--	---

<p>around hotspots</p>	<p>on-going programmes in the Basin (SADC/ COMESA/SAPP/NEPAD/Waternet/ IUCN/WWF/HYCOS/World Bank), including management commissions of sub-basins (Joint Water Commission, ZRA)</p>
<p>MAIN ACTIONS contd.</p> <p>(1.2)</p> <ul style="list-style-type: none"> • Support the development of agriculture through basic facilities such as reliable input supply and better road networks • Expand irrigated agriculture • Promote and support the restoration and sustainability of flood plain agriculture • Enhance the productivity of rain-fed agriculture through improved water management options <p>(2.2)</p> <ul style="list-style-type: none"> • Set up integrated water quality monitoring system • Harmonize legislation and enforcement systems • Promote clean technology <p>(3.2)</p> <ul style="list-style-type: none"> • Integrate flood management in development planning • Develop and implement effective land use planning • Strengthen and encourage collaboration of existing early warning institutions • Dovetail the operation of major water infrastructure to optimize flood storage • Formulate comprehensive flood preparedness and flood response mechanisms, making use of regional good practice <p>(4.2)</p> <ul style="list-style-type: none"> • Develop and implement performance based training programmes on water resources management based on institutional development assessments • Implement well-designed plan to harmonise water resources management policies, legislation and strategies of the basin states 	<p>(1.3)</p> <ul style="list-style-type: none"> • Develop appropriate river simulation models to identify the influence of dam operations on the downstream flow regime, including unregulated tributaries • Optimize multi-purpose management of existing reservoirs <p>(2.3)</p> <ul style="list-style-type: none"> • Harmonize the legislation on the control of aquatic weeds • Set up national focal points on aquatic weed control • Initiate regional capacity building • Initiate joint monitoring and survey of aquatic weeds • Adjust reservoir operations (incl. provision for weed control) <p>(3.3)</p> <ul style="list-style-type: none"> • Support development of drought management plans, including local irrigation development, improved food stock logistics, crop adaptation and drought insurance • Mainstream drought forecasting in water resources planning and management <p>(4.3)</p> <ul style="list-style-type: none"> • Formulate and implement a data and information sharing protocol for further operationalization of ZAMWIS • Harmonize data measurement and storage methods in basin • Improve basin-wide data (water quality and quantity measurements, sediment content, groundwater) collection systems • Priority improvement of data

<p>and knowledge base on groundwater resources</p> <ul style="list-style-type: none"> • Further development of ZAMWIS (increasing accessibility and interactivity and developing models and DSS tools) • Strengthen basin-wide research on water resources through joint programmes, collaboration of research institutions, and enhanced information exchange 	<p>(4.4)</p> <ul style="list-style-type: none"> • Strengthen stakeholder participation through policy and legislation review and revision throughout the basin states • Formulate and implement a public information programme to raise awareness among a broad range of stakeholders • Strengthen and sustain the Annual Basin Forum meetings as part of awareness and information sharing among basin stakeholders
<p>(3.4)</p> <ul style="list-style-type: none"> • Integrate strategies to deal with climate variability and climate change in national socio-economic development planning • Exploit development opportunities under global climate change protocols for afforestation and reforestation at national level • Setup a regional centre of excellence to document and support activities for effective adaptation to climate variability and climate change 	<p>(2.4)</p> <ul style="list-style-type: none"> • Collaborate with NEPAD programme towards improving fisheries productivity. • Integrate fisheries development with water resources development – new reservoir operating rules, fishery production, provision for fish migration
<p>(1.4)</p> <ul style="list-style-type: none"> • Improve overall investment climate to make water development infrastructure financing more attractive • Develop mechanisms for local infrastructure co-financing • Raise awareness of the vital role of the water sector in economic development and poverty alleviation 	<p>(2.5)</p> <ul style="list-style-type: none"> • Systematically integrate tourism development in water resources planning, development and management • Develop catchment management plans incorporating areas of
<p>MAIN ACTIONS contd.</p>	
<p>(1.5)</p> <ul style="list-style-type: none"> • Expand coverage of water supply and sanitation services in rural and urban areas 	<p>(2.5)</p> <ul style="list-style-type: none"> • Systematically integrate tourism development in water resources planning, development and management • Develop catchment management plans incorporating areas of

tourism value such as game management areas and wetlands.

- Operation of water infrastructure to support and enhance tourism management

(2.6)

MAIN ACTIONS contd.

- Prepare a comprehensive and spatially explicit map of ecosystems services
- Delineate high priority conservation areas such as headwaters, recharge zones and flood plains and implement land use plans for these areas
- Start international cooperation on linking areas with high significance for biodiversity – coming to Protected Area Networks
- Develop and implement guidelines for the use of proper EIAs and SEAs in development planning

Table 4 Zambezi IWRM Implementation Plan

Challenge / Strategy / Main action	Short Term (0-2 yrs)	Medium Term (3-5 yrs)	Long Term (6-15 yrs)	Lead institution	Main partner institutions	First action
1 INTEGRATED AND COORDINATED WATER RESOURCES DEVELOPMENT & MANAGEMENT						
1.1 Address high demand for infrastructure to meet energy security						
1.1.1 Joint development of feasible package of hydropower sites	x	X		ZAMCOM/SAPP	Riparian Energy Organizations, Ministries of Water Resources	Update current studies in view of electricity crisis in part of the Basin
1.1.2 Identify and promote options for small scale hydropower	x	X	x	ZAMCOM/SAPP	Riparian Energy Providers, Private Sector Regulators	Develop package of technical and financial options and case inventory
1.2 Address demand for water in agricultural development and regional food security						
1.2.1 Support the development of agriculture through basic facilities such as reliable input supply and better road networks		X	x	ZAMCOM/National Road Authorities	Ministries of Agriculture, Donor Organizations	Map main current/future agricultural production areas and marketing constraints
1.2.2 Expand irrigated agriculture	x	X	x	ZAMCOM/National Ministries of Irrigation	NEPAD, World Bank	Collate national plans and identify technical and capacity constraints
1.2.3 Promote and support the restoration of flood plain agriculture		X	x	ZAMCOM/Dam Operators	WWF/TNC/UNESCO-IHE	Review implementation experience in Kafue Plains and operationalize studies
1.2.4 Enhance the productivity of rain-dependent agriculture	x	X	x	National Ministries of Agriculture	Fertilizer boards, research and extension organizations	Identify current practices and regional/ international good practices
1.3 Improve operation of existing and new dams for multiple functions of water						
1.3.1 Develop river simulation models for dam operation and unregulated tributaries	x	X		ZAMCOM/WWF/TNC/UNESCO-IHE	Navigation, Fisheries, Weed Control, Flood Storage Agriculture	Define with many stakeholders all multifunctional requirements
1.3.2 Optimize multi-purpose management of existing reservoirs		X	x	ZAMCOM/Dam operators	Different stakeholders as above	Plan review first years flow regimes in practice - including communication

Challenge / Strategy / Main action	Short Term (0-2 yrs)	Medium Term (3-5 yrs)	Long Term (6-15 yrs)	Lead institution	Main partner institutions	First action
1.4 Increase funding for water resources development & management						
1.4.1 Improve overall investment climate to attract water development infrastructure financing	X			ZAMCOM	Ministries of Planning and Finance/ of Water Resources	Identify bottlenecks with possible investment funds
1.4.2 Develop mechanisms for local infrastructure co-financing			X	ZAMCOM/SAPP	Ministries of Planning and Finance/ of Water Resources	Initiate discussion with local financial institutes
1.4.3 Raise awareness of the vital role of the water sector in economic development and poverty alleviation	X			ZAMCOM	Ministries of Planning and Finance/ Water Resources	
1.5 Increase access to sustainable water supply & sanitation						
1.5.1 Expand coverage of water supply and sanitation services in rural and urban areas	X			ZAMCOM	Riparian ministries of water and sanitation	
2. ENVIRONMENTAL MANAGEMENT AND SUSTAINABLE DEVELOPMENT						
2.1 Adequately manage the ecological and economic functions of wetlands in the Basin						
2.1.1 Improve wetland related regulation and management between countries	X		X	ZAMCOM/IUCN	Local government, Ministries of Environment/ Fishery;	Assess current regulation and operational effectiveness
2.1.2 Assess and maintain environmental flow appropriate to each main river section	X			ZAMCOM/WWF/ TNC/ IUCN	Dam Operators, Ministries of Water Resources; academia	Synthesize current knowledge from various studies
2.1.3 Develop management plans for all major wetlands in the Basin taking into account multiple functions	X			ZAMCOM/IUCN	Local government, Ministries of Environment/ Fishery;	Identify and agree on list of main wetlands in the Basin
2.1.4 Develop and implement special initiatives for environmental management around hotspots	X		X	ZAMCOM/IUCN	Local government, Ministries of Environment/ Fishery;	Identify and agree major hot spots/ areas under threat

Challenge / Strategy / Main action	Short Term (0-2 yrs)	Medium Term (3-5 yrs)	Long Term (6-15 yrs)	Lead institution	Main partner institutions	First action
2.2 Control water pollution from point sources - especially urban centres and mines						
2.1 Adequately manage the ecological and economic functions of wetlands in the Basin						
2.1.1 Improve wetland related regulation and management between countries		x	x	ZAMCOM/IUCN	Local government, Ministries of Environment/ Fishery;	Assess current regulation and operational effectiveness
2.1.2 Assess and maintain environmental flow appropriate to each main river section	x	X		ZAMCOM/WWF/ TNC/ IUCN	Dam Operators, Ministries of Water Resources; academia	Synthesize current knowledge from various studies
2.1.3 Develop management plans for all major wetlands in the Basin taking into account multiple functions	x	X		ZAMCOM/IUCN	Local government, Ministries of Environment/ Fishery;	Identify and agree on list of main wetlands in the Basin
2.1.4 Develop and implement special initiatives for environmental management around hotspots		X	x	ZAMCOM/IUCN	Local government, Ministries of Environment/ Fishery;	Identify and agree major hot spots/ areas under threat
2.2 Control water pollution from point sources - especially urban centres and mines						
2.2.1 Set up integrated water quality monitoring systems with real time communication		X		ZAMCOM/ SADC	National Ministries of Water Resources	Prepare overview of on-going activities; identify priorities and communication
2.2.2 Harmonize legislation and enforcement systems on water quality		X		SADC/ZAMCOM	National Committees; National Organizations	Inventory of on-going legislation and operational effectiveness, including labs
2.2.3 Promote clean technology through system of environmental audits		x	x	Industry/ Mining Associations	Ministries of Planning and Finance/ Industries	Review financing/ enforcement mechanism to support clean technology
2.3 Control invasive aquatic weeds and prevent new outbreaks						
2.3.1 Harmonize legislation on control of aquatic weeds		X		SADC	Ministries of Fisheries/ Environment/ Water Resources	Inventory of on-going legislations and operational effectiveness
2.3.2 Set up national focal points on aquatic weed control	x	X		SADC	Ministries of Fisheries/ Environment/ Water	Describe minimum requirements for Focal Point

Challenge / Strategy / Main action	Short Term (0-2 yrs)	Medium Term (3-5 yrs)	Long Term (6-15 yrs)	Lead institution	Main partner institutions	First action
	Resources					
2.3.3 Exchange experience and initiate regional capacity building	X			SADC	National Focal Points	Describe based on on-going work and literature good practices in weed control
2.3.4 Initiate joint monitoring and survey of aquatic weeds proliferation	X	X	X	ZAMCOM/ Focal Points	Ministries of Fisheries/ Environment/ Water Resources	Agree on parameters, frequency and means of communication
2.3.5 Adjust reservoir operations including provision for weed control	X	X	X	ZAMCOM/Dam Operators	Other stakeholders in dam operations as described above	Describe based on on-going work and literature good practices in weed control
2.4 Promote sustainable fisheries management as contribution to regional food security						
2.4.1 Collaborate with NEPAD programme towards improved fisheries productivity	X	X		ZAMCOM/NEPAD	Reservoir Operators; Private Sector; Ministries of Fisheries	Develop long-list of improved fishery/ marketing practices of relevance for the Basin

3.5.4. Zambezi IWRM Implementation Plan

3.5.4.1. Implementation Plan

The Implementation Plan for the Zambezi IWRM Strategy is meant to take the strategy beyond general statement of common intent and describes how the different components of the strategy can be implemented.

The strategic actions described in the Strategic Framework have been prioritized into actions or initiatives that need to be undertaken in the short-term (0-2 years), medium-term (3-5 years) and long-term (6-15 years). The implementation plan also describes the organizations that should take the lead and that should be actively engaged in these activities, as well as a short description of the trigger actions in each field. The sequencing of activities has endeavoured to strike a balance between strengthening the basic framework for cooperation as well as working on substantive activities (joint investments to address energy, food and environmental needs) yielding tangible benefits of water resource development and management in the Zambezi Basin. This, it is envisaged, will sustain Basin cooperation. A second consideration in the prioritization in time is the expected institutional development in transboundary water resource management in the Zambezi Basin.

The responsibility for implementation of a Basin-wide strategy rests with a river Basin organization, which ultimately is ZAMCOM. In the interim, the proposed Interim Secretariat will play a key role. Another important development is that there are several initiatives on-going in the Basin that are closely related to central aspects of the Strategy. By bundling these initiatives and by coordination through the Interim Secretariat and ZAMCOM, a critical mass of activities in support of the integrated water resources development and management could develop, while retaining progress under different initiatives. These considerations have determined the assignment of roles and responsibilities for implementation of activities stated in the IWRM Strategy.

The proposed implementation plan, the key actors, and the support partners are presented in **Table 3**. The blocks highlighted in the Table, indicate activities that are directly applicable to the Botswana National Government and may have an impact on water resources. The key role of ZAMCOM and the Interim Secretariat is worth noting.

3.5.4.2. Financing Strategy Implementation

There are different categories of activities to be funded as part of the implementation of the strategy. In essence there are:

- Institutional costs related to the basic operation of ZAMCOM Secretariat (or Interim secretariat), including staff salaries, cost of organizing and attending meetings of ZAMCOM and its organs.
- Programme costs related to development, implementation, coordinating and monitoring the implementation of programmes and projects, such as Strategic Plans,

data collection system, communication strategy, and special studies identified under the Strategy.

- Programme and Investment costs on joint programmes and projects that are major elements of the Strategy where ZAMCOM collaborates with other Basin partners who in turn are responsible for the implementation of the related activities (for example hydropower development).
- Investment costs for special development activities, as above, but implemented by ZAMCOM directly.

The proposed funding modalities for these categories of activities are indicated in **Table 4**.

Table 5 Funding Modalities

Funding category	Source of funding
Basic operation of Interim Secretariat and future ZAMCOM	<ul style="list-style-type: none"> • Contributions from Riparian Countries, monetary and in-kind (staff secondment) • Special contribution or privileges from hosting country
Regulatory and coordination functions of Interim Secretariat and future ZAMCOM, such as joint data base and communication system	<ul style="list-style-type: none"> • Contribution and cooperation from riparian countries • External funding for establishment costs • For consideration – part of revenue generated from joint infrastructure to cover for running or program development costs of ZAMCOM
Programs on major elements of the Strategy, strengthening management capacity or preparing investment programmes coordinated by ZAMCOM but implemented by others	<ul style="list-style-type: none"> • External funding • Implementation directly by service providers with preferably provision for costs of Secretariat/ Riparian Countries
Program on major elements of the Strategy, strengthening management capacity or preparing investment programmes directly implemented by ZAMCOM	<ul style="list-style-type: none"> • External funding • Directly implemented by Secretariat/ ZAMCOM including provision for operational expenditures

3.5.4.3. Coordination and Monitoring

It is proposed that within the Interim Secretariat a position is created for a Coordination & Monitoring Unit. This Unit is expected to develop a detailed monitoring plan, making use of the implementation plan, to facilitate tracking the activities and progress made on different components of the Zambezi IWRM Strategy. The Unit will keep close contact with on-going activities, including those by SADC, SAPP, NEPAD, WWF/TNC/TCF, IUCN, Miombo Network, Waternet, WARFSA, SIDA-RAMBOL and RETOSA. Monitoring and coordinating these activities will help link the otherwise isolated activities to other on-going developments and integrate them with political and decision making processes in the Basin.

3.5.4.4. Key Follow-up Steps

The Implementation Plan identifies short term activities for the implementation of the IWRM Strategy. The activities relate both to the establishment and functioning of the Basin organization as well as the coordination of different activities for the development and management of the Zambezi Basin water resources. It is recommended that the activities relating to the establishing the Basin organization should take precedence so as to provide the key driver for the rest of the activities. To this end the following key steps are recommended in the short term:

- Establish an agreed agenda for the Interim Secretariat, endorsed and supported by the Basin States
- Support ratification of ZAMCOM by initiating special initiatives, such as high level meetings to raise awareness of the benefits of Basin cooperation, potential for win-win joint projects and programmes
- Closely liaise with the different on-going programmes by various organizations and service providers, formalizing the relations through Memorandums of Understanding (MoUs)
- Strengthen data sharing as a continued input to the Zambezi Water Information System (ZAMWIS), removing bottlenecks in timely supply and financial contribution
- Strengthen communication function in cooperation with the National Committees to make Basin Cooperation come alive on a number of practical items.

3.5.5. Recommendations and Actions

Zambezi IWRM Implementation Plan

Botswana's role in the activities highlighted in the Implementation Plan should be included into the National IWRM Action Plan to ensure integration into national planning.

Funding

The future of the ZAMCOM is to be funded by the member States. A recommendation is that a funding plan for Botswana be developed and proposed.

Linkage to Civil Society: Zambezi Has Its People

The Kalahari Conservation Society is to implementing the project, Zambezi Has Its People (ZHIP), along the lines of the Every River Has Its People project. The project is intended to facilitate broader community participation and promote sustainable management of natural resources in the Zambezi River Basin for the benefit of basin residents and states. The planned project is a response to issues arising from stakeholder conferences under the Zambezi Action Plan Project 6 Phase II (ZACPRO 6.2) Project. Increased stakeholder participation in the development and management of the water resources of the Zambezi river basin at all levels is one of ZACPRO 6.2's objectives. Progress on this project and any related activities should be considered in the Botswana National IWRM Action plan.

3.6. Cubango-Okavango River Basin

The Cubango-Okavango River Basin includes the Okavango Delta and covers an area of about 725 000 km², **Figure 4**. The active drainage part of the basin is about 200 000 km², spread over Angola (77 % of the total area), Namibia (5 %) and Botswana (18 %). In 2004 there were approximately 600 000 people living in the active drainage part of the basin. The Okavango River system drains towards the interior of the continent to the Okavango Swamps, the largest freshwater swamp in the southern hemisphere and the world's largest inland delta. The river (~1,100 kilometres in length) is one of the few large rivers in the world without any dams.

Applicable International Agreements include the Permanent Joint Technical Committee bi-lateral agreement between Angola and Namibia (established in 1990), the Joint Permanent Water Commission bi-lateral agreement between Botswana and Namibia (established in 1990), and the Agreement for establishing OKACOM ratified by Angola, Botswana and Namibia (established in 1994).

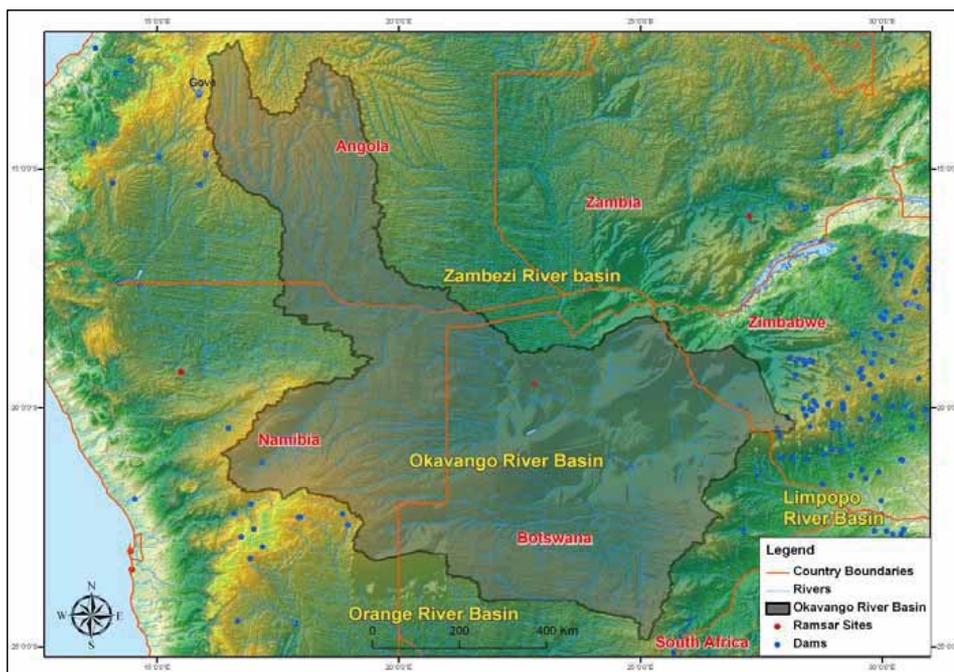


Figure 4 Cubango-Okavango River Basin (UNEP 2008).

3.6.1. Institutional Review (Pietersen and Beekman)

The 1994 OKACOM Agreement built upon previous riparian agreements including the 1990 Permanent Joint Technical Committee on the Cunene River between Angola and Namibia, and the

Joint Permanent Water Commission between Botswana and Namibia on water matters of mutual interest. OKACOM’s primary objective is "to act as technical advisor to the Contracting Parties (the Governments of the three states) on matters relating to the conservation, development and utilisation of the resources of common interest to the Basin member States and shall perform such other functions pertaining to the development and utilisation of such resources as the Contracting Parties may from time to time agree to assign to the Commission". Essentially, OKACOM seeks to promote coordinated and environmentally acceptable regional water resources development objectives, while addressing the legitimate social and economic needs of the riparian states.

Water sector reforms in all three countries have recently brought about the review and revision of national water policies and legislation. In all three countries the opportunity has been taken to incorporate international water management concepts such as Integrated Water Resources Management, Water Demand Management, Polluter Pays Principle, Environmental Flow Requirements and a basin-wide approach to water resources management. Stakeholder participation is promoted and recognition is given to national obligations with regard to shared waters. All three countries are signatories of the Ramsar Conventions and both Namibia and Botswana have recently drafted their National Wetland Policies (Bethune 2004; NNF 2004).

Organizational Structure

The OKACOM Agreement effectively defines three organs within OKACOM, namely the Commission, the Okavango Basin Steering Committee (OBSC) and the Permanent Secretariat, **Figure 5**.

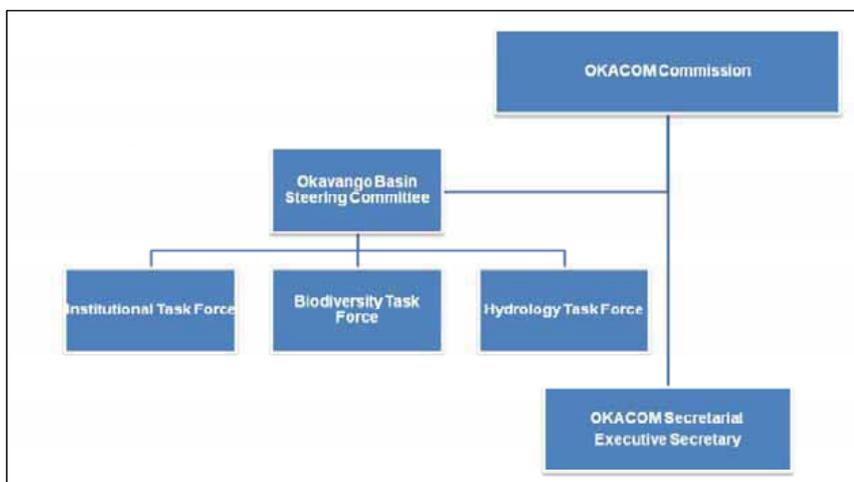


Figure 5 OKACOM Organizational structure.

Organizational Structure OKACOM

The OKACOM Commission is the principle organ of OKACOM, and consists of representatives from each of the three member states: high-ranking officials from government ministries related to water and natural resources management. The Commission is chaired on a rotational basis by the chairperson of a National Commission or delegation of the respective member state.

The OBSC advises the Commission on technical issues, reviews topics scheduled for discussion, and is staffed by technical specialists from related government departments. The OBSC was originally appointed in June 1995 and is chaired by an expert from the member state having the Chair of the OKACOM Commission at the time.

In 2004 the OKACOM Commission began to institute steps towards forming a permanent Secretariat, which would implement the decisions of the Commission and also provide administrative, financial and secretarial services to OKACOM. Prior to this, an interim secretariat had been operational. The permanent Secretariat would also be responsible for communication and for data collation and sharing. In April 2007 Angola, Botswana and Namibia signed a new agreement pertaining to the "Organizational Structure for the Permanent Okavango River Basin Water Commission", which legally established the Secretariat. A hosting agreement, signed in April 2007, determined that the Secretariat will be based in Maun, Botswana in the offices of the Botswana Department of Environmental Affairs for the first three years of its existence and possibly longer.

Functions and mandate

The most important role of OKACOM is to coordinate or streamline riparian management and resource development, and in doing so anticipate and reduce unintended or unnecessary negative consequences. To do so it has developed a coherent approach to managing the river basin. That approach is based on equitable allocation, sustainable utilisation, sound environmental management and the sharing of benefits. The 1994 OKACOM Agreement gives the Commission legal responsibility to:

- Determine the long term safe yield of the river basin;
- Estimate reasonable demand from the consumers;
- Prepare criteria for conservation, equitable allocation and sustainable utilisation of water;
- Conduct investigations related to water infrastructure;
- Recommend pollution prevention measures;
- Develop measures for the alleviation of short term difficulties, such as temporary droughts; and
- Address other matters determined by the Commission.

Rules on Decision-making and Procedure for Dispute Resolution

Decision-making is carried out by means of negotiations among the concerned parties and is based on consensus. If no decisions can be reached, the matter is referred to the member states for further negotiation. There are no formal sanctioning mechanisms for non-compliance of agreed upon rules and procedures. Any dispute concerning the interpretation or implementation of the OKACOM Agreement is to be settled by the member states (AMCOW, 2007).

RBO Programmes and Capacity Building Processes

As part of its commitment to consultation and community involvement, OKACOM established a Basin Wide Forum (BWF) as part of the “Every River Has Its People Project” organised by the Namibia Nature Foundation (NNF) and aimed at the sustainable management of natural resources of the Okavango River involving local-level community participation. The BWF is a transboundary committee with ten local community representatives from each of the riparian states. At a country level, the members are called Country Forum Members, and they meet twice a year at national level and at least once a year at basin level. The primary aim of the meetings is to share experiences and generate a 'bird's eye view' of the socio-economic and hydro-environmental landscape of the basin in order to help formulate knowledge-based community livelihoods and environmental action plans. OKACOM supports the USAID-funded Okavango Integrated River Basin Management (IRBM) project. The IRBM project trains local community members in sustainable environmental practices, and is currently launching a number of community projects in Menongue, Angola.

Funding and financing mechanisms

Financial responsibility for OKACOM is taken jointly by the three riparian states, who work with partner countries to ensure financial sustainability. For example, in May 2007, OKACOM signed an agreement with the Government of Sweden for a US\$ 2.2 million financing towards the set-up and first three years of operation of the OKACOM Secretariat. Swedish International Development Cooperation Agency (SIDA) has committed to supporting the activities of the Secretariat for ten years, during which time Swedish funding will decrease while member state funding increases. The US Agency for International Development (USAID) has provided Interim Secretariat Services for OKACOM, including start-up support for the Secretariat and assistance with the website and newsletter. On April 27th 2006 a two-year grant agreement worth over US\$ 2 million was signed between USAID and the Southern African Development Community (SADC), aimed at providing support to river basins in the SADC region, including the Okavango. The Global Environment Facility (UNDP-GEF) project of the United Nations Development Programme has initiated a project to strengthen the mechanisms for joint implementation, develop a transboundary diagnostic analysis and formulate a Strategic Action Plan for the Okavango Basin. OKACOM meetings rotate between the member states, each state pays for its delegation, and the host state bears the meeting costs. At present OKACOM has a relatively small budget.

3.6.2. Comments

Policy development

OKACOM lacks formal mechanisms for translating policy and findings at transboundary level to the national executive in the three member countries. At present this depends on senior members of the OKACOM Commission also being senior members of government in their respective countries. However, national governments are not bound to respect OKACOM's findings.

Political commitment

The OKACOM Commission is the principle organ of OKACOM, and consists of representatives from each of the three member states: high-ranking officials from government ministries related to water and natural resources management. The Commission has significant political backing.

R/LBO specific

- OKACOM has limited authority, mostly an advisory role. There are no formal sanctioning mechanisms for non-compliance of agreed upon rules and procedures. Any dispute concerning the interpretation or implementation of the OKACOM Agreement is to be settled by the member states.
- OKACOM functions as the appropriate vehicle for the implementation of the SADC Protocol on Shared Watercourses. Early 2007 the OKACOM organizational structure was modified to bring it into line with the requirements of the Protocol
- OKACOM receives support from international organizations for various capacity building initiatives and support programmes. One such programme is the USAID funded Okavango Integrated River Basin Management (IRBM) project with the training of local community members in sustainable environmental practices. SIDA provides support to OKACOMs activities for ten years and UNDP-GEF has initiated a project to strengthen mechanisms for joint implementation, a transboundary diagnostic analysis and the formulation of a Strategic Action Plan.

R/LBO - National Government linkages

- Key governmental institutions are national ministries for water resources and/or environment
- The OKACOM Commission consists of high-ranking officials from government ministries related to water and natural resources management.
- The Okavango Basin Steering Committee (OBSC) who advises the Commission on technical issues is staffed by technical specialists from related government departments.
- There is continuous dialogue at the political level
- The OKACOM secretariat is housed within the Department of Environmental Affairs, Maun, Botswana, which may further cement linkages with the national executive

Public participation and empowerment

- OKACOM established a Basin Wide Forum (BWF) as part of the “Every River Has Its People Project” to involve local-level communities. The BWF is a transboundary committee with ten local community representatives from each of the riparian states
- OKACOM is linked to national and regional NGOs, who may have considerable lobbying power at national/executive level

Information management

The permanent Secretariat is responsible for communication and for data collation and sharing. The Harry Oppenheimer Okavango Research Centre (HOORC) in Maun hosts the Okavango Delta Information System (ODIS) and is linked to various international institutions that carry out research in the delta. There is quite a lot of data and information on the Okavango Delta. In other parts of the basin (e.g. in Angola), however, data is mostly lacking. There is a resourceful OKACOM web-site.

Financial aspects

Financial responsibility for OKACOM is taken jointly by the three riparian states, who work with partner countries to ensure financial sustainability. To date, except for meetings, OKACOMs activities have mostly been supported by donors (USAID and SIDA). OKACOM has a relatively small budget.

The reliance on external donor support raises concerns about the long-term sustainability and viability of the basin organization's activities. It is in this context that Sweden, through SIDA, has committed to support OKACOM Secretariats activities for ten years during which time Swedish funding will decrease while member state funding increases. On the other hand, there is much international interest in the Okavango Delta, making the funding and technical support for OKACOM more secure.

3.6.3. Botswana National Action Plan for the Okavango

Botswana National Action Plan 2011-2016 (April 2011), details the Cubango-Okavango Strategic Action Programme, and the priorities themes and activities of particular relevance to Botswana.

The Cubango-Okavango Strategic Action Programme (SAP) is supported at national level by the respective National Action Plan (NAP) of each basin state, making the NAP a critical tool for the implementation of SAP priority actions at national level and the integration of transboundary and basin concerns into national legislative, policy and budget decision making processes.

National Action Plans (NAPs) for Angola, Botswana and Namibia identify priority problems and interventions based on the Cubango-Okavango Transboundary Diagnostic Analysis. The NAPs are strategic implementation plans for the national part of the river basin, endorsed at political level.

The National Action Plans (NAPs) represent an awareness of and commitment to enhanced sustainable management of water resources by the basin states. It is critical that all states continue to make further steps towards improved stewardship of all natural resources at the national level, with the confidence that even the smallest action can lead to large improvements when taken collectively.

While the NAPs feed into the SAP, they are also cohesive, independent documents which detail national objectives, targets and interventions to be achieved. They have common guidelines and, like the SAP, will be implemented in two separate five-year periods and will be reviewed every five years. Implementation of the NAPs moves forward independently of the SAP process but their updating shall be undertaken concurrently with the SAP.

The basin states have ensured and will continue to ensure that the NAP and SAP content, policy and measures, are coordinated and consistent with those developed across the sectoral ministries. The NAP consultation process leading to endorsement was designed to ensure all key government stakeholders are consulted fully and in a timely way to ensure integration. In preparing the NAPs the basin states referred to existing development and environment plans and it has been stressed that each riparian state should ensure that its body of laws and regulations is fully coordinated and supportive of environmental policies developed through the SAP.

The Cubango/Okavango Basin is currently in a remarkably good ecological condition, compared to most river basins around the world. Current trends by the riparian countries, however, threaten this near pristine status of the river Basin. The following sections provide an analysis of the drivers that potentially can affect change in the Basin and in particular the Botswana part of the Basin, what impact does the driving factors have in the Basin and what are the areas of concern for Botswana and the Basin as a whole.

3.6.3.1. Driving factors

The Transboundary Diagnostic Analysis (TDA) has identified four key factors that will drive change in the Cubango/Okavango River Basin, namely population dynamics, poverty, climate change and change in land use. These factors are equally important in the Botswana part of the Cubango/Okavango River Basin. *Population growth* will increase the demand for resources and put pressure on the ecosystem; but for poverty to be tackled, more resources need to be utilised. Where poverty is high, population growth is undesirable, but where income levels are high, and livelihood options more diverse and not too dependent on the environment, population growth is not always a problem, and may in fact facilitate economic activity and generate growth. *Poverty* therefore, needs to be understood in historical and socio-political contexts, and its multiple dimensions appropriately addressed.

As noted by the SAP and substantiated by the TDA, high-use developments on the basin will not necessarily lead to a reduction in poverty. As the main reason for high levels of poverty is the unequal distribution of wealth, therefore access to development benefits will be crucial for reducing poverty. In the Okavango Delta, like the rest of the Basin, direct access to wetland resources is critical for households' livelihoods; accessing natural resources for food, fibre and fuel, while important for meeting basic household needs, is also important for income generation. *Climate change* will exacerbate poverty by reducing the coping abilities of households and individuals and increasing their vulnerability to its impacts. As a way of reducing risks associated with climate and an unstable environment, most locals in Ngamiland area maintain a diversified income generation system. However, activities such as fishing and flood recession agriculture can be adversely affected by changes in flood regime. *Land use change* is a driving force for change and will have an impact on water quality and biodiversity in the Okavango Delta. There is an increased demand for arable land along the river and tourism establishments within the Okavango Delta, if not well managed, can have significant impacts on the quality of water and the ecosystem as a whole.

All the drivers mentioned above are interrelated and they impact on the priority concerns for the Okavango Delta. Changes in flow regimes will lead to changes in land use and livelihood options. Equally, the impacts of policies and institutions could result in land use and flow regime changes. It is therefore important to recognise and understand the interconnectedness of the issues and come up with integrated solutions for potential problems. For the Okavango Delta, these issues are enhanced by the fact that it is located downstream, as well as the sensitive nature of the ecosystem.

3.6.3.2. Priority Areas of Concern

The drivers mentioned above will have an impact on the integrity and functioning of the Cubango/Okavango River Basin, causing several areas of concern for the riparian countries. The Transboundary Diagnostic Analysis identified four areas of concern in the entire basin:

- Variation and reduction of hydrological flow
- Changes in sediment dynamics
- Changes in water quality
- Changes in the abundance and distribution of biota

For Botswana, the priority concerns are related to those of the basin. However, being a downstream riparian country with an extremely sensitive wetland ecosystem, some concerns are more relevant and more significant than others. The priority concerns for Botswana are listed and discussed in detail below.

- Changes in flow regimes
- Changes in water quality
- Changes in land use
- Changes in abundance and distribution of biota
- Changes in livelihood options
- Inadequate policies and institutions
- Inadequate research, information and communication

Changes in Flow Regimes

The Cubango/Okavango River Basin is referred to as a 'losing' system in that nearly all the water in the basin is generated upstream of the basin, particularly in Angola. Downstream of the river basin, such as the catchments of the lower Cubango/Okavango and the Cuito River, contribute very little flow to the system. The river system also loses water through evapotranspiration and groundwater recharge, particularly in the upper catchment. This leaves very little flow to the lower part of the system, making the Okavango Delta extremely vulnerable and sensitive to hydrological changes and reduced flow. Although hydrological change is inherent in the Okavango Delta ecosystem, it is also not always permanent. Flood dynamics in a channel-floodplain system can change due to *exogenic* processes such as climate change, *endogenic* processes such as geomorphological evolution of river channels and floodplains, and *anthropogenic* processes such as channelization, regulation and water diversion (Wolski and Murray-Hudson 2006). Understanding the causes of change and the impacts on the system dynamics (e.g. vegetation species composition and distribution) (Ramberg et al 2006) is therefore critical for determining whether that change is desirable or not and how to address its negative impacts and indeed reduce or manage the negative causes. Historical analysis shows that major changes in water distribution in the Delta have occurred in the past (Wolski and Murray-Hudson 2008). Wolski and Murray-Hudson note that change in flooding in the Okavango Delta results from either variation in hydrological

inputs (inflow from the feeding Okavango River and local rainfall), which vary strongly, or by change in distribution of water within the system. In the long term, they argue, variation is dominated by cyclicity (characterised by recurrence in cycles). They state that the important difference between change in flooding resulting from variation in inputs and that resulting from endogenic processes, is in permanency. Reduction in flooding caused by decrease in inputs is reversible – larger floods will come in years of higher rainfall and inflow. Reduction in flooding caused by endogenic processes is rather irreversible – increase in flooding cannot be expected within the geomorphological cycle of aggradation or desiccation, typically 150 and more years. They therefore point out, that it is important to distinguish between these two types of change in order to inform management decisions.

According to the Integrated Flow Assessment of the Okavango/Cubango River Basin, under the high water use scenario, large parts of the system would be unable to sustain present beneficial uses and causing significant drying of the Okavango Delta (TDA, 2011). The impacts of change in flow regimes will affect many of the human activities that depend on flooded plains and flowing rivers and the ecosystem services they provide. These range from subsistence uses such as fishing, harvesting reeds and grass, to water supply and tourism. Too little water in the system will inevitably lead to reduced flows and desiccation of floodplains and channels, resulting in a myriad of socio-ecological impacts such as lack of water for domestic and agricultural use, reduced area for floodplain agriculture and reduced fishing effort, among others. Equally, too much water in the system could result in floods not receding and therefore decrease in arable land, rotting crops, water-related health concerns and disastrous floods that can cause damage to life and property.

Changes in water quality

As noted by the TDA, at present the water quality of the whole basin is considered to be very good; characterised by very low suspended solids and turbidity, with very clear water, low nutrients and low organic content for most of the time. The quality of water in the Okavango Delta is also exceptionally good and for purposes of human consumption, generally safe. This is particularly so for surface water which many communities in remote parts of the Delta already use for drinking and other household uses. According to Wolski (2005) the clean quality of the water is due to the vegetation and the low-nutrient sands which act as a natural filter. Human activities can however introduce waste and other chemicals into the water that could render it unsafe. Water in stagnant pools close to settlements and livestock grazing areas may therefore be contaminated. The colour of the water is however not always clear due to dissolved organic matter. This is usually because of decaying vegetation, and gives the water a red/brown or murky colour. Despite this, the quality of surface water in the river and floodplains is generally good, compared to other river systems around the world.

The situation is however different for groundwater. Although the surface waters are pure enough to drink, the groundwater of the Delta is typically very saline, with traces of Arsenic in the deeper aquifers (Wolski, 2005; Huntsman-Mapila et al. 2006:1376). Minerals accumulate in the groundwater giving the Okavango waters its salty taste. The most saline ground waters are found towards an island's interior. This explains the dominance of salt tolerant vegetation, such as grasses and wild sage, near the centre of islands, and less salt-

tolerant vegetation, such as woodland trees and Phoenix palms, near the outer margins of islands.

The TDA and SAP highlights the limitations of available data in giving a comprehensive picture of the current status of water quality in the whole basin, including the Okavango Delta. As is noted only a few parameters are well known and even though pollution is often acknowledged, the exact nature, source and location of the pollution are not always defined. The SAP highlights this as one of the most critical gaps within the TDA.

Many factors locally and outside the Delta can contribute to changes in water quality. These include current and future development activities in Angola and Namibia; agricultural and other activities in Namibia - settlements/ camps/ lodges/ fishing/ houseboats activities in Botswana (Biokavango Project). Some research has alluded to inappropriate handling of waste and potential water pollution in the Delta originating from tourism facilities (Mbaiwa et al 2004). Understanding the quality of the water in the system is crucial not only for determining the health implications for humans, livestock, vegetation and wildlife but also for identifying the cause and managing the changes in the quality of the water. It is also important because the rapid growth in Maun, estimated at 3.5% annually, has necessitated exploration of groundwater resources. These groundwater resources have to be appropriate for human consumption.

Changes in land use

Changes in land use are triggered by a variety of factors, some environmental and others socio-political (e.g. policies or economic status of the population). In the Okavango Delta, the distribution of land use types largely depends on factors such as distribution of water, soil and range land quality, and the presence of vector-borne diseases, but also strongly related to the traditional preferences of different ethnic groups for particular economic activities (Bendsen 2002; Meyer and Bendsen 2003). As noted by Scudder et al. (2003) the importance of the individual economic activities varies from household to household; community to community; from season to season; and from year to year in response to variations in rainfall and flooding, access to resources, labour and capital and cultural and other factors influencing preferences.

Many households, especially in areas where conflict with other uses is high (e.g. the eastern-side of the Panhandle where wildlife (elephant) populations are high), households have reduced the area cultivated, or do not cultivate their fields at all. Many more households do not cultivate land, or cultivate less area due to lack of draught power (cattle), farm labour and other implements. Many female-headed households, who often use hoes to cultivate their fields, cultivate even less area due to this challenge.

Livestock rearing has always been an important aspect of rural Botswana and has formed the backbone of the household economy for generations. In communal areas, livestock is mainly concentrated along the fringes of the *melapo* during the dry season and during the rainy season, livestock graze in the dryland pastures. Many poorer households in Ngamiland consider farming (both arable and livestock rearing) as risky due to periodic outbreaks of

livestock diseases (e.g. Foot-and-Mouth), reduced grazing potential in areas close to protected areas (e.g. Moremi Game Reserve) and lack of labour and draught power.

Government policy, zoning and land-use planning decisions have primarily influenced land use changes. The growth of tourism and conservation in the last few decades has also facilitated a significant change in land use. Research by Magole and Magole (2009) shows that since the declaration of Moremi Game Reserve in 1963, more and more land has been allocated to conservation, which has increasingly benefitted tourism development. Additionally the Tribal Grazing Land Policy has dramatically changed the land tenure in Botswana since the late 1970s by creating private cattle ranches, and fencing of grazing areas through the Agricultural Development Policy (ADP) of 1991. The creation of Wildlife Management Areas (WMAs) through the ADP meant even less land became available for communal use. The **Table 5** gives a summary of the changes in availability of communal land over time, and the population growth-land use dynamics.

Understanding how land-use is changing is important not only for determining appropriate policies to manage and regulate activities, but also to understand the economic status of households and the reasons for that change. Environmental factors (rainfall, flood distributions, state of range resources) and political decisions (policies) as well as household income status and cultural preferences influence land-use decisions. As noted, in the Okavango Delta, fewer households own cattle, and less land is being cultivated. It is therefore important to know what alternative activities these households engage in, and if they are better or worse off as a result.

Table 6 Summary of changes in availability of communal land overtime

Year	Ngamiland district population	Land available for communal use	% of total district land	Actions responsible for reducing communal land
1964	42,500	111,650	100	All land communal
1981	68,000	102,423	92	Establishment of protected areas, parks and game reserves
1991	94,500	58,508	52	Establishment of commercial ranches and WMAs
2001	124,700	58,508	52	–

Source: Magole and Magole (2009)

Also important is to understand the environmental sustainability of the current land-use practices. What are the impacts of land-use changes on the physical environment? How are the negative environmental and social impacts of increasing tourism managed? These questions will become increasingly important as the decisions to balance sustainable use of resources and economic development become more pertinent.

Another concern in the Okavango area is the practise of indiscriminate quarrying. There are no known sites that are designated for quarrying for gravel and road construction aggregates, as well as sand excavations. As a result, these activities are often practised

without the required authorisation. This leads to degradation of the landscape and the environment, and the creation of rehabilitated borrow pits.

Changes in abundance and distribution of biota

The Cubango/Okavango River Basin is still regarded as highly impressive in terms of abundance and diversity of flora and fauna, with the Delta being exceptionally endowed with rich biodiversity. However, changes discussed above (water quality, land use and flow regime) and many others, will have a direct impact on the abundance and distribution of biota. Abstraction of water, harvesting of reeds, fish, grass, and conversion of land for farming will inevitably change the ecosystem of the river basin and the Delta in particular.

The ecological diversity of the Okavango Delta is generally well understood. Species diversity in the Okavango Delta is a consequence of the unique environment with dynamic shifts in flooding patterns that in turn force constant changes in patterns of plant succession and dependent animals. Temporal variations in flooding also cause accumulation and sudden mobilisation of nutrients which are readily used by well adapted plant species. As a consequence, locally high biological productivity occurs, which in turn results in high number of grazing mammals. Households reported that resources such as water lilies, medicinal plants, palm trees and papyrus have declined, while fish, birds and wildlife were reported to be increasing (Kgathi et al. 2005). The total number of fisheries in the Okavango Delta has increased from mid 1970s to the late 1990s. There are many reasons for this, including the efficiency of the artisanal fishing gear (fishing baskets, traditional hook and line etc.), resulting in relatively low fishing pressure on the system.

Changes in abundance and distribution of biota may be driven by changes in flow regimes, abstraction or harvesting levels, introduction of alien invasive species which may result in declining populations of other species due to predation. Many other threats to biodiversity are anthropogenic, and may result because of limited human activities and well as large developments. Ramberg et al. (2006) argue that the highest habitat diversity is found in the fringes of the Delta, implying that the total species diversity is also highest here. It can be concluded therefore that the highest losses of species are likely to be caused by water development schemes, and already face human pressure from subsistence uses close to settlements.

Changes in livelihood options

The Okavango Delta has enjoyed a diversified rural economy for many generations (Campbell 1976) as people pursued different activities to reduce risk in an unstable environment. The main economic activities are rainfed and flood recession (*molapo*) agriculture, livestock rearing and management, fishing, hunting, gathering and harvesting of non-timber wild resources (e.g. fruits, grass, reeds), small-scale commercial enterprises such as production and sale of crafts, food and beverages, wage labour in the tourism industry and formal employment in the government and private sectors (Bendsen 2002).

The Okavango Delta is however an unpredictable environment, with variable rainfall and flooding patterns (Meyer and Bendson 2003; Ramberg et al. 2006). This has direct implications on people's ability to not only access resources but also to build sustainable

livelihoods. As noted under 'Land-use changes', a significant amount of households in the Okavango Delta no longer engage in livelihood activities that they previously did as a result of socio-political and environmental factors such as human-wildlife conflicts, reduction in available communal land, and unpredictable rainfall patterns. There is a trend towards dependence on the cash economy through seeking formal employment, wage labour and small-scale enterprises such as fisheries and food and beverage sales (Mbaiwa et al. 2004; Mosepele and Ngwenya 2008). Factors such as human well-being, labour availability and access to income and credits also determine the types of livelihood activities that households and individuals engage.

The HIV/AIDS situation in the Okavango Delta is significant, and has been shown to affect households' ability to fish (Ngwenya and Mosepele 2007) and harvest reeds and grass (Wilk and Kgathi 2007). The Okavango Delta is characterised by increasing migration from rural to urban areas in search of employment in the tourism industry, especially among youth and adult males (Vanderpost 2007). This leaves behind women to carry out rural livelihood activities and raise younger children, often HIV/AIDS orphans. Traditional household activities such as farming and collecting wild resources therefore decline and dependence on remittances and cash income increases as households are no longer able to meet their household food requirements through farming.

Most of the changes in livelihood options arise from reduced access to productive resources (e.g. land, wetland resources such as fish, grass, reeds). As most land in the Okavango Delta has been allocated to conservation and tourism, fences have reduced amount of grazing land available, and livestock and human diseases increased in incidences; households have had to change the way they construct their lives. Conflicts over resources result from this situation. Even though jobs have been created through the growth of the tourism industry, they have fallen short of the requirements of the growing number of people who need jobs precisely because they lost access to some subsistence resources (Vanderpost 2006). The formal job market also has its problems, particularly in the tourism industry, where it is significantly controlled by an expatriate community of a different background to the local Okavango Delta population. The local population is also often unable to meet the skills requirements of the tourism industry, resulting in some (usually high-paying) posts being reserved for expatriates causing resentment among locals, many of whom remain unemployed (Vanderpost 2006).

Animal diseases have always been an issue of concern in the Okavango Delta. They have influenced settlement patterns, livelihood strategies and choices of communities and households for many generations (Tlou 1972; Campbell 1976). In the past tsetse-fly and sleeping sickness decimated herds of cattle and resulted in declines in human populations. In the mid-1990s it was the CBPP and currently the Okavango Delta region is struggling with the control of periodic outbreaks of Foot-and-Mouth disease. This is an issue of concern as it has direct implications on the livelihoods of communities who depend on keeping livestock and is also costly to governments that have to invest in controlling the spread of diseases to uninfected areas.

Inadequate policies and institutions

The Okavango Delta is typical of many environmental resources of global significance in that three competing types of proprietorial claim can be identified: different stakeholders may assert that it is a local common belonging to local peoples, or a national resource to be used for national development, or part of the global heritage of mankind, i.e. global common (Thomas 2003). For this reason, policies for the Okavango Delta, perhaps more so than other parts of the Basin, have to respond to these three competing claims: international conservation obligations as required by the Ramsar Convention and other international obligations, local economic and social demands to tackle poverty, and national sovereign rights and aspirations to utilise its resources. But as is the case, the Okavango Delta is also part of a wider system, so decision-making about the use of the resource needs to be negotiated also at the regional, basin-wide level.

The conservation status of the Okavango Delta is generally high as a result of the gradual adoption of strict conservation policies over the years. At the international level, the Ramsar Convention has an overarching role over 'wetlands of international importance' through which Ramsar principles have to be followed in the management of Ramsar sites. CITES, UN Convention on Non-navigational Uses of International Watercourses, UN Convention to Combat Desertification and other international and regional (SADC) policies and agreements also shape Botswana's national policy towards the Okavango Delta. Nationally, many policies have been adopted that regulate the use of and conservation of wildlife, forests, fisheries, water and other resources. A key question in this regard is to what extent national policies have taken into consideration international obligations?

As noted by the SAP, the problem of conflicting policies is common among all Okavango countries. In the Okavango Delta, the main conflicts can be observed between traditional subsistence activities such as farming, fishing, gathering of veld products, and hunting which are often considered incompatible with wildlife-tourism and conservation (Vanderpost 2006, Darkoh and Mbaiwa 2009). Land-use policies often do not integrate these issues in the planning process as often they are sectoral (Magole 2008). The SAP raises the importance of stakeholder participation in the planning processes for the basin. In the Okavango Delta, it has been demonstrated through the ODMP planning process that this is achievable.

Modern policies have tended to displace traditional practices based on traditional knowledge and discrediting the knowledge of local people in informing policy, and favoured modern scientific knowledge instead. As a result, often policies reflect the interests of modern (scientific) institutions such as international conservation organisations, and business (e.g. tourism industry) and undermine those of traditional subsistence users (e.g. fishers). Strengthening existing local institutions and organisations to participate in decision-making and management processes is also a decision that has to be made at the OKACOM policy-making level.

Inadequate research, Information and Communication

Research and communication are important aspects of governance. Several studies have been conducted in the past on social, economic, ecological and management topics related to the Okavango Delta. These studies are useful as they enhance and deepen the collective

understanding of the functioning, structure and composition of the ecosystem and how communities in the Okavango Delta area derive livelihoods from the Okavango ecosystem goods and services.

The ODMP (2008) process facilitated the development of the Okavango Research Strategy. This strategy has outlined the following areas where research is limited:

- Understanding of the different ways in which the Cubango/Okavango River Basin responds to change (climatic and hydrological) and how these affect the ecological and social processes;
- A thorough understanding of the physical, chemical, ecological, socio-economic and political factors that influence the interactions within and between society and ecosystem components;
- Directed management oriented research that answers focused 'cause and effect' questions.

These areas are crucial for enhancing the understanding of the Okavango Delta and for the formulation of appropriate management interventions. In the past, individual research agendas were pursued, rather than coordinated research programmes that are more focussed and comprehensive. The added value in having a coordinated approach to research in the area needs to be realised. Environment and development research also needs to be locally-relevant and located in the socio-political and cultural realities of the people and environment it studies (see Magole and DeMotts 2007).

3.6.4. Management Interventions - Botswana Specific Thematic Areas

In response to the problems identified at a transboundary level and the priority areas of concern identified at a national level, six thematic areas were developed for the Botswana part of the Cubango/Okavango River Basin. **Table 6** shows the driving force, their impact on the Okavango delta (priority concern) and management intervention to mitigate against the impact (thematic area).

Table 7 Thematic areas, identified priority concerns and the driving forces

Thematic area	Priority concern	Driving force
1. Livelihoods and socio-economic development	Changes in livelihood options; Indigenous Knowledge; Animal diseases	Poverty, climate change, land use change, population dynamics.
2. Water resources management	Changing flow regimes; Changes in water quality;	Climate change, population dynamics
3. Land management	Changes of land use	Land use change, population dynamics
4. Biodiversity and environment	Changes in abundance and distribution of biota;	Land use change, population dynamics, poverty
5. Policies and institutions	Policies and institutions	Land use change, poverty

6. Research, information and communication	Research information and communication;	Climate change, poverty
--	---	-------------------------

Each thematic area relates to one or more outcomes that it aims to achieve. These outcomes are identified and described in the logical framework (refer to detailed Botswana NAP Report, 2011) together with the supporting intervention, timeframe and the institutions responsible for its implementation. Each of the outputs in a thematic area includes interventions that realize the output. Interventions are actions undertaken to realize a deliverable, the output and include indicators that allow measuring the progress of each activity in the implementation of the NAP are described. The sections below provide a brief description of each thematic area proposed.

Thematic Area 1: Livelihoods and Socio-economic Development

Poverty, climate change, land use change and population dynamics are among the key driving forces in the Okavango Delta that can potentially have an impact on livelihood options for many people in the area. Most of the changes in livelihood options arise from reduced access to productive resources, either through climate change, land use change or population dynamics.

In order to address this challenge, a comprehensive and detailed understanding of the social dynamics around changing livelihoods, their impacts on household economies, and social relations deserves attention. The dynamics of social impacts of tourism and conservation in particular deserve attention if socio-environmental goals are also to be achieved. Benefit-sharing mechanisms need to be put in place to ensure that communities that lose their livelihoods due to conservation and tourism can also benefit from the growth derived from these tourism activities. Many studies have been conducted and needs to be incorporated into decision-making processes at the policy level. This will also facilitate the institutionalisation of processes and programmes that can effectively address poverty. If the negative impacts of power relations and the wider political economy of conservation and tourism are not fully addressed, they will inevitably contribute to reduced household capacity to build sustainable livelihoods and cope with environmental change, which will subsequently reverse the goals and benefits gained from conservation of the Okavango Delta.

Climate change affects everyone, but more to those individuals and communities that are totally dependent on climate sensitive sectors. Climate proofing and building the resilience of households and livelihoods will be important in the medium to long term. In the short term, creating awareness about the impacts of climate change and putting in place mitigation and adaptation plans suitable for the sub-basin will be crucial.

Disease outbreaks are a key concern for the people of the Okavango Delta and perhaps a threat to their livelihood. In the Delta where wildlife and livestock are in close proximity and interactions are high, Foot and Mouth Disease (FMD) outbreaks are a constant reality. Rapid responses to outbreaks are therefore crucial for containing diseases. Periodic monitoring of livestock movements and their health status, a costly exercise, therefore needs to be institutionalised.

The Sustainable Livelihood (SL) approach will be used in developing these management interventions. This will ensure that interventions go beyond the conventional definitions and approaches to poverty eradication. There are three basic features to the SL approach. The first is that its focus is on the livelihoods of the poor. The second is that the approach rejects the standard procedure of conventional approaches of taking as an entry point a specific sector such as agriculture, water, or health. And finally, the SL approach places great emphasis on involving people in both the identification and the implementation of activities where appropriate.

Thematic Area 2: Water resources management

Two key driving forces for the water resources management thematic area are climate change and population dynamics. While some work on the assessment of causes and impacts of changing flow regimes on the Okavango Delta has already been done, more work needs to be carried out to develop a baseline. Tools for monitoring and managing flooding and drying, and the extreme events that occur due to these processes are therefore required to enable early warning systems to be put in place. It should be noted that the quantification and analysis of baseline information on Okavango Delta Flow regimes has been done from a research perspective, however, this information has not translated into policy and informing government decisions. Management responses to change in flow regimes will therefore have to be informed by comprehensive and up-to-date understanding of the causes of the changes (exogenic or endogenic) in the flow regimes. This would require understanding the system as a whole, and being aware of what changes have occurred upstream (within and outside the Delta) and their causes.

The exact situation of water quality needs to be understood so that appropriate solutions can be put in place. Cost effective monitoring programmes that can be integrated into community programmes and undertaken by semi-skilled personnel can contribute towards a comprehensive, up-to-date understanding of the water quality situation in the Delta. Environmental awareness programmes would also play an important role in sensitizing communities and businesses about the impact of certain human activities on the quality and health of water resources and the environment in general. Most importantly, capacity to identify changes when they occur, and the reasons and scale and frequency of their occurrence will be critical in the medium- to long-term.

Thematic Area 3: Land Management

Under the ODMF and Tawana Land Board, an integrated land use and land management plan was developed for the years 2005-2029. This plan however is largely unimplemented. One of the main challenges is the absence of a proper land data base management system, resulting from poor record keeping of land allocated for different uses. Development of a comprehensive land information management system or the expansion of the existing Tribal Land Information Management System will become a key activity under the NAP. Perhaps the greatest challenge to land management is the enforcement of the provisions contained in a land use plan. Effective implementation of these provisions depends to a large extent on the involvement and participation of local communities.

Community participation becomes important for the long term success of programmes in the Okavango Delta. Such approaches tend to be more effective because it incorporates traditional knowledge and the relevant experience of those affected by land decisions and in this way, help to mitigate potential and existing conflicts arising from land use.

Thematic Area 4: Biodiversity and environment

Land use change, population dynamics and poverty are the three key drivers of change in abundance and distribution of biodiversity in the Okavango Delta. This change is not only contributing to biodiversity loss, but also threatens to impact on the lives that are dependent on these resources. Some changes are caused by natural processes such as shifting direction of river flows, drying floodplains, and climate-driven change. A comprehensive knowledge and understanding of the status of the Basin and the spatial-temporal dynamics of change is required within the ecosystem. Understanding and being able to distinguish the cause of change is also an important step to managing that change. Natural changes in the system also have the potential to disrupt entire frameworks of resource access and expose livelihoods to vulnerability. These activities are of course necessary for human development. Therefore, establishing limits (development space) in line with international best practice, based on the ecosystem approach and development needs of the population is an important step.

Thematic Area 5- Policies and institutions

A key concern for the Cubango/Okavango River Basin is conflicting policies among all Okavango countries. In the Okavango Delta, the main conflicts can be observed between different resource users, such as traditional subsistence activities (farming, fishing, gathering of veld products), and hunting. A key activity for the NAP then becomes to review these policies with the aim of identifying policy gaps.

As a downstream member of the Basin, it is in Botswana's interests to facilitate harmonisation of policies and programmes throughout the Basin. The downstream impacts of a lack of harmony between policies can result in uncoordinated efforts that may in the end nullify the gains achieved from cooperation.

Engaging local communities in decision-making would also strengthen support and ownership of decisions, policies, and programs and benefit from the indigenous knowledge that local resource-users possess. While science has a role to play in policy and resource management, so does indigenous knowledge. Local institutions and the indigenous knowledge held by communities have been shown to contribute towards sustainable resource management and conservation for generations.

Thematic Area 6: Research, Information and Communication

Several research programmes have been developed in the Okavango Delta, however, they remain uncoordinated and not translated into policy. Communication of research results is perhaps the most important part of the research process. Where research is conducted to inform decision-making, it needs to be packaged and presented in an accessible and simplified manner. This not only helps inform people but also provides them with space to participate in research and decision-making. Collaborative research between research

institutions and government institutions would also go a long way to institutionalising decision-making based on properly-conducted science and build the capacity of government institutions to conduct research and also utilise research findings in management and decision-making.

The storing of information in a systematic manner and the accessibility of that information is crucial at institutional level. Establishing appropriate data sharing mechanisms such that they are accessible to decision-makers, managers and local community members is a critical part of the governance process. Often information exists but does not inform decision-making, management and practice because it is not processed, packaged and accessible to potential users. Harmonisation of data collection, analysis, processing and sharing protocols will be important for informed and sustainable management of the Okavango River resources. Mechanisms therefore need to be put in place to coordinate these efforts at OKACOM level. There is also a need for common databases for the three riparian states, for planning and for deeper understanding of the system. There is even a greater need for long term research and monitoring programmes in the Okavango Delta and the basin as a whole.

3.6.5. NAP Implementation

This section outlines the implementation of the activities identified in the Botswana National Action Plan (NAP) as prioritized activities for the next 5 years. The development of the NAP was done with active participation of all stakeholders at district and national level. Similarly, for the NAP to be successfully implemented, it requires the active participation and collaboration of all the relevant stakeholders. It should be noted that the structure for Botswana NAP implementation is strongly informed by the successes, failures and experiences of the implementation of the Okavango Delta Management Plan (ODMP). While the ODMP has remained largely unimplemented, valuable lessons can be drawn from its implementation that will inform the NAP implementation and coordination. The structure and bodies that will be involved for facilitating and ensuring smooth and effective implementation of the NAP activities are discussed.

3.6.5.1. Institutional set up for NAP coordination

The Department of Environmental Affairs in the Ministry of Environment, Wildlife and Tourism will be the coordinating unit of NAP implementation. Building on the experience and trust established through the ODMP process, DEA being the lead institution in the coordination of NAP activities will ensure the connection and therefore continuity of the ODMP and the NAP. DEA is also the national coordinating unit for the National Wetlands Policy and Strategy and the focal point for the Ramsar Convention, making it an appropriate institution to coordinate activities in the Okavango Delta. To empower DEA and give it mandate to coordinate NAP implementation, a cabinet directive will be issued. A Project Management Unit (PMU) will be established and hosted in DEA Maun office to run the day to day activities of NAP implementation. The PMU will work closely with the International Waters Unit (IWU) and the Okavango Wetland Management Committee (OWMC). Overall guidance and strategic direction will be provided by the proposed Water Resources Council

(WRC). To avoid the creation of new institutions, the NAP will largely be implemented from existing institutions with the required mandate, save for the PMU which is a new unit to be established for coordination purposes. **Figure 6** shows the NAP implementation structure.

The Project Management Unit (PMU)

The PMU will be the coordinating unit for NAP implementation and will be hosted by DEA in the Maun office. This unit will be responsible for overseeing the effective and efficient implementation of the NAP, resource management and the monitoring and evaluation aspects of all the NAP activities. Headed by the NAP Coordinator, the PMU will be staffed by two other senior officers; a chief technical advisor and a communication officer. It is proposed that the three senior personnel should be recruited at government salary scale equivalent to D1. The specific qualifications of the persons to be employed will be defined at the time of recruitment; however, the persons should be highly experienced with demonstrated knowledge in water resources management in Botswana. The NAP Coordinator will report to the DEA North West District Coordinator and the Water Resources Council and work closely with the International Waters Unit. DEA will have the responsibility of reporting all NAP activities and progress to OKACOM.

International Waters Unit (IWU)

It is important for the PMU to ensure strong linkages with the International Waters Unit (IWU) during NAP implementation for three reasons- 1) IWU's experience with the TDA, SAP and NAP process; 2) as the institution responsible for transboundary water resources activities; and 3) its strategic position and strength in leveraging funds for transboundary activities from ICPs and other organisations. The IWU will therefore have a coordination role of NAP activities in Botswana with those of Angola and Namibia. The IWU will also be responsible for leveraging funds for national level and transboundary water resources activities. It is proposed that a dedicated office/focal point be established for NAP implementation in the IWU. This could either be through the deployment of a staff member within the ministry to IWU or establishing a focal point within the IWU with existing staff.

Water Resources Council (WRC)

The proposed Water Resources Council (WRC) will provide strategic and policy guidance, oversight and monitoring of NAP implementation. Given the multi-sectoral composition and the functions of the proposed WRC, they are well positioned to provide monitoring and oversight functions to NAP implementation. The current proposed membership of the WRC will be high level officials, predominantly from government, with private sector and NGO representation. The WRC will have a functional secretariat based at the DWA, a government budget and full time employees that will be responsible for the day-to-day functions of the secretariat. The WRC will meet twice a year to discuss NAP progress. Additional meetings will be organized as and when required.

The Okavango Wetlands Management Committee (OWMC)

The Okavango Wetlands Management Committee (OWMC) is a district level institution with supervisory and cross sectoral mandate. Its role in NAP implementation will be to provide institutional linkages of Okavango Delta related activities to ensure implementation. The

OWMC is chaired by the district land authority, the Tawana Land Board, and it is composed of representatives from all government departments, civil society organisations and community organisation. This composition is important for NAP implementation and monitoring at the local and district level.

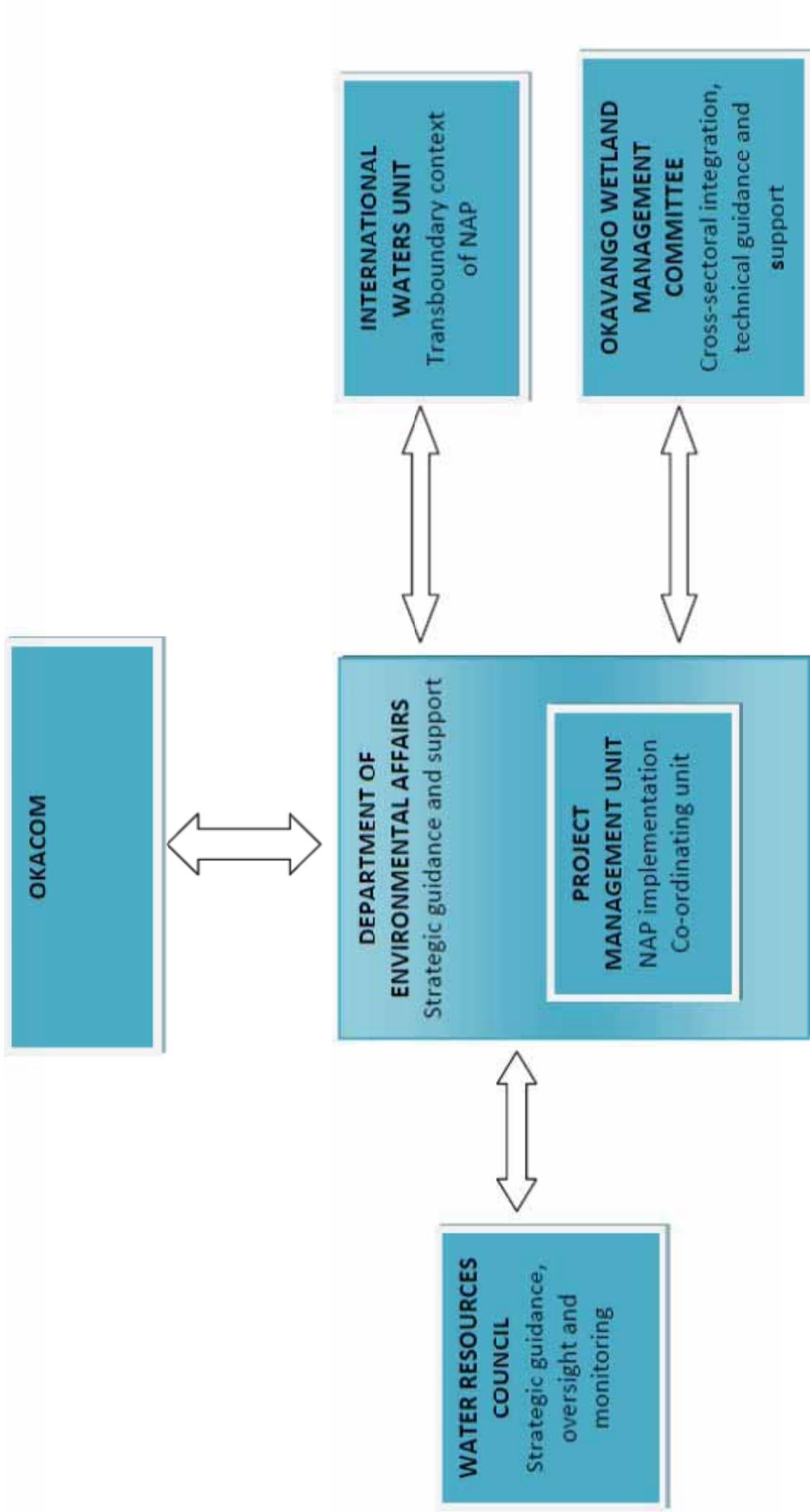


Figure 6 Botswana NAP Implementation Structure

3.6.5.2. Monitoring and Evaluation Mechanisms

Monitoring and evaluation (M&E) can aid the successful implementation of the NAP, ensure that targets and goals set out in the NAP are achieved and problems regarding implementation are detected early and addressed. Two types of monitoring activities will be carried out under the NAP implementation:

- Monitoring of the actual NAP, its performance and achievements. This will be done on the basis of the Logical Framework Analysis and Objectively Verifiable Indicators, using the NAP Log Frame developed.
- Monitoring of the implementation of the NAP and its impact on the Okavango wetland and its ecological character as a whole.

Monitoring and evaluation will be guided by the specific result based indicators described in the Log Frame (Refer to detailed Botswana Nap Report, 2011). The reporting system would have to be designed in such a way that progress tracked for the individual activities of the NAP, problems encountered and the measures taken to address the problems are reported on a quarterly and annual basis. In addition, systematic periodic evaluation and objective assessment of the progress made towards the achievement of the NAP overall goal will be done.

Therefore, the main monitoring and evaluation activities for the Botswana NAP are as follows:

- Development of a comprehensive M&E plan is an integral part of successful implementation of any action plan. It is recommended that at the inception phase of NAP implementation, the PMU should facilitate the development of an M&E plan for NAP implementation. The structure and elements of the M&E plan will be defined during the inception phase, however, the M&E will include SMART indicators, outline means of verification, develop budget for all thematic areas and outline the reporting and reviewing schedules. All indicators must be accompanied by baselines and targets. Without baselines and targets, measurement of change over time is not possible.
- The OWMC which has the main task of coordinating and ensuring cross sectoral planning, integration and implementation, will take the lead in monitoring at the district level. The OWMC will work closely with the PMU and report to the District Development

Committees. This OWMC will utilise the existing reporting structures at a district level to ensure implementation.

- The proposed Water Resources Council will have an oversight and monitoring role for the NAP implementation. It is proposed that the WRC meets twice a year to discuss general progress of NAP implementation and problems encountered.
- It is recommended that in addition to the interim quarterly progress reporting that will be carried out by the PMU during NAP implementation, mid-term evaluation and post-implementation reviews after 5 years should be undertaken. This will provide early feedback to DEA on progress towards success, and also a means of meeting accountability and transparency requirements.

3.6.5.3. Required resources and possible funding

Developing a detailed funding strategy for NAP implementation will be the responsibility of the PMU, working closely with the implementing institutions. This strategy will outline

- A detailed budget for each thematic area of the NAP and the corresponding intervention and;
- The various sources of funding that exist for NAP implementation through national budgets, International Cooperating Partners (ICPs) and the funded projects currently underway.

The Botswana National Action Plan 2011-2016 (April 2011) is presented in **Table 7**.

Table 8 Okavango - Botswana National Action Plan 2011-2016

Outcome	Outcome indicator	Output	Intervention	Time frame	Lead / support institution
Thematic Area 1- Livelihoods and Socio-Economic Development					
Sustainable tourism development with enhanced benefits for local communities	Tourism information system developed (includes capturing of baseline data)	Electronic tourism information system in place at BTO	Improve and implement tourism information system (Data and monitoring) Missing from the info system- community initiatives. Packaging and access the information for different audiences.	1-5 years	Lead- BTO, Department of Tourism, Tour operators and DEA.
Capacity and participation of locals in the tourism sector strengthened	Economic benefits derived from tourism for locals	Socio-economic Impact of tourism survey Report	Carry out periodic socio-economic impact surveys of tourism in the Okavango Delta (5 years)	1-5 years	Lead- BTO, Department of Tourism, Tour operators and DEA.
	Community Based Organisations (CBOs) trained in tourism development	Increased benefits derived from tourism development due to increased knowledge in the sector.	Identify capacity building needs and develop the capacity of Community Based Organisations in the tourism sector	1-5 years	Lead- BTO, Department of Tourism, Tour operators and DEA.
	Local participation and ownership in the tourism industry quantified	Increased participation and ownership by locals in the tourism industry.	Assess the level of participation and ownership of tourism operations by locals. Issues to include: access to markets, information and funding	1-5 years	Lead- BTO, Department of Tourism, Tour operators and DEA.
Gendered and pro-poor development in the Okavango Delta supported.	Biannual stakeholder workshops on tourism	Regular stakeholder forums on tourism	Strengthen collaboration between local, national and international stakeholders in the tourism sector	1-5 years	Lead- BTO, Department of Tourism, Tour operators, ORI, CBOs and DEA
	Household income of local communities increased by the year 2016 relative to 2008.	Socio-economic survey showing livelihoods have improved	Develop gender-sensitive pro-poor programmes that will improve livelihood opportunities for local communities	1-5 years	Lead- NWDC, Support- ORI, NGOs, TLB, NWDC, BTO, MoA, DWNP, DFRR, MTI
	Implementation mechanism for benefit sharing developed	Benefit sharing guidelines for natural resource use developed for Botswana	Develop options and implementation mechanisms for benefit sharing (e.g. CBOs, opportunity lost due to zoning)	1-5 years	Lead- DEA Support- NGOs, CBNRM Forum, ORI, TLB, NWDC, MoA, DWNP, DFRR

Outcome	Outcome indicator	Output	Intervention	Time frame	Lead / support institution
Human-wildlife conflicts reduced	Reduced reported incidents of human-wildlife conflicts by 50% by 2016 Reduce the extent of damage of the conflict-measure the losses e.g. changes in harvests	Mitigation strategies for human-wildlife conflict developed and implemented using participatory approaches	Develop integrated mitigation strategies for human-wildlife conflict Review the policy and compensation structure governing human wildlife conflict	1-5 years	Lead- DWNP Support – MoA, ORI
The impacts of climate change (differentiated by socio-economic class and gender) understood and appropriate adaptation strategies developed	Impacts, and pro-poor coping and adaptation strategies for men and women documented by 2013	Gendered pro-poor adaptation strategies for climate change implemented	Develop pro-poor and gendered climate change adaptation strategies and awareness raising	1-5 years	Lead- DMS, DEA, Support: Health, MoA, DWNP, Dept. of Women's Affairs, ORI
Cross cutting issues (human health, gender and poverty) mainstreamed into development planning processes.	Gender, human health and Poverty reflected in planning documents	Gender, human health and poverty mainstreaming in all planning documents	Develop a tool for mainstreaming human health, gender and poverty in planning processes (health issues lagging behind- involve the authorities that deal with health)	1-5 years	ALL
Animal disease control programmes reviewed with the aim of improving livelihoods in the Okavango Delta	Animal disease control programmes respond to poverty challenge in the Okavango Delta	Animal disease control programmes reviewed	Evaluate the impact of animal diseases and animal disease control programmes on livelihoods	1-5 years	Lead- MoA. Support: TLB, MEWT, MLG
Thematic Area 2- Water Resources Management					
Improved understanding of the	Spatial and temporal distribution patterns of	Hydro-Ecological Models that factor flow regimes.	Gather and analyse all available baseline information on Okavango Delta Flow regimes	1-5 years	Lead DWA. Support- ORI

Outcome	Outcome indicator	Output	Intervention	Time frame	Lead / support institution
current and historic flow regimes in the Okavango Delta	water in the Okavango Delta quantified		Package the information and make accessible to decision makers	1-5 years	Lead DWA, ORI Support- DEA, OP, Tourism
Causes and impacts of changing flow regimes on the Okavango Delta identified and understood	Baseline information on the causes and impacts of changing flow regimes in the Okavango Delta quantified and validated	A Hydro-Ecological models that factor flow regimes Comprehensive understanding of flow change impacts on ecosystem and livelihoods	Gather and analyse the required information on the exogenic and endogenic causes and impacts (climate change and upstream development) of flow change regimes on the Okavango Delta.	1-5 years	Lead-DWA. Support- ORI, Meteorology,
Management mechanisms for responding to changing flow regimes developed	Long term monitoring plan for changing flow regimes developed	Long term monitoring plan for changing flow regimes developed and implemented Continuously updated database of flow regimes available for use by stakeholders A decision support system that relies upon real time hydrological data and provides future forecasting of changes in flow regimes Early warning system for floods and drought	Identify and improve existing or develop where required management responses to changing flow regimes	1-5 years	Lead DWA. Support- ORI
Water quality that meets national and international standards is maintained in the Okavango Delta	National standards for water quality for both Surface and Ground water developed	Systematic water quality monitoring in the Okavango Delta Dissemination of water quality monitoring data for use by ecosystem managers	Develop national surface and ground water quality standards	1-5 years	OKACOM, DWA, DWMP. Support- ORI, BOBS, NWDC, DoT

Outcome	Outcome indicator	Output	Intervention	Time frame	Lead / support institution
Future water quality trends in the Okavango Delta Determined	Okavango Basin water quality standards/guidelines developed	Coordinated water quality monitoring in the Okavango/Cubango River Basin	Synchronise water quality standards across the three riparian states of the Okavango/Cubango River Basin	1-5 years	DWA, DWMPC, Support-ORI, BOBS, NWDC, DoT
	Water Quality database developed	Water quality surveillance programme implemented.	Develop water quality surveillance programme	1-5 years	OKACOM, DWA, DWMPC
	Water quality threats in the upper catchment assessed	Threats to water quality in the upper catchment defined	Review of development scenarios to determine future threats to water quality Develop water quality decision support system and water quality thresholds	1-5 years	Support ORI, BOBS, DoT DWA, DWMPC, Lead- DWA, DWMPC. Support- ORI, BOBS, NWDC, DoT
Pollution in the Okavango Delta prevented, controlled and managed.	Guidelines for solid and liquid waste management developed and enforced	Guidelines for solid and liquid waste management developed	Develop guidelines and implementing mechanisms for solid and liquid waste management in the Okavango Delta	1-5 years	Lead-DWMPC, DWA, NWDC, TLB. Support- KCS
	Persistent Organic Pollutants (POPs) levels for fish and crocodiles determined	POPs levels known and communicated to stakeholders	Carry out baseline survey to determine the levels of POPs in plants and animals.	1-5 years	Lead-DWMPC, DWA, Dept of public health, Ministry of Agriculture. Support- ORI, DEA
	Targeted annual training programmes on water quality issues developed	Different target groups (e.g. Tourism establishment management, local communities) knowledgeable of water quality impacts	Develop and implement targeted training and awareness programmes on water quality	1-5 years	Lead- DWMPC, and DWA. Support- NWDC
	Guidelines for acceptable farming practises piloted in 3 sites in the Okavango Delta	Guidelines developed and implemented across the Okavango Delta	Develop and implement guidelines for acceptable farming practises	1-5 years	Lead- MoA, NWDC, DAR, ORI
	Water quality database and monitoring programme developed	Collaborative pollution monitoring programme developed and	Develop a water quality database for the Okavango Delta	1-5 years	Lead DWA, DWMPC, Agriculture. Support- DoT, NWDC

Outcome	Outcome indicator	Output	Intervention	Time frame	Lead / support institution
Thematic Area 3 - Land Management					
Land use planning that promotes the development of local livelihoods, access to resources for the poor, maximises tourism potential and reduces land use conflicts.	Land allocation and management is guided by the integrated land use plan from 2011	implemented	Conduct pollution monitoring in the Okavango Delta through collaboration with main stakeholders (Tourism, Agriculture, Wildlife, Environment and communities etc.)	1-5 years	Lead DWA, DWMPC, Agriculture. Support- DoT, NWDC
	Land authorities trained in sustainable land management	Land allocated and managed as per the integrated Land use plan Annual training of land authorities using existing training manual (Developed under Biokavango)	Review implementing strategy for the Ngamiland integrated land use plan- Roles, responsibilities, timelines and budgets	1-5 years	Lead- TLB, NWDC ORI and DoL. Supporting- DEA, DFRR
	Sand mining and quarrying activities guided by environmental principles and guidelines	Guidelines to monitor and control sand and gravel mining and quarrying.			
	A Strategic Environmental Assessment (SEA) for the Okavango Delta developed	A comprehensive SEA for the Okavango Delta	Develop a SEA as a tool that will inform development planning		
Land data collected, managed and analysed to inform decision making and land management	TLIMS reviewed and institutionalised	Land information system that is updated regularly	Expand, institutionalise and network the Tribal Land Information Management System	1-5 years	Lead- MLG, TLB, NWDC and DoL[8] Supporting- DEA, DFRR
	LAPCAS implemented	Area coding system developed and updated regularly	Implement LAPCAS (MLH, Postal services)- find the exact meaning of LAPCAS		
	Physical planner's portal implemented	Physical planning information system that is updated regularly	Implement Physical planner's portal		
	Number of land officers trained in land management	Land management Officers equipped with relevant skills to develop	Strengthen skills of Land management Officers		

Outcome	Outcome indicator	Output	Intervention	Time frame	Lead / support institution
		and implement land use plans			
	Database developed for natural resource use (selected key resources)	Long term resource monitoring plan	Monitor natural resource use of the Okavango Delta (selected key resources)	6-10 years	Lead- DFRR, DWNP
The negative impact of flooding is effectively reduced	Effective flood management	The impact of flooding on local livelihoods is understood and mitigated.	Develop a flood management strategy	1-5 years	Supporting- TLB, DEA Lead- OP, DA, NWDC, disaster management and TLB
Increased levels of community participation and use of indigenous knowledge systems in land use and sustainable management processes.	Enhance participatory planning in the Okavango Delta	Lessons learnt documented and participatory planning upscaled to the Okavango Delta	Participatory land planning piloted in 3 sites in the Okavango Delta	6-10 years	Lead- TLB, ORI and Local communities
	IK documented and used to ensure the sustainable use of natural resources in the Okavango Delta	Natural resource management plans developed through documented IK	Document the IK for the management of the Okavango Delta resources (traditional land use, cultural /heritage initiatives, biological, etc.)	1-5 years	Lead- DEA, Support: TLB, DFRR, DWNP, ORI, MoA
Thematic Area 4- Environment and Biodiversity					
Threatened and endangered species protected.	Evidence of the populations of endangered species decreasing, stabilizing or increasing	Biodiversity field surveys undertaken with research needs defined for threatened species (population dynamics, genetic viability and susceptibility to climate change)	Develop a programme for the management of threatened and endangered species in the Okavango Delta, and develop monitoring plans	1-5 years	Lead- DFRR, DWNP, DEA and TLB
	Monitoring plans for endangered species developed and implemented with communities (MOMS), Private sector	Endangered species inventory Species-specific management plans (status and threats)			

Outcome	Outcome indicator	Output	Intervention	Time frame	Lead / support institution
Zero introduction of alien and invasive species	(concessionaires), public sector, NGOs				
	No new introduction of invasive species	Species inventory of current and potential invasive species	Develop a programme to control the introduction and spread of alien species	1-5 years	Lead- DFRR, DWNP, DEA and TLB
Existing biodiversity related plans implemented	Decline of the spatial distribution of invasive species within the Okavango Delta	Species specific management plans developed for existing invasive species			
	Implementation of alien and invasive monitoring plans by different stakeholders	Alien and invasive species monitoring plans developed Mapping the distribution and spread / retreat of the invasive species in the Okavango Delta			
Effective fire management in the Okavango Delta	Biodiversity related plans reviewed and approved by relevant authorities (NBSAP by 2012, ODMIP by 2014, NAP by 2014)	Reviewed biodiversity related plans Implementable actions from the biodiversity plans prioritized with reference to SAP and NAP	Review and implement biodiversity related plans, such as the NBSAP, ODMIP and ensure linkages with approved SAP and NAPS.	1-5 years	Lead- DFRR, DWNP, DEA and TLB
	Fire maps developed	Fire management strategy for Botswana and ODMIP's fire management strategy for the ODRS implemented	Develop fire maps for the Okavango Delta	1-5 years	Lead- DFRR, DWNP, DEA, TLB and Disaster management
	Decrease in economic value of damages by fires Number of communities /stakeholders employing		Assess the socio-economic and biodiversity impact of fires in the Okavango Delta Assess the potential change of current fire risks and threats relating to future climate		

Outcome	Outcome indicator	Output	Intervention	Time frame	Lead / support institution
	fire as a management tool (annual)		change, flood dynamics, land use etc.		
			Improve early warning system for fires through GIS / Modis		
Land use management threats to biodiversity reduced		Biodiversity threats identified	Isolate and implement the biodiversity aspects of the land use management plans such as Ngamiland Integrated Land Use Management Plan / Pan handle Management Plan etc.-	1-5 years	Lead-DWNP and DFRR, Museum Support: DEA, TLB
	Area of established and recognized wildlife corridors	Trans-boundary wildlife corridors established	Assess the transboundary wildlife movement corridors around the Okavango Delta		
Biodiversity monitoring strategies established	monitoring strategies established Indicator species trends used as part of decision supporting system	Annual land use cover maps for three indicator habitats (e.g. riparian woodlands, seasonal floodplains and permanent swamps), established Annual monitoring reports for key indicator species	Establish and implement biodiversity monitoring surveys for key indicator species.	1-5 years	Lead- DFRR, DEA and DWNP
Thematic Area 5- Policy and Institutions					
National policies and legislation aligned with appropriate international obligations.	National policies and legislation not in conflict with international obligations National policies and legislation reviewed and aligned with sustainable development priorities	National policies and legislation aligned with international obligations Policies and legislation on sustainable development and natural resources management reviewed	Harmonise national legislation and policies (e.g. water quality, waste management) and align with international obligations and agreements. Review and analyse all policies and legislation on natural resources management and sustainable management (, and identify policy gaps including issues relating to poverty, gender and health.	1-10 years 1-5 years	Lead- DEA Lead- DEA
Policies that regulate the introduction and	Legislation that regulates alien and invasive species	Alien and invasive species regulated	Review and align legislation related to alien invasive species (Aquatic Weeds Control Act,	1-5 years	Lead- DFRR, MoA, DEA, DWNP, DWA

Outcome	Outcome indicator	Output	Intervention	Time frame	Lead / support institution
control of alien and invasive species are developed.	developed		Herbage Preservation Act, Agricultural Conservation resources Act, District Councils Act)		
	Reduction in the spread of alien invasive species		Develop water traffic regulation for the Okavango Delta	1-5 years	Lead- DFRR, MoA, DEA, DWNP, DWA
Policies and institutions that respond to the environmental and social challenges of the Okavango Delta reviewed.	The sustainable livelihoods framework and SEA used to review policies, regulations and guidelines	Policies, regulations and guidelines that support sustainable livelihoods	Review policies, regulations and guidelines (e.g. fishing, veld products, aquaculture) to ensure that they support sustainable livelihoods.	1-5 years	Lead- DEA, Support: ORI, DWNP, DFRR, DWA
			Institutional review- capacity, constraints,- for NAP implementation. Gap analysis of implementation of plans	1-10 years	Lead- DEA, ORI Support- NWDC,
Approaches and guidelines for sustainable natural resources management in the Okavango Delta developed	Wetland policy tabled in parliament	An approved wetland policy	Facilitate the approval of wetland policy and develop implementation plan, together with time frame, activities and institutional responsibilities.	1-5 years	Lead- DEA, DWA
	Guidelines for SEA developed for projects and policies by 2012	SEA Guidelines developed	Develop guidelines for all policies and projects to be subjected to a Strategic Environmental Assessment and the Sustainable Rural Livelihoods Framework.	1-5 years	Lead- DEA Support: NGOs, OP, NWDC,
Thematic Area 6- Research and Communication					
Enhanced understanding of the physical, chemical and biological processes in the Okavango Delta and the interaction with social and economic	Research programmes developed to address knowledge gaps	New research that integrates social and physical data	Develop research programmes that will address information gaps to enhance the understanding of dynamics within the Okavango Delta	1-5 years	Lead- ORI Support- Meteorology Dept, Department of Research, Science and Technology, DEA, DWA.
	Development of climate change research programmes by 2012	Research programmes that address climate change			

Outcome	Outcome indicator	Output	Intervention	Time frame	Lead / support institution
processes	Local problems solved through uptake by policy makers of research findings	Innovative solutions to livelihood and natural resources Research council established to integrate the public / private and research sectors to develop innovative thinking	Develop an innovative programme to integrate and apply research findings on the interaction of biodiversity, livelihoods and ecosystems in the Okavango Delta, including issues such as ethics, culture, economics and governance.	1-5 years	Lead-ORI Department of Research, Science and Technology
	Long term research programme in place	Research and monitoring programme developed	Develop long term research and monitoring programmes for the entire basin	1-10 years	ORI
Participatory planning in the Okavango Delta enhanced. Research findings processed, packaged and disseminated to decision makers and the broader public.	Annual stakeholder conference held to share practical research findings and policy issues	Research findings and policy solutions communicated and appreciated by decision makers.	Enhancement of participatory planning in the Okavango Delta Package of information and research findings	1-5 years	ORI
	Research findings communicated to stakeholders, brochures printed and biannual seminars to decision makers				
Comprehensive information system on the Okavango Delta developed.	ODIS expanded	Information on the Okavango Delta accessible	Expansion of the Okavango Delta Information System and improve accessibility of ODIS.	1-10 years	ORI, OKASEC.

3.6.6. Recommendations and Actions

3.6.6.1. Botswana National Action Plan for the Zambezi

The applicable water resources management activities, and others if necessary, included in the Botswana NA Plan must be included in the Botswana National IWRM Plan to ensure integration of these activities into the national planning processes. These should also include the monitoring requirements.

3.6.6.2. Funding

All the basins rely extensively on external donor support to fund their activities. Reliance on this support endangers the sustainability and effectiveness of the R/LBOs. The Swedish Government, through SIDA has committed to supporting the activities of the OKACOM Secretariat for ten years. The first three years of the Secretariat's operations are mostly funded by SIDA. Countries do contribute to the three year programme. The commitment is to have the Secretariat fully funded by the countries themselves after year 10. From year 4 of Secretariat operations external funding starts to decline while increasing national contribution. A funding plan should be developed to ensure Botswana's commitment to the OKACOM.

3.7. Orange-Senqu River Basin

The Orange-Senqu River is the main river in the Basin and it originates in the Lesotho Highlands, Figure 7. It is joined by the Makhaleng, Caledon, Vaal and Fish Rivers and drains into the Atlantic Ocean in the west. The Orange River Basin is highly developed, with many dams and transfer schemes. About 60% of the ~1 000 000 km² area of the Orange River Basin lies in South Africa and the remainder in Botswana (13%), Namibia (25%) and Lesotho (2%), which it completely encapsulates. The Orange River Basin is home to over 14 million people.

Applicable International Agreements include the following:

- The Joint Permanent Technical Commission of 1996 - a Bi-lateral Agreement between Lesotho and South Africa which became the Lesotho Highlands Water Commission in 2000
- The Permanent Water Commission of 1992 established by South Africa and Namibia which replaced the Joint Technical Committee (JTC) which was established in 1987; and
- The ORASECOM Agreement of 2000, ratified by Botswana, Lesotho, Namibia and South Africa.

3.7.1. Institutional Review (Pietersen and Beekman)

The ORASECOM Agreement

This agreement was concluded in November 2000 and is not expressly based on the Revised SADC Protocol (signed in August of the same year) or the principles contained therein.⁷ A study of its content will show that it does not directly aim at facilitating or implementing the concepts underpinning the management of a shared watercourse as found in the Revised Protocol. In its present format it does not seem to be entirely suitable and sufficiently equipped to function as the instrument for accommodating an IWRMP for the Orange River. It does not contain a definitional clause.

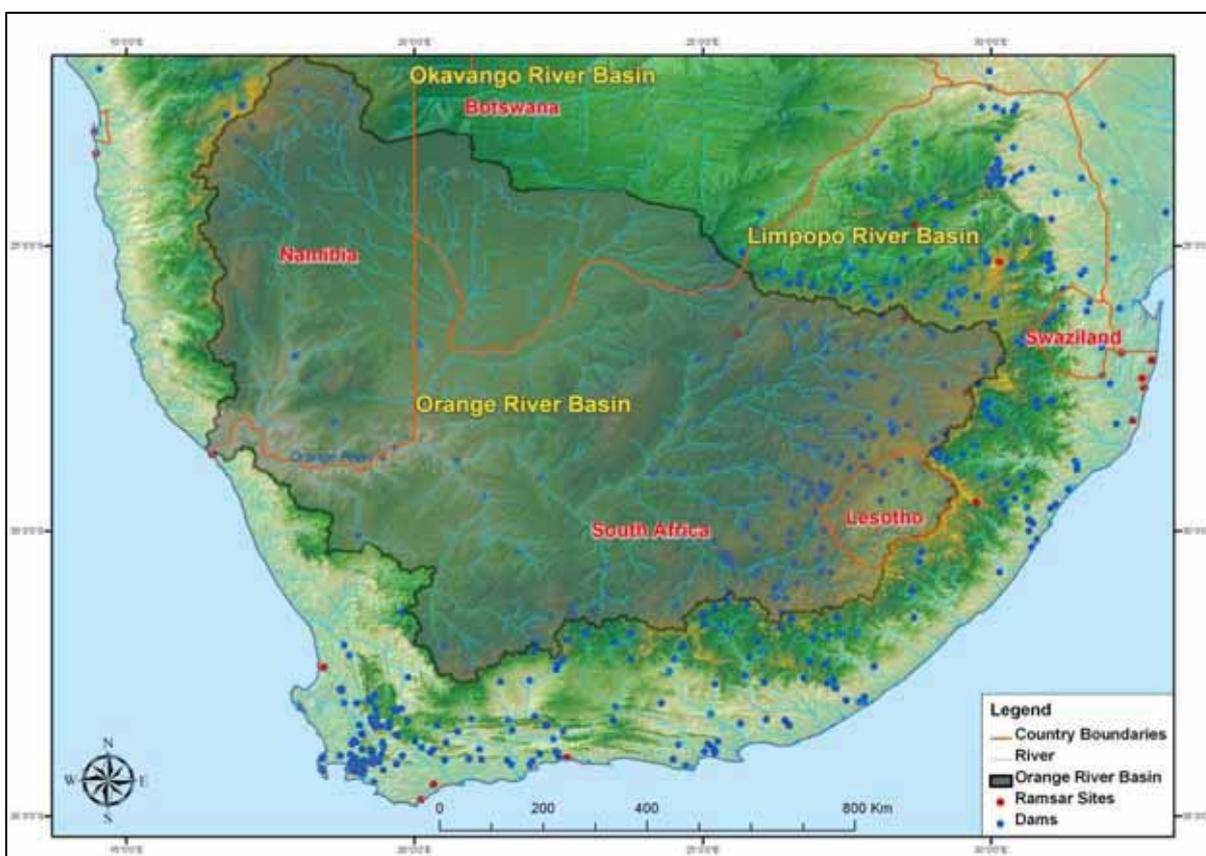


Figure 7 Orange-Senqu River Basin (UNEP 2008)

Its Preamble is inspired by wide-ranging sources such as the Helsinki Rules (with its acceptance of sovereignty), the 1997 UN Convention and the first SADC Water Protocol. Its basic objective seems to be to “extend and consolidate the existing tradition of good neighbourliness and friendly relations between the Parties by promoting close and coordinated co-operation in the development of the resources of the River System.” It does not invoke the principles of “judicious, sustainable and

⁷ See however the strange reference to the Revised SADC Protocol in article 7.3, ORASECOM Agreement. No such reference appears in its Preamble.

co-ordinated management, protection and utilization of shared watercourses” or the “unity and coherence of each shared watercourse” on which the Revised Protocol is based.

The main result is the establishment of ORASECOM as an international organization with legal personality and certain institutions and powers. But nothing “shall affect the prerogative of any number of the Parties to establish among themselves river commissions with regard to any part of the River System”. Such commissions will then be subordinate to ORASECOM.⁸

The Council serves as the technical advisor to the Parties. It has both “functions” and “powers”. The former are about advice and recommendations to the Parties; the latter about appointment of technical experts, ensuring the implementation of the functions and regulating costs.

Article 7 lists the obligations of the Parties. These are about the manner in which the resources of the River System are utilized “in their respective territories”. This should happen “with a view to attaining optimal and sustainable utilization thereof, and benefits therefrom, consistent with adequate protection of the River System.” An interesting rider is provided in that “equitable and reasonable” shall be interpreted in line with the Revised Protocol on Shared Watercourses” of SADC. The latter elaborates on “equitable and reasonable” in article 3(7). The same approach is adopted with respect to the meaning of “significant harm”. Notification and communication duties are also included.

If ORASECOM or an ORASECOM type institution, has to become the vehicle for giving effect to the objectives of the Revised Protocol, we recommend that the necessary effort is made and a suitable body be established, complete with the required powers to implement all the objectives of the revised Protocol. This latter document was adopted with the explicit objective to replace and repeal the former one and it has now entered into force.

It may even be argued that since it entered into force there is now an obligation on the member states to implement the Revised Protocol by ensuring that inconsistencies are addressed. This will entail bringing the ORASECOM Agreement in line therewith, a possibility provided for in article 6(2) of the Revised Protocol. Another possibility is to amend the ORASECOM Agreement in terms of its article 11.2. The best option might be to do a proper job and draft a new and comprehensive agreement, which can then accommodate all the additional aspects of an IWRMP for the Orange River.

We have been informed that Namibia and South Africa have started negotiations on a bilateral agreement on the “Utilization of the Water Resources along the Lower Orange River.” This has apparently not resulted in a final agreement yet. It is based

⁸ Art.1.4.

on article 1.4 of the ORASECOM Agreement, which provides for this type of “follow-up” arrangement. It may not be wise to proceed with these plans if the intention is to adopt an IWRMP for the whole Orange River. Such a plan, especially if implemented along the lines suggested above, should provide for one integrated arrangement for the whole river. Fragmentation should be prevented. Once this overall plan is discussed, the special needs and conditions of the Lower Orange can also be accommodated; or it can be mandated as a special task for the proposed Institution for this river.

Shared watercourse agreements are flexible and “may be entered into with respect to an entire shared watercourse or any part thereof or a particular project, programme or use except insofar as the agreement adversely affects, to a significant extent, the use by one or more other Watercourse States of the waters of the watercourse, without their express consent.” (Article 6(4), Revised Protocol.) A special watercourse agreement for the Lower Orange is permissible in terms of the Revised Protocol, but then it should be based on all its applicable requirements.

Organizational structure

The highest body of the Commission is the Council which is supported by various Task Teams who manage the projects and a Secretariat (ORASEC), **Figure 8**. The Council consists of the participating countries, delegations, each having three members.

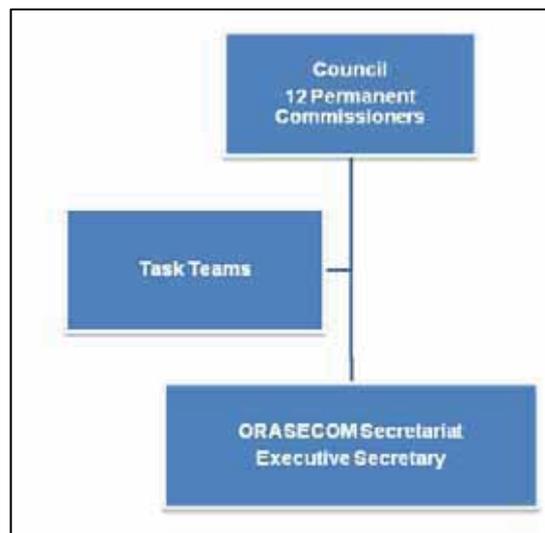


Figure 8 ORASECOM Organizational structure.

Delegations of the respective member states are from:

- Ministry of Minerals, Energy and Water Resources – Botswana
- Ministry of Natural Resources – Kingdom of Lesotho

- Ministry of Agriculture, Water and Forestry, Namibia, and
- Department of Water Affairs and Forestry – South Africa

In June 2006, ORASECOM established an Interim Secretariat (ORASEC) and an agreement to establish a Permanent Secretariat has been ratified by the member states. A chief executive officer has already been appointed.

The Commission mostly works through a sub-committees system of legal and technical Task Teams in which the members are technical experts or advisors nominated by each delegation.

Functions and Mandate

ORASECOM, through the Council, serves as technical adviser to the riparian countries on the development, utilization, and conservation of the water resources of the basin. The Commission is mandated to develop a comprehensive perspective of the Basin, study the present and planned future uses of the river system, and determine the requirements for flow monitoring and flood management. The main objective is the realization of the principle of equitable and reasonable utilization, as well as the principle of sustainable development with regards to the River System. The executive functions remain with the relevant Water Authorities of the four member states.

The following functions were assigned to ORASEC (Hollingworth, 2007):

- A secretariat function related to administration, financial control and technical back-stopping to the Commission in order to facilitate its functions;
- A management function related to the provision of support to the joint management of those projects in the basin that are under the auspices of the Commission;
- A coordination function related to harmonizing development activities in the basin and facilitating the participation of all stakeholders in the activities of ORASECOM;
- A communication function related to the maintenance of a comprehensive database on the basin, with a view to enabling transparent dialogue between the Commission, the scientific community, NGOs and other stakeholders; and
- A screening function related to ensuring the execution of decisions made by the Commission and the assessment of proposals for new activities submitted by a variety of outside interests.

Rules on Decision-making and Procedure for Dispute Resolution

At the level of Tasks Teams, studies are done to provide the information to enable the committees to reach consensus around technical issues. The leader of a sub-committee will then present the technical conclusions, based on the facts established through research, studies and investigations, and communicate the joint recommendations of the sub-committee to the Commission. The Commission then

discusses the results and develops a joint advice to the respective governments. The Council shall make every effort to take decisions on the basis of consensus. No decision of the Council shall be valid unless taken at a meeting attended by the members of at least three of the riparian states. In the event of failure to reach agreement at such a meeting of the Council, the matter shall be made the subject of negotiations between the Parties. Any dispute between the Parties arising out of the interpretation or implementation of the Agreement shall be settled amicably through consultation and/or negotiation between them. In case of a dispute, decisions are transferred to the political level. If a dispute cannot be resolved, the case is referred to the SADC Tribunal whose decisions are final and binding.

RBO Programmes and Capacity Building Processes

ORASECOM and its Secretariat receive support from several International Cooperating Partners (ICPs) through tailor-made backing of the SADC-RSAP2 program (SADC, 2005) to develop measures and frameworks that strengthen their legal, institutional and organizational structures. In common with SADC Water Division they also receive assistance in various fields of capacity building with the aim to conduct basin studies, design IWRM plans and to formulate procedures for dispute resolution (Krantz et al, 2005; 2007; Beekman and Pietersen, 2008).

ORASECOM has presented a portfolio of projects to the EU-Water Initiative (EUWI) relating to the harmonization of the legislation in the riparian countries, a study of transboundary aquifers, water demand management, a basin information system, capacity building, and stakeholder participation. The Commission is undertaking a joint assessment of all the resources of and uses in the basin with the aim of developing an integrated water resources management plan (IWRMP).

Funding and financing mechanisms

ORASECOM is financed by the respective Ministries responsible for the management of water resources of the member states. Each member state covers the costs of its delegation. Meetings are financed by the hosting member state. All further costs or liabilities incurred by the Commission are equally covered by all member states. The ORASECOM agreement, however, is unclear on mechanisms to fund the Secretariat and the Task Teams and it does not provide a financial or regulatory framework within which to manage funding streams (Hart, 2005). Other sources of funding are contributions from donors.

3.7.2. Comments

Political commitment

The highest body of ORASECOM is the Council which consists of the participating countries' delegations, each having three members and mostly from ministries related to water and natural resources. There seems to be significant political backing for transboundary cooperation in the four riparian countries.

R/LBO specific

- ORASECOM is a well-structured relatively young organization, is operational and operates in a stable institutional environment
- ORASECOM does not replace existing bilateral Commissions between any of the watercourse states but is complementary as to facilitate an overall basin approach
- ORASECOM through the Council serves as technical adviser to the riparian countries on the development, utilization, and conservation of the water resources of the basin. The executive functions remain with the relevant Water Authorities of the four member states
- Capacity within the Commission as well as in the water administration of the individual countries is limited.
- ORASECOM and its Secretariat receive support from several International Cooperating Partners (ICPs) through tailor-made backing of the SADC-RSAP2 program with BMZ (GTZ), UNDP and French GEF support with the aim to strengthen their legal, institutional and organizational structures. They also receive assistance in various fields of capacity building. Currently a portfolio of projects is being implemented through the EU-Water Initiative that focuses on harmonization of legislation in riparian countries, establishing a basin information system, capacity building and stakeholder participation.
- There are clear rules for ORASECOM with regards to decision-making and procedures for dispute resolution. In case of a dispute, decisions are transferred to the political level and if a dispute cannot be resolved, the case is referred to the SADC Tribunal whose decisions are final and binding.
- ORASECOMs participation processes and community awareness creation are being developed and implemented.
- ORASECOM has a strong foundation and mandate in legislation

R/LBO - National Government linkages

- Key governmental institutions are national ministries for water resources and/or environment and energy.
- Members of the Council are from the Ministry of Minerals, Energy and Water Resources in Botswana, Ministry of Natural Resources in the Kingdom of Lesotho, Ministry of Agriculture, Water and Forestry in Namibia, and Department of Water Affairs and Forestry in South Africa. The fact that the Commissioners are very senior water managers in their respective countries would guarantee that basin issues will receive attention at the highest level and that results of any study are taken seriously and could be implemented without too many objections
- However, there have been difficulties with regards to implementing ORASECOM's programmes at national government level mostly due to a formal decision made at SADC Summit level to sideline SADC Water Sector Institutions such as the Committee of Water Ministers and the Committee of Water Senior Officials, which left a huge decision-making gap with regards to

project implementation, i.e. leaving RBOs without the necessary support (GTZ, 2005).”

- Liaison with other stakeholders is through ORASEC (ORASECOM Secretariat) and the Task Teams

Community participation and empowerment

- ORASEC has a coordination function with regard to facilitating the participation of all stakeholders in the activities of ORASECOM
- To date there has not been much public participation in ORASECOMs activities except for specific projects through the lead Departments.

Information management

- South Africa has a wealth of information available on surface water resources and groundwater but the other riparian countries have very limited monitoring programmes and consequently data available.
- ORASEC has a communication function related to the maintenance of a comprehensive database on the basin, with a view to enabling transparent dialogue between the Commission, the scientific community, NGOs and other stakeholders. Information sharing has taken place on a limited scale, e.g. through forums such as wetlands committees and national water week events.

Financial aspects

- ORASECOM is financed by the respective Ministries responsible for the management of water resources of the member states.
- The ORASECOM agreement, however, is unclear on mechanisms to fund the Secretariat and the Task Teams and it does not provide a financial or regulatory framework within which to manage funding streams
- Main sources of funding for ORASECOM’s programmes are contributions from donors and this poses the question of the sustainability of current efforts in the long term.

Recommendations

According to the Pietersen and Beekman Report⁹, the current structure of ORASECOM contradicts the integrated framework provided for in the broader international instruments, specifically the SADC Protocol, which is binding on all four of the Orange-Senqu Basin States. The report explains that as it is currently structured, ORASECOM essentially provides a forum for discussion on Basin issues and operates as a funding coordinator (Tompkins, 2007). Tompkins therefore proposed a new structure for ORASECOM that considers not only international conventions, but also the linkages to the national governments and bilateral agreements.

⁹ Pietersen, K and Beekman, H.E. (2008) A Comparative Study on the Linkages between River/Lake Basin Organizations and the Respective Cooperating National Governments in Seven Major African Basins. GTZ.

ORASECOM provides for interaction at state level only, and does not at this stage have adequate measures to support the implementation of an integrated management plan, incorporating basin-wide issues. Coordination between international organisations in the Basin, as well as mechanisms for the incorporation of issues below state level, require extensive discussion and review in order to improve the level of integration in the current structure. **Figure 9** sets out a structure that could serve as a basis for such discussion. Such a structure would require the revision of the terms of the ORASECOM agreement as well as changes to the structure of the LHWC and the PWC.

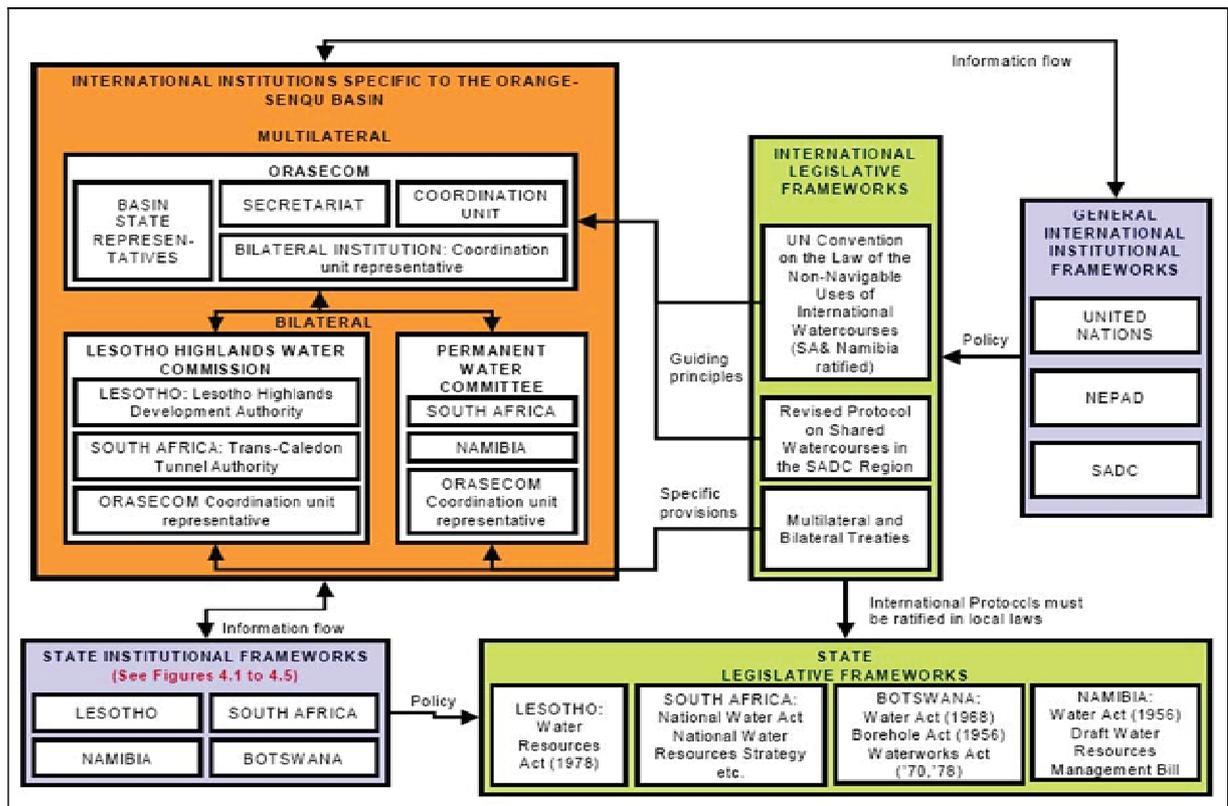


Figure 9 Proposed Revised ORASECOM Structure. (Tompkins, 2007)

This potential structure requires the formation of a permanent Secretariat, as well as a Coordination Unit, to ensure adequate links between ORASECOM and the LHWC and PWC. The coordination unit could consist of a high-level panel of various disciplines, so as to be able to address political, legal, social, technical and environmental issues, and should also include representatives from a coordination body within the LHWC and the PWC. The coordination unit could be permanent or semi-permanent, in the sense that the relevant member expert panel could be called on when necessary, and able to assemble the required staff for any detailed investigation required. The composition of the coordination unit would need to be agreed upon by the member states, and potential staff identified in detail as part of the formation of the unit. The unit would also require adequate funding in order to ensure its operational effectiveness and continuity.

The unit could be responsible for the on-the-ground implementation of the IWRMP, and report regularly to the Secretariat. The Secretariat should be responsible for the operation and maintenance of the basin-wide database, but this may already have been taken into account, since the structure of the Secretariat, which is currently being formed, is not yet known and understood.

High-level state meetings could still be held on an annual basis in terms of the ORASECOM agreement, but including permanent ORASECOM structures could improve the speed and effectiveness of ORASECOM's reaction to issues raised. ORASECOM is probably the most complex river basin organisation in Southern Africa, because it involves so many riparians, and existing, often highly elaborate bilateral schemes, without necessarily having jurisdiction over these schemes. Given this complexity, an adaptable management structure is essential in order to be able to implement the Integrated Water Resource Management Plan.

3.7.3. Orange-Senqu IWRM Plan

The development of the Orange-Senqu River Basin-Wide Integrated Water Resources Management Plan has been divided into three phases. Phase I was implemented between 2004 and 2007, and focused on collating existing information that then described the water resources of the basin. Topics addressed were:- hydrology and water resource availability; economics and current use of economic tools in water resource management and allocation; demographics, water demand, and water resources development in the basin; water infrastructure in the basin; policy, legal and institutional frameworks related to water resources management in the basin; water quality and pollution; ground water availability and use; and environmental considerations.

Phase II of the IWRM Planning Programme was implemented between 2009 and 2011, and focused on bridging the planning gaps identified in Phase I. The work was divided into six packages as follows:- (i) Assessment and upgrading of the Integrated Orange-Senqu River Basin Model; (ii) Updating and extension of the hydrology; (iii) Assessment of requirements for, and the development of, an Integrated Water Resources Quality Management Plan; (iv) An assessment of the impact of global climate change on the hydro-climatology, water resources, vulnerabilities and adaptation requirements; (v) An assessment of environmental flow requirements; and (vi) An assessment for the potential for water demand management in the irrigation sector.

In addition a significant number of other studies have been completed or are in process and are going to be building blocks towards the Basin-wide IWRM Plan.

Strategically, ORASECOM has approached a point where, with some exceptions, sufficient preparatory work has been done to move towards drafting a Basin-wide IWRM Plan. Phase III of the IWRM Plan scheduled for 2012/2013 will consolidate all

the work done to date. It will set out the actions necessary to achieve the strategic objectives of ORASECOM. Some of these will be short term and others longer term. The Plan will signify a transition from planning to implementation of the actions that are determined in the Plan. Procurement for the compiling of the plan is currently underway.

The following sections present relevant information from the Integrated Water Resources Quality Management Plan, and the Environmental Flow requirements, that are applicable for Botswana.

3.7.4. The Interests of Botswana (Heyns, 2004)

Although there is a limited contribution to the surface runoff in the Orange from Botswana territory, Botswana was included as Party to the Commission because Botswana is a strategically important and economically significant SADC State in the Orange Basin.

Botswana is faced with extremely arid conditions in the southern parts of its territory because it forms part of the Kalahari Desert. Access to water is critical and the only surface water resources of significance are the Nossob River coming from Namibia and the Molopo River originating in Botswana and South Africa. Both of these rivers are ephemeral and although the floods in the upper reaches drain southwards towards the Orange, the rivers are endoreic downstream of their confluence and dissipate in the desert before reaching the Orange River.

Botswana is contemplating to draw water from the Zambezi in the distant future to augment the existing North-South Carrier supplying the capital city, Gaborone. The city is located in the Limpopo Basin and can already receive water from the Molatedi Dam in the Limpopo Basin in South Africa. However, when the link to the Zambezi is built through Botswana, there may be merit in increasing the capacity of such a water carrier from the Zambezi to transfer water to the highly industrialised Highveld of South Africa as well. Both Botswana and Namibia are riparian States of the Zambezi and the future transfer of water from the Zambezi to South Africa may require the blessing of Namibia and Botswana who both have interests on the Orange and Botswana on the Limpopo. Botswana would therefore remain an important role player as far as the future augmentation of the water resources in Southern Africa from the Okavango River to the central parts of Namibia, or from the Zambezi River to Botswana itself or to South Africa is concerned. The importance of good neighbourliness between Botswana, Namibia and South Africa is clear.

Furthermore, it is technically possible to transfer water from the Lesotho Highlands to Gaborone instead of augmenting the North South Carrier from the Zambezi. In order to optimise these alternative solutions to meet future water demands, it will require joint planning on a regional scale between the Orange River Basin States, the Limpopo Basin States and the Zambezi River Basin States in particular

The importance of the Orange-Senqu River Commission and the participation of Botswana as a “limited water contributing” basin State in the Commission should therefore not be underestimated as far as hydro-political considerations with regard to regional and local water security in Botswana, Namibia and South Africa is concerned.

3.7.5. Development of Water Quality Monitoring Programme and Data Management Framework (2011)

This Task of the greater Orange-Senqu IWRM Project was to develop a water quality monitoring programme and data management framework. This involves several elements, as discussed in this section.

Sampling Points

12 transboundary sampling points have been identified, as indicated in Table 8. Botswana is responsible for point 11. The sampling points are indicated in Figure 11.

Analytical Laboratories

The laboratories which will conduct the water quality sample analysis include:

- Lesotho - Department of Water Affairs, Water and Sewage Authority and National University of Lesotho;
- Republic of South Africa - Department of Water Affairs;
- Namibia – Namwater; and
- Botswana – Department of Water Affairs and Geological Surveys.

The sampling personnel will take bottles to the sampling sites. There will be two samples collected at each site for each laboratory. One bottle will contain a preservative and will be for the nutrient fraction and the second for the major cations and an-ions.

Table 9 Orange-Senqu sampling points.

Sampling Site	Co-ordinates		Details of Location	Member states responsible for sampling*
	South	East		
1.	-28.6948	28.23486	D2H012Q01 Little Caledon River at the Poplars	Lesotho/South Africa
2.	-28.8833	27.89	D2H035Q01 Caledon at Ficksburg at Ficksburg bridge	Lesotho/South Africa
3.	-29.2978	27.48528	D2H011Q01 Caledon River at Maseru	Lesotho/South Africa
4.	-30.16	27.40145	D1H006Q01 Kornetspruit at Maghaleen	Lesotho/South Africa
5.	-30.3377	27.36277	D1H009Q01 Orange River at Oranjedraai	Lesotho/South Africa
6.	-29.0528	23.68738	C9R003Q01 Vaal River at Douglas Barrage	South Africa
7.	-28.4249	20.00087	D8H008Q01 Orange River at Pella Mission	South Africa/Namibia
8.	-28.7621	17.72631	D8H003Q01 Orange River at Violsdrift (GEMS SITE)	South Africa/Namibia
9.	-28.1229	16.89032	OSEAH 28 5 Orange River at Sendelingsdrift	South Africa/Namibia
10.	-28.5669	16.50728	D8H012 Alexander Bay	South Africa/Namibia
11.	-	-	Vaal Gamagara Pipeline providing water to Botswana	South Africa /Botswana
12.	-29.123686	23.619969	Orange River Downstream of Vaal confluence	South Africa

*Botswana may join any of the teams at sites of preference. While Lesotho, South Africa and Namibia have allocated sites of responsibility for the inter-lab sampling exercise, they may also join in sampling at other sites. Sampling personnel from all four member states were trained

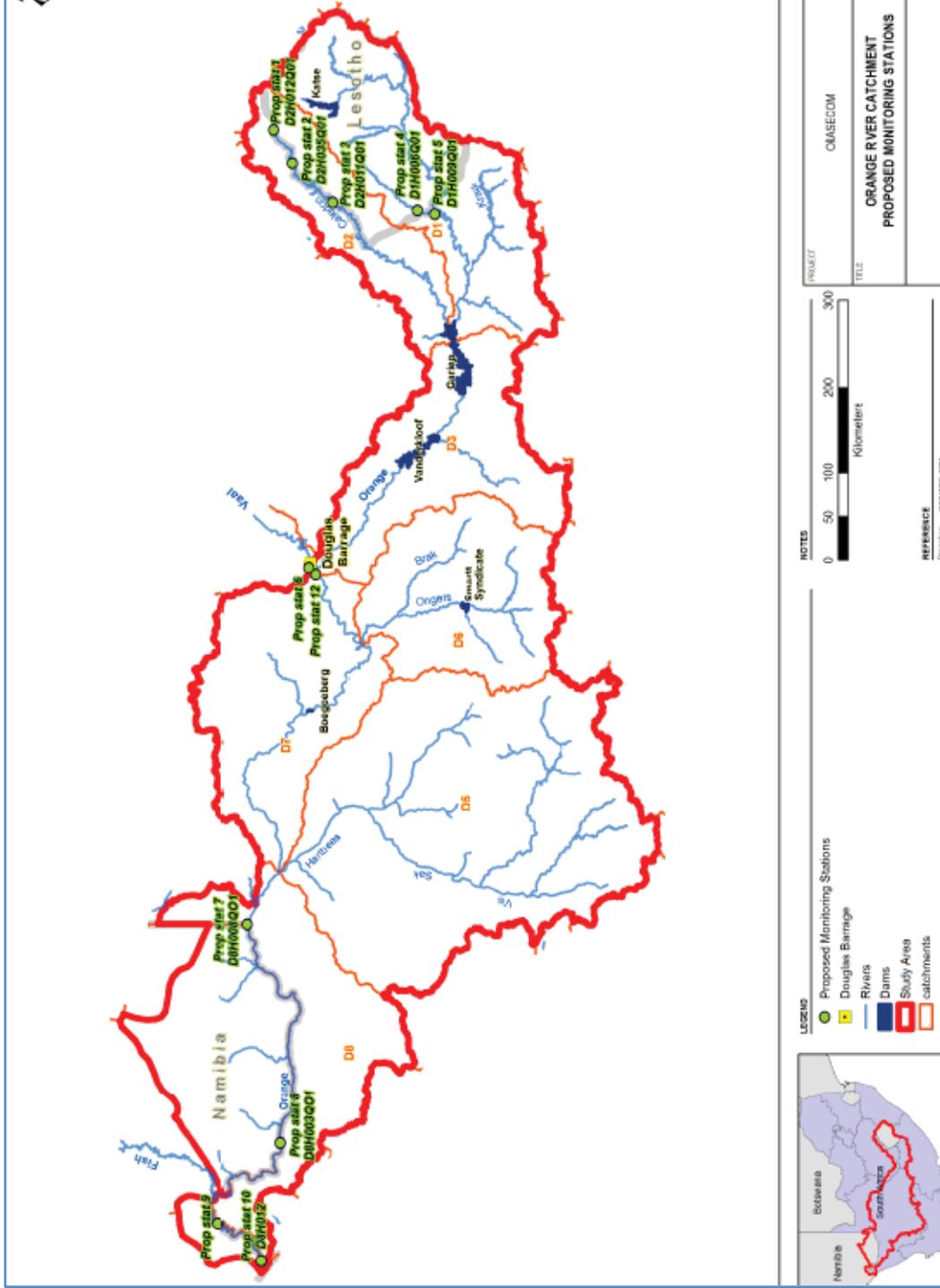


Figure 10 Location of sampling points.

Sampling Frequency

The goal was to collect the optimal number of samples that would provide reliable results. For rivers (flowing water), more frequent samples are required. In general, bi-weekly samples from a river are adequate. This will be sufficient to identify any water quality changes. The minimum and recommended number of samples and sampling frequency for the Orange, Caledon and Senqu Rivers is listed in **Table 10**. Initially the sample frequency for the trans-boundary monitoring program will be monthly. This can be revised at a later date depending on the results and the objectives of the monitoring program.

Table 10 Minimum and Recommended Sampling Frequency

Sampling site	Water quality variables	
	Physical	Chemical/microbiological
Caledon and Senqu Rivers Sites 1 to 5	pH, Electrical Conductivity/Total Dissolved Salts Suspended solids	Na, Cl, NH ₄ , NO ₃ -NO ₂ , PO ₄ , EColi
Orange River Sites 6 to 12	pH, Electrical Conductivity/Total Dissolved Salts	Na, Ca, Total alkalinity, Mg, Cl, K, SO ₄ , F, NH ₄ , NO ₃ -NO ₂ , PO ₄ , E-Coli At site 11 residual chlorine to be added

If any serious water quality deterioration or contamination is detected, sampling frequency should be increased to weekly if possible.

3.7.6. Data Management

Current Data Management Methods

The water quality data management in the basin states involves a combination of spreadsheets, database systems and GIS systems linked to a database. The data supplied by Botswana was in spreadsheet format. The laboratories used in Botswana are the Department of Water Affairs and Geological Surveys.

Proposed Data Management Structure

The proposed data management system is based on the individual basin states' ability to provide data in spreadsheets. The proposed data management structure is shown in **Figure 12**. The member states will manage the data in their individual data management systems. The data will be output from these systems, in spreadsheet format, and sent to ORASECOM by e-mail. ORASECOM will collate the water quality data, carry out QA/QC on the data and produce the required reports for distribution to the member states. The final set of water quality data will be sent to RQS Directorate of the South African Department of Water Affairs. The data will be stored on the WMS system and access will be provided through the Google viewing system.

This is a practical interim proposal to manage the water quality data. Ultimately the water quality data management system should be linked to the hydrology data

management system. The proposed system does, however, rely heavily on ORASECOM having suitable capacity and funding to manage the data.

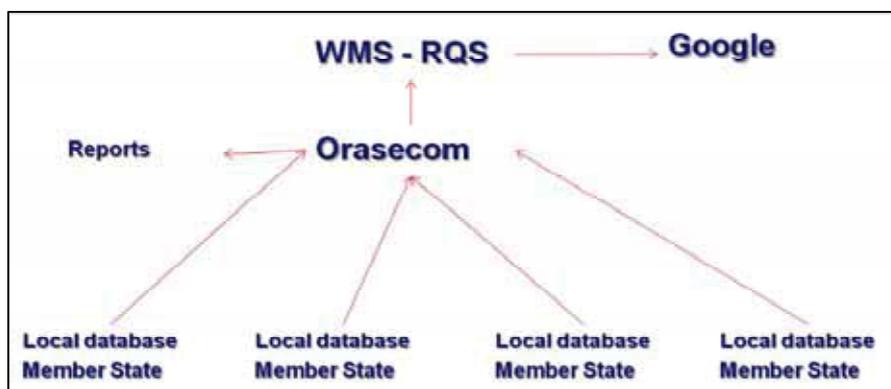


Figure 11 Proposed Data Management Structure

Inter-Laboratory Benchmarking

The Joint Basin-wide Survey (JBS) survey was carried during September and October 2010. The analysis results from the participating laboratories were collated and compared. The results are listed in **Table 11** for one of the sampling points where 1 and 2 designate duplicate samples. An independent laboratory and a spiked sample were also included in the inter-laboratory bench marking exercise. The spiked sample was prepared by the South African Bureau of Standards (SABS). The comparison of the laboratory results to the spiked sample is shown in **Table 12** where a variation of more than 10% from the spiked sample is shown shaded in grey.

Table 11: Results of Inter Laboratory Benchmarking

Variable	RSA		Botswana	Namibia		Botswana	Lesotho		Waterlab
	DWA RQS		DWA	NamWater		Geo			
	1	2	1	1	2	1	1	2	1
Ammonia as NH4	<0.05	<0.05							
Sodium (Na)	36.1	35.9	33.5	36	36	35.4			36
Fluoride (F)	0.312	0.32	0.18	0.3	0.3	0.31			0.3
Conductivity	46.7	46.7	47			46.6			46.1
pH	8.29	8.29	7.19			7.94			8.4
Temperature	24	24							
Potassium (K)	2.44	2.48	11.34	2	2	2.22			2.2
Calcium	34.84	33.085	34.13	31	32	32.4			36
Chloride (Cl)	29.436	29.856	41.73	26	26	32.62			35
Magnesium (Mg)	16.746	17.138	17.15	16	16	17.8			18
Nitrate + Nitrite as N	<0.05	<0.05							
Nitrate as N				<0.5	<0.5	1.28	5.5	3.6	0.2
Nitrite as N				<0.1	<0.1		0.002	0.001	
Phosphate (PO4)	<0.01	<0.01	0.03				1.72	1.76	<0.01
Silica (Si)	8.077	8.07							4.5
Sulphate (SO4)	40.261	40.01	29.81	39	39	39.2	48	47	44
Total Alkalinity	161.868	163.388					123	128	156
TDS			334		293				316
Count	12	12	11	7	7	11	5	5	13
Total	18	18	18	18	18	18	18	18	18
Percentage	66.7	66.7	61.1	38.9	38.9	61.1	27.8	27.8	72.2

Table 12 Comparison of Laboratory Results to the SABS Spike Sample

	Lab 1		Lab 2		Lab 3		Lab 4		Lab 5	Lab 6	Lab 7	Lab 8	SABS VALUES
	Run 1	Run 2	Run 1	Run 2	Run 1	Run 2	Run 1	Run 2	Run 1	Run 1	Run 1	Run 1	
Sample 1													
pH	8.6	8.41	8.11	7.99	8.108	8.111			7.95	7.22		8.1	7.9
EC (uS/cm)	292 uS/cm	293 uS/cm	28.4mS/m	28.4mS/m	29.73 mS/m	29.78 mS/m			291	31 mS/m		29.8 mS/m	30.5 mS/m
TAL (mg/l CaCO3)					97.879	94.401				86.95		80	94.22
Sample 2													
Ca (mg/l)					461.361	461.79	1280	1240	2896	1336		1643	1444.98
Mg (mg/l)					360.73	364.6	280	280	345	361			358.83
Na (mg/l)					99.4	98.5	900	920	863.6	869		1103	934.65
K (mg/l)	175.2	175.2			17.1	16.9	370	370	335	752		416	359.50
Sample 3													
Cl (mg/l)			1477		1179.42	1179.42	1220	1220	1291	1413.65		1363	1352.86
SO4 (mg/l)					1238.14	1239.03	1480	1480	1154	1273.45		1035	1291.88
F (mg/l)					20.1	23.9	19.7	19.7	9.21			18	19.99

Trigger Values

The trigger values set at the sampling points 6 to 12 are listed in Table 12. Point 11 which Botswana is responsible for monitoring is highlighted in green. The trigger values are instream concentrations which, if the measured values exceed a response, must be triggered by ORASECOM to further investigate the cause of the trigger values being exceeded. The trigger values are based on DWA (2009) and ORASECOM (2009). The Resource Water Quality Objectives set in DWAF (2009) were used in the ORASECOM (2009) to recommend trigger values for the various sampling points.

Table 13 Trigger Values for sampling points 6 to 12

Water Quality Variable	Unit	Trans-boundary Point						
		6	7	8	9	10	11	12
pH		8.5	8.5	8.5	8.5	8.5	8.5	8.5
Total Alkalinity		300	300	300	250	300	300	300
EC	mS/m	100	85	85	85	85	100	85
Ca	mg/l	80	80	80	80	80	80	80
Na	mg/l	115	93	93	93	93	115	93
Mg	mg/l	70	70	70	70	70	70	70
K	mg/l	25	25	25	25	10	25	25
Cl	mg/l	200	100	100	100	100	200	100
SO4	mg/l	200	150	150	200	150	200	150
F	mg/l	0.7	1.0	1.0	0.7	0.7	0.7	1.0
NH4	mg/l	0.015	0.03	0.03	0.015	0.015	0.015	0.03
NO3/NO2 as N	mg/l	0.4	0.15	0.15	0.4	0.25	0.4	0.15
PO4 as P	mg/l	0.05	0.03	0.03	0.05	0.03	0.05	0.03
E-Coli	Cfu/100ml	400	130	130	130	130	0	130

3.7.7. Recommendations

- The trigger values, sampling point locations, sampling frequency and the water quality variables to be tested for can be changed as the transboundary monitoring programme evolves going forward.
- The linking of the sampling points to the hydrology network and the installation of continuous monitoring equipment should be considered going forward.
- The establishment of a central database and management system at ORASECOM to handle the data must be developed in the future. The system should be web enabled which allows the input and access to the data by the Basin States.
- Key groundwater trans-boundary sampling points of the major aquifers should be added to the reporting system in future.
- The initial inter-laboratory bench marking indicated that a number of the laboratories, including the independent laboratory used in the JBS, did not compare well with the spiked sample concentrations. In the future, training and

continued use of samples must be carried out during the trans-boundary sampling program, to bring all the laboratories to the same level.

3.7.8. Environmental Flows

The following sections describe the environmental conditions and flow requirements applicable to Botswana in respect of the Orange-Senqu River Basin.

Conservation Areas

The conservation areas found in the Molopo River Basin are presented in **Table 13** and shown in **Figure 12**. There are no other planned protected areas in the Basin (Broekhuis, Jan F, DWNP, Pers. comm., 11th November 2005). The significance of the existing conservation areas may be observed in Figure 4.10, which shows that during the dry season of the year 2004 the majority of the wildlife biomass observed by the DWNP in the Basin was in such areas.

Table 14 Conservation Areas in the Molopo River Basin

Name	Code	District	*Estimated Total Area (km ²)	Estimated Area in Molopo River Basin	Percentage of Area in Molopo River Basin
Gemsbok National Park	KD\4	Kgalagadi	26,208	17,389	66
Khawa Wildlife Management Area	KD\15	Kgalagadi	7,712	7,573	98
Inalegolo Wildlife Management Area	KD\12	Kgalagadi	10,004	2,691	27
Corridor Wildlife Management Area	SO\2	Southern	2,520	1,627	65

* Area estimated by GIS using DWNP spatial data.

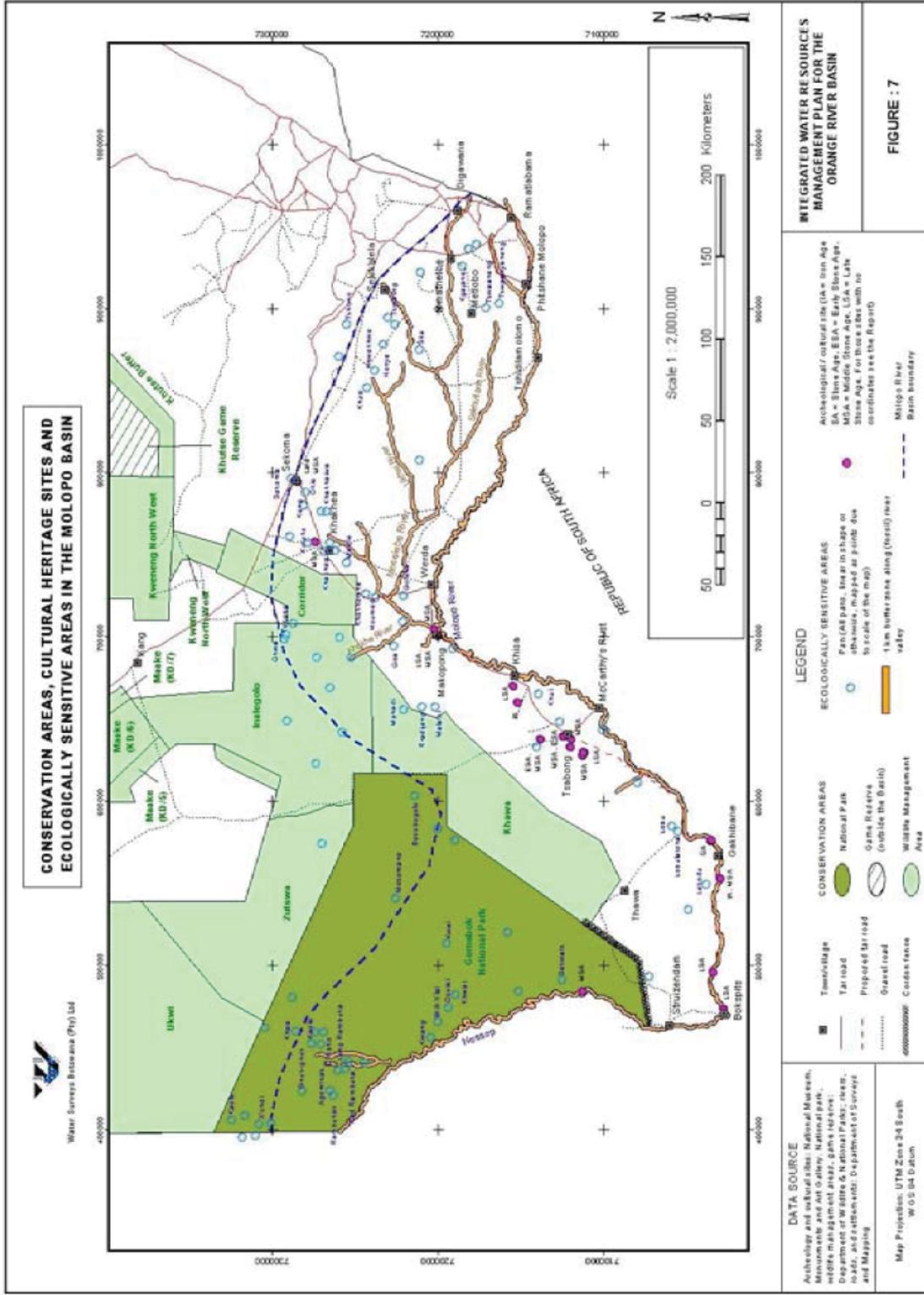


Figure 12 Conservation Areas, Cultural Heritage Sites and Ecological Sensitive Areas in the Molopo Basin

Environmental Impacts from Previous Developments in the Molopo River Basin

The 2001 Population and Housing Census data (Central Statistics Office, 2001) indicate that the Molopo River Basin is sparsely populated. The entire area had a population of 47,661 people in 2001. With an approximate land area of 71,000 square Kilometres, the population density was thus 1 person per square Kilometre. The population density is assumed not to have changed significantly since then. The population centres in the area include Goodhope, Gathwane, Mogojogojowe, Mmathethe, Digawana, Thareseleele, Ramatlabama, Mokatako, Phitshane-Molopo Mmakgori, Tshidilamolomo, Mabule, Selokolela, Metlobo, Magoriapitse, Sekoma, Khakhea, Makopong, Khisa, Omaweneno, Maleshe, Tsabong, Werda, Maralaleng, Struizendam, Rappelspan, Khuis, Bogogobo, Middlepits, Khawa, Gakhibane and Bokspits (See Task 10 Report for details on demographic characteristics of the area).

The area is relatively less developed compared to other parts of Botswana. In part this may be due to the low population density, scarcity of water resources due to the arid to semi-arid climate and the low production potential of the sandy soils in the area. Most of the developments take place in and close to big villages like Tsabong, Goodhope, Khakhea, Werda and Sekoma. Such developments usually entail construction of public facilities like clinics, Government offices and residential houses in the villages. The potential environmental impact from such developments on the general ecology of the Molopo River Basin is generally of low significance.

The Tsabong Groundwater Resource Investigation, Assessment and Development project (1999) by the Department of Water Affairs under the Ministry of Minerals, Energy and Water Resources is one of the recent major developmental projects in the Molopo River Basin. The project aimed at identifying and quantifying the groundwater resources in the exploration area. The overall impact on the environment from the groundwater exploration activities in the area was minor.



Figure 13: Gravel road to be upgraded in Molopo River Valley at Hoekrans.

(Source: Roughton International, 2001)

Another developmental project in the area is the proposed Tsabong-Bokspits Tar road by the Department of Roads under the Ministry of Works, Transport and Communications. Under this project, it is intended to upgrade the current gravel road from Tsabong up to Bokspits. Presently, this road is situated in the Molopo River valley along much of the area with the exception at a few places near some villages such as Tsabong and Middlepits (**Figure 13**). The presence of active sand dunes in the areas adjacent to the road and the absence of water flow in the river over the decades may have influenced its alignment in the valley.

The EIA for the Middlepits-Bokspits section of the proposed road indicates that the new road will follow the existing gravel road with the exception of two short sections through the villages of Middlepits and Khuis and the section between Khuis and Gakhibane, where the new road alignment will be moved out of the Molopo valley (Roughton International, 2001). Apart from the engineering advantage of building on an already compacted base, Roughton International argues that the selected road alignment (amongst 3 options) is advantageous because it would reduce the need for earthworks and compaction, require less materials and minimize the amount of virgin ground subjected to disturbance, thus substantially reducing both the visual impacts of construction of the new road and its overall 'environmental footprint'. Two other alternative routes and the "no-project option" were considered and rejected as they all had much higher environmental impacts and lower benefits as compared to the selected option. The other options would have involved extensive construction work in the sand dunes, which would have had major negative environmental impacts (Roughton International, 2001).

The EIA identified a number of potential environmental impacts that could accrue from the road project during the construction and the operation phases. The construction impacts were considered to be short-term in nature and related to disruption of established patterns of access to essential assets and resources, heavy construction traffic, and generation of noise and dust. The possibilities of establishing borrow pits in the Molopo River valley was noted by the EIA as a major project impact. The area of greatest concern was the length of the Molopo valley between Khuis and Gakhibane, where it was proposed to develop a large calcrete borrow pit. The study observed that the proposed borrow pit site was situated in the most spectacular part of the valley (between Middlepits and Bokspits) where there is no topsoil. It was thus considered by Roughton International that use of the pit would do irreparable damage to the unique scenic resource of the Molopo River valley. Two other borrow pit sites between Gakhibane and De Brak were expected to have similar impacts. The study noted that rehabilitation of the borrow pits after use would be difficult because:

- Calcareous sites are inherently difficult to rehabilitate;
- Rehabilitation is always difficult in an arid and variable climate due to the lack of soil moisture for plant growth; and
- There is no soil for the plants to grow in.

The EIA recommended that no further material for road construction should be obtained from the Molopo Valley between Khuis and Gakhibane Villages. The risk to the road infrastructure in case of future water flow in the river was not evaluated in the study nor the vulnerability of underground water resources in the valley to pollution in case of accidental pollutant release, for instance during a road accident.

Apart from the above road project, there are no other major construction works in the Molopo River Valley or any of its tributaries. Furthermore there are no river impoundments or inter-basin water transfers because water no longer flows in the rivers of the Basin.

A significant challenge facing environmental protection and conservation of natural resources, particularly wildlife resources, is increasing pressure from other forms of land use. Traditional livestock rearing, which requires large expanses of land, is the main form of land use for the majority of the people in the Basin. This form of land use poses a significant challenge especially to wildlife conservation in the area. Data from the Department of Wildlife and National Parks show that areas with high populations of livestock have low populations of wild animals. In addition, some people in the area are of the view that the protected areas (i.e. Gemsbok National Park and the Wildlife Management Areas) deprive them of land, which could have been used for livestock grazing (Broekhuis, Jan F, DWNP, Pers. comm., 11th November 2005).

Common Environmental Issues

The major drivers in the Orange River Basin are as follows:

- Altered flow regime or hydrology (dams. Interbasin transfers, Hydro-electrical flow releases, irrigation and mining abstraction)
- Water quality (salinization due to mines and irrigation diffuse return flows, nutrient build up due to agricultural use of fertilizers and irrigation diffuse return flows)
- Geomorphology (river channel not being scoured due to reduced flood regime and changed seasonal flows)

Figure 14 illustrate the linkage between impacts to system drivers and the resultant biological response. **Table 14** identifies the drivers and responses relevant to each member-state of the Orange-Senqu River Basin.

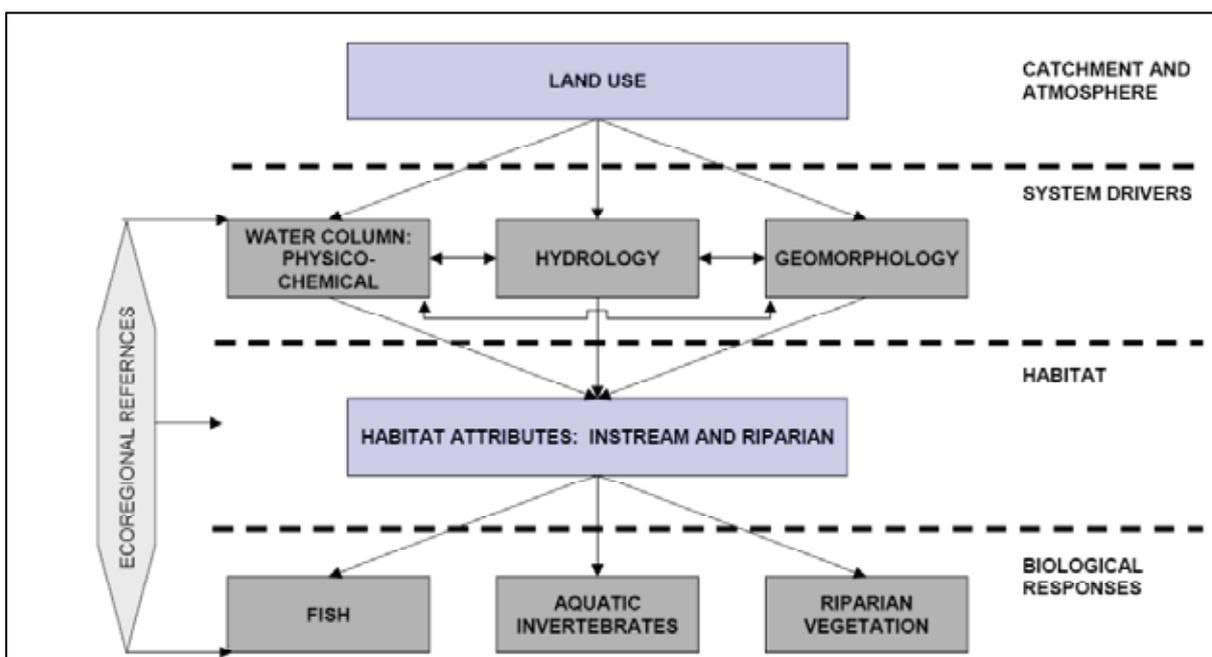


Figure 14 Typical habitat drivers and biological response for rivers.

Environmental flows are not a high priority for the highly seasonal rivers of Botswana that flow into the Orange River.

General Recommendations and Gaps

- Holistic management of the Orange River Basin: the flows that go to sea at the Orange River mouth should be managed in an integrated manner starting with environmental flow releases from Lesotho, the Vaal River system as well as in stream dams along the length of the Orange River. The Orange River mouth salt marsh losing its RAMSAR status is mainly due to the altered flows due to dams in the system. The ORASECOM initiative is an excellent starting point for the holistic management of the Orange River Basin's flows.
- Environmental flows method to be confirmed for the Orange River Basin: at present there is no agreed upon environmental flow assessment method for the Orange River basin. Lesotho and South Africa have applied slightly different methods for environmental flows but these methods are not fundamentally different and recent research has shown that the results from these methods are statistical. In addition, a single methodology should be applied to both the river and the estuary. Currently, two different methodologies are used, but the interface between the two is now improving. It is critically important that a comprehensive or high level of confidence Environmental flows study is undertaken for the Orange River Basin. This full assessment requires better data (including low flow information). Thus, a focused monitoring system should be established to provide the necessary information, for a period of two years. It is planned that the Vaal River system will undergo a comprehensive Reserve

(environmental flows) study from 2006 to 2008. This study needs to be extended to include the whole Orange River basin.

Table 15 Major environmental aspects within the different countries of the Orange River Basin.

Country	Drivers				Response	
	Hydrology	Geomorphology	Water quality	Species diversity	Increased pests	
Lesotho	Flow modifications Dams for water supply and hydropower	Flow modifications Dams trapping sediments		Habitat inundation by dams		
South Africa	Flow modifications Dams for water storage and hydropower, unseasonable winter flows, reduction in annual volumes, wet and dry seasons reduced, lack of flow variability	Floods masked by dams reduce scouring and sediment transfer, islands due to sediment deposits, reeds in river, channel encroachment, flood attenuation capacity reduced	Nutrient, temperatures changes, enrichment	Artificial flows, species threatened, salt marsh lost	Water hyacinth, blackflies	
Botswana	Irrigation and mining abstractions		Salinization Pesticides	RAMSAR status		
Namibia	Unseasonable winter flows, reduction in annual volumes, wet and dry seasons reduced, lack of flow variability	Irrigation and mining abstractions	Nutrient enrichment Salinization Pesticides	Salt marsh lost RAMSAR status	Blackflies	

- Water flow monitoring in the lower Orange River: the flow gauging system in this section of the basin is inadequate. This is particularly true for low flows, where existing data is unreliable. This information is needed (and low flow info is particularly important) for environmental flow management. Good flow gauging stations need to be established that provide reliable data during low flow periods. These gauging stations need to be monitored. Historic data needs (as far as possible) to be adjusted, based on the results from the new gauges.
- Environmental economics data for the whole Orange River: a preliminary set of environmental accounts have been developed for the Orange River some 5 years ago. These need to be updated and refined. Of particular relevance is a good understanding of the value of water and its use, including (a) basic human needs and ecological needs, particularly with regard to the ecological services that water provides; and (b) value-adding for different water uses. This exercise should go further, to investigate how a “water stock exchange” could be established, so that water quotas could be traded, thereby creating a mechanism that would, at the same time (i) create optimal value for water, so that it became (over time) used for the most value-adding and strategically important activities, and (ii) it became viewed as a high value commodity and was not wasted (i.e. creating policy incentives for “water demand management”).
- Environmental water flow requirements of the Fish and other ephemeral rivers: while there are methodologies in place (which have been well tested) to determine environmental flow requirements of perennial river basins, there are no clear mechanisms to determine environmental flows for ephemeral systems. It is important that this issue be addressed, for the Fish River (because of its periodically significant contribution to the Orange River mouth, as well as for the optimal management and development of the Fish River system), as well as for some other, more arid systems which contribute little or nothing to the Orange (e.g. Nossob / Auob), but which have important groundwater aquifers used for domestic and agricultural purposes. A current Water Research Commission Project is being funded in South Africa to address the issue of how to determine environmental flows for ephemeral rivers. Similarly the Department of Water Affairs and Forestry in South Africa has developed a prototype method for a groundwater reserve determination.
- Socio-economic conditions around informal settlements: new projects along the lower Orange River, e.g. prospecting and mining, grape and other farming, have resulted in informal settlements becoming established. People arrive with the hope of work, and/or people are employed on a highly seasonal basis (e.g., grape picking) and remain in the area, in informal settlements, throughout the remainder of the year with no formal income. This results in high pressure on local resources (e.g. riparian woodlands stripped for timber for building informal houses and for energy; fishing in

river, using fine mesh nets (even mosquito nets) and thus stripping the fish resources), and uncontrolled domestic stock entering protected areas and overgrazing the river banks and floodplains – all leading to severe environmental degradation. It also results in social degeneration, with poor housing, no adequate schooling and medical care, escalating poverty, illegal border crossings and transfer of goods, prostitutions, escalating incidents of HIV/Aids, etc. There is little information available on this rapidly changing and expanding situation, and even less decisive action. It is important that the situation be properly understood, and that some clear development plan is implemented to address the situation before it spirals out of control.

- Impact of climate change on security of water supply and hydrology of the system. The impacts of climate change need to be monitored and the security of water supply needs to be planned for. The common management of the Orange River Basin across international boundaries will go a long way to improving the understanding and water needs of the countries and regions.

3.7.9. IWRMP Recommendations and Actions

Detailed Investigations of Key Legal Problem Areas

- Analyse existing legislation in detail to establish main problem areas for the implementation of an Orange River WRMP;
- Establish what new legislation is envisaged and propose new legislative provisions specifically aimed at enabling the implementation of an Orange River WRMP;
- Propose possible interim legislation for this purpose.
- Establish Options for the optimum implementation of a Water Resources Management Plan for the Orange River.

International / regional Actions

- Make recommendations for the best balance between regional and national powers and duties;
- Alternatively, give options for ORASECOM and the 4 countries to decide;
- Make recommendations whether the existing ORASECOM agreement should be adapted and upgraded or whether a new Treaty is required.

In-stream Flow Legal Requirements

The question of In-stream Flow Requirements (IFR's) requires legal investigation because different countries have different requirements in their legislation. In addition, the LHWP Treaty has its own requirements. This could be a major stumbling block since the requirements of upstream and downstream countries are not identical.

Implications of Changes to National Systems

The “Legal Aspects” report has identified specific requirements (in terms of national legislative changes) for effective implementation of the IWRMP. If these are implemented, the institutional structures established by the legislation, will also change. Furthermore, given that two of the basin states’ institutional and legislative frameworks are already under review (including Botswana), and all are considered to be in a state of transformation, an investigation of the impacts of these changes was scheduled to be carried out in Phase 2 of the Orange-Senqu IWRM Plan Project.

Organisational Funding

If the administrative and coordination bodies were permanent within ORASECOM, they would require funding. Costs of these bodies should not necessarily be equally distributed across the basin states, but could be based on relative benefits of the use of water. A link with an analysis of the benefits of the use of water throughout the basin could also inform the criteria for equitable allocation. The development of the funding plan to support ORASECOM should also be included into the National Botswana IWRM Plan to ensure integrated planning.

Allocation Criteria

The ORASECOM agreement states that the definition of equitable use should follow that set out in the SADC Protocol. The criteria set out in the Protocol are necessarily vague, since they relate to all basins in the SADC region. Conditions are different in each basin, and, as such, it may be more practical to develop basin-specific criteria. This would improve the flexibility of the allocation criteria, as well as their adaptability in changing conditions. An investigation for the quantity and quality of allocations and the practical applicability of the criteria was proposed to take place during Phase 2. This could be linked with the study of the relative benefits of water use to allow for scenario planning for future use or development of the basin. The investigation could also include an assessment of the flexibility of the set of criteria, possibly through case studies – such as the potential development of the Lower Orange.

Information Systems

One of the key principles of IRBM agreements is the sharing of information between basin states. Moreover, an essential prerequisite of effective management (especially in the context of the complexities of international waters) is an adequate information system. Phase 2 of the Orange-Senqu IWRM Plan Project should have included an assessment of the parameters of a basin-wide information management system. The Water Quality Monitoring Management Framework provides some indications in terms of this.

Dispute Resolution Mechanisms

The legal report in this series (series refers to the series of reports produced in the Orange-Senqu IWRM Project) suggests an investigation of more flexible dispute resolutions mechanisms; given that the SADC Tribunal has only recently been established and does not necessarily have the technical capacity to address the complexities inherent in issues relating to international waters.

Water Quality Management Framework

- The linking of the sampling points to the hydrology network and the installation of continuous monitoring equipment should be considered going forward.
- Key groundwater trans-boundary sampling points of the major aquifers should be added to the reporting system in future.
- The initial inter-laboratory bench marking indicated that a number of the laboratories, including the independent laboratory used in the JBS, did not compare well with the spiked sample concentrations. In the future, training and continued use of samples must be carried out during the trans-boundary sampling program, to bring all the laboratories to the same level.
- Botswana specific – Action: bring laboratory to same level
- Botswana to ensure monitoring of point 11 according to recommended time frame and parameters to be measured

Environmental Concerns and Flows

The environmental issues associated with the Orange River are directly related to the anthropogenic use of the water. The major impact is due to the altered flows of the Orange River due to man reallocating this water for uses outside the catchment, for hydro-power, agricultural and mining use. As a result the river's ecological integrity has been compromised to such an extent that the current flow regime has resulted in the loss of biodiversity, nutrient enrichment, increasing salt loads and nuisance plants and animals.

In order to manage the Orange River basin's environmental aspects in a holistic manner the ORASECOM initiative must continue to promote the use of environmental flow requirements. A comprehensive environmental flow study should be undertaken for the Orange River. This will include the existing study that has been undertaken in Lesotho for Phase 1 as well as the comprehensive study to be undertaken for the Vaal River system (2006 to 2008). It is important that all the countries within the Orange River basin are part of this study and that the appropriate socio-economic assessments and public participation takes place concurrently with the environmental flows study.

The following recommendations are suggested:

- The holistic management of the Orange River Basin (source to sea) should be promoted through ORASECOM;
- The data collected in each country (water quality, flow, GIS etc.) should be collated and stored in a standardized format that will allow way easy exchange between countries;
- ORASECOM initiative must continue to promote the use of environmental flow requirements (and appropriate methods for all countries and rivers);

- Environmental water flow requirements of the Fish and other ephemeral rivers should be determined;
- Appropriate socio-economic assessments and public participation takes place concurrently with the environmental flows study;
- The flow monitoring in the lower Orange River is inadequate and should be addressed; and
- Agricultural return flows, and more efficient irrigation should be studied as results to date have shown that the degraded condition of the Lower Orange River is only partially as a result of the severely altered hydrology of the system.

3.8. Limpopo River Basin

Draining an area of approximately 408 000 km², the Limpopo River Basin **Figure 15**, encapsulates a diverse landscape and four SADC countries – Botswana (20%), Mozambique (20%), South Africa (45%) and Zimbabwe (15%). The Limpopo River travels a distance of over 1 750 km from the confluence of the Marico and Crocodile Rivers in South Africa to the Indian Ocean at Xai Xai, in Mozambique. Along its route, the river forms the border between Botswana and South Africa, then the border between Zimbabwe and South Africa, before passing into Mozambique at Pafuri. The Limpopo River basin receives contributions from 24 individual tributaries. The catchment characteristics are very diverse covering different climatic and topographic zones as well as land use types, including protected areas. Also the social and economic development features are highly diverse.

Applicable International Agreements include the following:

- Limpopo Basin Permanent Technical Committee of 198; and
- An Agreement signed in November 2003 by the Republic of Botswana, the Republic of Mozambique, the Republic of South Africa, and the Republic of Zimbabwe, for the establishment of the Limpopo Watercourse Commission (LIMCOM).

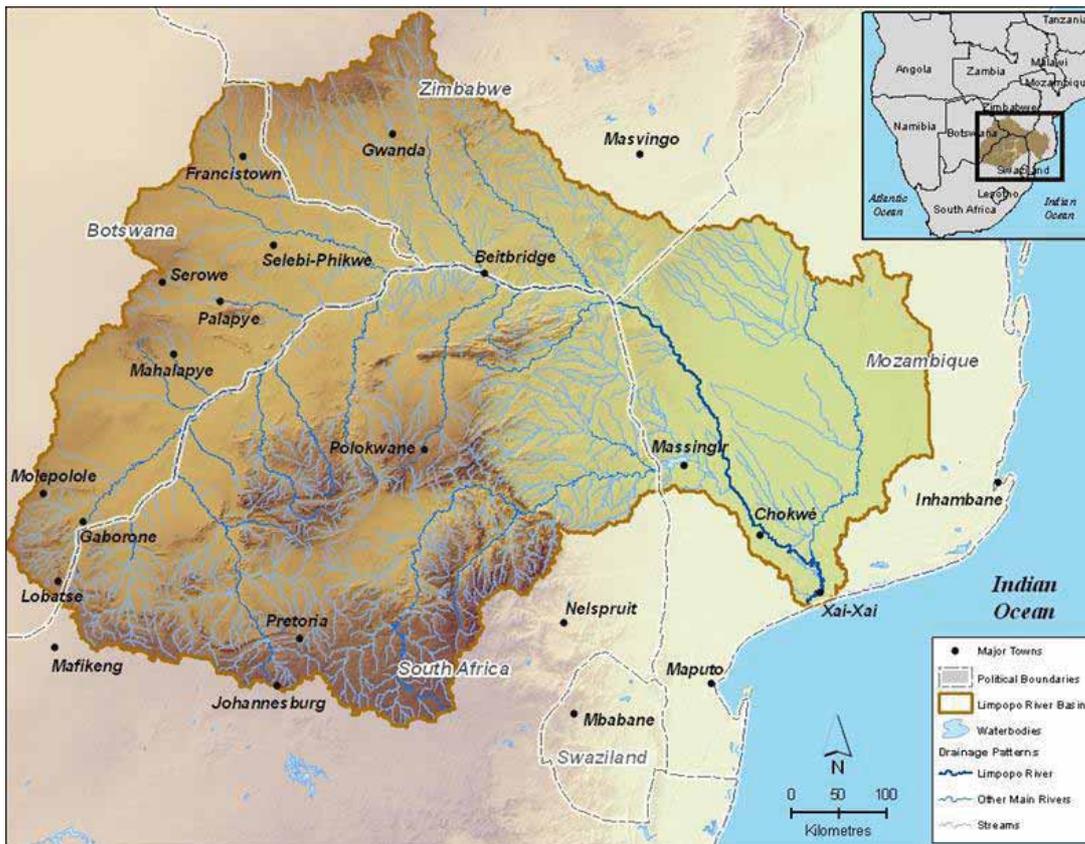


Figure 15 Limpopo River Basin (Source: www.limcom.org)

3.8.1. Institutional Review

Progress on the establishment of the River Basin Organisation LIMCOM has been made since Pietersen and Beekman (2008) conducted their review and analysis of the seven major transboundary rivers in Africa. Unfortunately there is no detailed analysis, but the available information is presented. The LIMCOM Agreement was signed in 2003 with the objective of establishing a River Basin Commission to advise the Contracting Parties and provide recommendations on the uses of the Limpopo River, its tributaries and its waters for purpose and measures of protection, preservation and management of the Limpopo River Basin. The principal organ of the Commission is the Council. The Council is designed to act as a technical advisor to the Contracting Parties on matters related to the development, utilisation and conservation of the water resources of the Limpopo.

Mandate and Functions

The functions of the LIMCOM Council include the following:

1. Measures and arrangements to determine the long term safe yield of the water available from the Limpopo;
2. The equitable and reasonable utilisation of the Limpopo to support sustainable development in the territory of each Contracting Party and the harmonisation of their policies related thereto;

3. The extent to which the inhabitants in the territory of each of the Contracting Parties concerned shall participate in the planning, utilisation, sustainable development, protection and conservation of the Limpopo and the possible impact on social and cultural heritage matters;
4. All aspects related to the efficient and effective collection, procession and dissemination of data and information with regard to the Limpopo;
5. Contingency plans and measures for preventing and responding to harmful conditions whether resulting from natural causes such as drought or human conduct as well as emergency situations that result suddenly from natural causes such as floods or human conduct such as industrial accidents;
6. The investigations and studies, separately or jointly by the Contracting Parties with regard to the development of the Limpopo including the construction, operation or maintenance of any water works;
7. Measures with a view to arriving at settlement of a dispute;
8. Any other matters affecting the implementation of the Protocol.

3.8.2. Joint Limpopo River Basin - Scoping Report (SADC 2010)

Opportunities and challenges

From an integrated water resources management point of view, the Limpopo River basin offers both challenges and prospects. One of the largest challenges of the Limpopo River basin is to distribute the water resources in an equal and sustainable way. **Figure 16** shows that a very large part of the Limpopo River basin has semi-arid to arid conditions. In these areas water resources are scarce and pro-longed periods of droughts can occur. Many people living in the semi-arid areas are thus vulnerable for secure water supply for domestic use and livestock and reliability of subsistence agriculture.

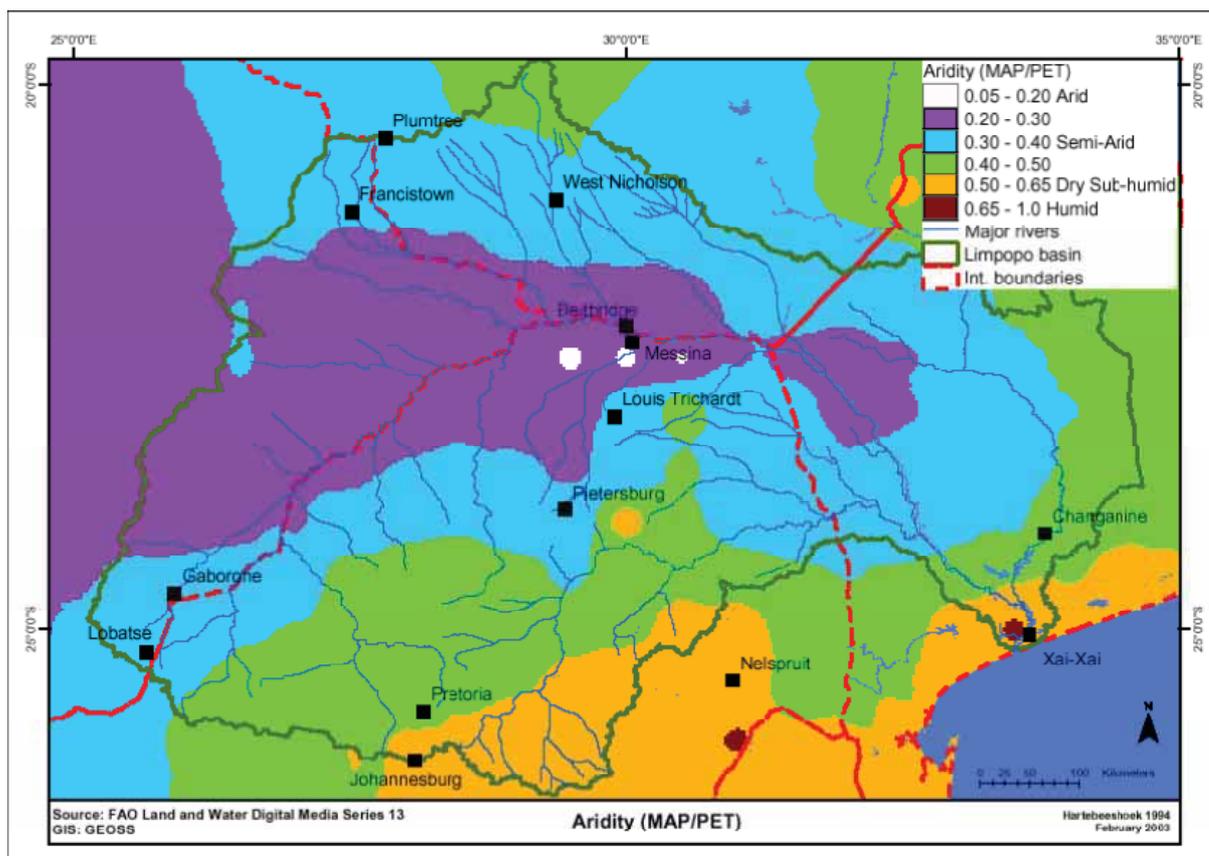


Figure 16: Map of aridity index defines mean annual precipitation divided by the potential evapotranspiration (CSIR, 2003).

On the other hand, the records of river flows in the Limpopo River in Mozambique show that a considerable volume flows into the sea. Although the river regime shows large variability with floods that cannot be captured and that the estuary demands a considerable inflow, this indicates the opportunity for infrastructural development to increase the efficiency of the water resources utilisation. The large scale utilisation, **Table 15**, of the tributaries for domestic and agriculture purposes, and mining and power production in mainly South Africa is an example of how the water resources can be utilised to create economic growth and improve livelihood.

Table 16: Present water use by sector for Limpopo member States (Mm³/a).

Country	Urban	Rural	Irrigation	Mining	Power	Others	Total
Botswana	60	12	20	9	*	0	101
South Africa	665	140	1,485	230	215	295	3,030
Zimbabwe	690	6	640	*	*	0	1,366
Mozambique	4	9	270	0	0	0	283
Total	1,419	167	2,415	239	215	295	4,750

*included as part of urban

Protected environmental areas comprise a very large part of the Limpopo River Basin. The large national parks contain unique biota with several threatened species

and provide a significant part of economic activities in the river basin through tourism. It is therefore essential that any development of infrastructure, agricultural or industrial schemes are made without causing harmful effects to the environment and especially the protected areas. The preliminary analysis of the water quality data in the Scoping Phase has indicated that the river is already impacted. The potential further deterioration of the water quality by unsustainable upstream practices in urban areas and along the river with the agricultural and mining activities must be contained.

Groundwater in the Limpopo River basin is currently utilised to a large degree, especially in Botswana. The groundwater is, however, seldom taken into account in the river basin management that are generally focussed on surface water. A major challenge in the Limpopo River basin therefore is how to integrate groundwater and surface water use optimally to mitigate droughts. For this the groundwater/surface water interaction needs to be understood to a larger degree than is possible currently and methods of integrating groundwater sources in the system yield analysis tools must be improved.

Floods are a severe problem for the Limpopo River basin. The large floods in February 2000 by the Cyclone Elaine caused enormous human and economic damage to the lower Limpopo River stretches. More than 700,000 persons were displaced and close to 1,000 died of drowning. Global warming can severely increase the effects of both drought and floods. Recent studies have indicated that the intensity of extreme rainfall events has increased during the last decades. At the same time average rainfall is forecasted to decrease with up to 15% for large areas of the Limpopo River basin (Schulze et al 2001). To understand the effects of climate change is one of the major challenges for the future water resources management of the Limpopo River basin.

Opportunities do, however, exist to improve the water use efficiency and to distribute the water resources to all users in the Limpopo River Basin. River basin management has up to today mainly been focussing on the national problems and prospects. A joint management of the river Basin is likely to provide opportunities for joint solutions for the above challenges. Similarly water demand management has so far been implemented to a limited degree, which can open opportunities for more efficient use of the water resources.

Need for transboundary water resources management

Mutual benefits and equitable sharing of resources are key components to cooperation on water management and this is no different in the Limpopo River Basin. There are four types of benefits:

- Benefits to the river;

- Benefits from the river e.g. agriculture, hydro power, secured urban water supply, etc. The challenge in this case is the optimisation and equitable sharing of these benefits;
- Reducing the costs caused by the river, e.g. flood and drought early warning systems; and
- Benefits at regional level, e.g. integration of regional infrastructure and markets.

Different joint visions or different investment priorities require various types of strategy documentation. However, in the case of the Limpopo River there is potential for mutual benefits in all of the above listed types.

The complexity of the Limpopo River basin is illustrated by the brief description in Chapter 2, while many challenges have been identified above for the future water resources management of the Basin. It is thus clear that joint transboundary river basin management is required to reach equality and sustainability for water resources of the Limpopo River Basin. Development of water-related infrastructure in the four countries must be conducted with clear guidelines on allocated water and agreed minimum border flows. Similarly, mechanisms for exchange of data and information must be developed for compliance and for drought and flood emergency management.

The establishment of the LIMCOM and the Secretariat has created the basis for implementing joint transboundary river basin management in the Limpopo River Basin. The joint management will enhance the possibility to focus the activities and development to the most needed areas and to overcome some of the limited resources that individual countries have.

Through the establishment of a common agreed baseline in terms of river basin characteristics, such as hydrology, environmental status, water demand and environmental flow requirements, the countries could have the basis for a water-sharing agreement. Identification of possible development options as well as mitigation measures for drought, floods and ecological deterioration will enable the four countries to establish a Joint Water Resources Strategy. The joint management process will create an understanding of each other's challenges and prospects that will improve the possibilities to solve joint problems both for long-term development and emergency situations.

The water authorities of the four countries currently have varying capacity both in terms of human and financial resources. This requires focussed capacity building in which the four countries can contribute in combination with external support. Substantial investment funds will be required for the water resources management process and the necessary water infrastructure.

Similarly, the stakeholder participation process is essential to enable implementation of guidelines and allocation of water resources use. The awareness creation of the

principles of water resources management is essential for successful implementation.

3.8.3. Limpopo IWRM Plan

The Monograph, to determine the current or baseline situation in the Basin is currently underway. Key activities with respect to IWRM Implementation Plan for Botswana will likely only be identified in future reports in 2-3 years-time. It is suggested the general task be included into the BN IWRM-WE Plan to provide feedback on findings of the Limpopo IWRM Plan to the IWRM-WE management team.

3.9. Conclusion

Transboundary national resources management (TBNRM) is said to be still in its infancy in Botswana, despite some activity in this area. There is room for the development and adoption of a formal and proper TBNRM policy framework. The different stakeholders could become more involved. The government of Botswana is aware of these needs and the further development of formal instruments.

3.9.1. Challenges of linking R/LBOs with national governments

Central to river basin management are the R/LBOs whose main objectives are to facilitate and coordinate the sustained integrated development and management of their respective Basins. Although a blue-print for international transboundary water resource management does not exist, “basic ingredients” for sustainable river Basin management can be distilled from practical experiences gained over the past decade. There are several factors that facilitate effective linkages between R/LBOs and national governments:

3.9.1.1. Political support and commitment

All the R/LBOs that were examined by Pietersen and Beekman (2008) were founded on the principles of international law and have adequate legal frameworks or agreements in place. However, if there is no associated political support the particular R/LBO cannot use its structure effectively to implement and advance IRBM in the respective Basins.

Another example constraining effective linkages between the RBO and national governments is the Revised Protocol on Shared Watercourse Systems in SADC which established the SADC water sector organs, and consists of the Committee of Water Ministers, the Committee of Water Senior Officials, the Water Sector Coordinating Unit and the Water Resources Technical Committee and Subcommittees. Most of these structures were considered non-essential and abolished. This action left a huge decision-making gap which negatively impacted RBO activities of the southern African region.

In order for R/LBOs to influence policy makers and national government policies, Pietersen and Beekman (2008) recommend the following:

- Ensure that the organizational structure of the R/LBO includes the highest level of decision-makers e.g. the LCBC, NBA and OMVS have as their highest decision-making structure the Heads of State of the respective countries.
- The agenda of the R/LBO needs to be aligned to the important developmental issues of the riparian countries. The Nile Basin Power Forum is an example of a forum that was created to link and influence national agendas on energy issues.
- Set up regional dialogues with parliamentarians of the respective basin countries; e.g. the LCBC established a Regional Parliamentary Committee of the Lake Chad Basin to assist amongst others in raising public awareness both at local, national, regional and international levels.
- Facilitate inter-ministerial coordination through the establishment of national focal points. In Niger, for example, the focal point is the National Committee for the Environment and Sustainable Development, which includes the Cabinet Leader, Ministers, Civil Society, Universities and National Government Organizations. This structure is the primary vehicle for gathering and expressing community opinion on water resource management.
- Strengthen feedback loops to national governments to build further synergies between R/LBOs and national government programs. The LCBC has a Basin Committee for Strategic Planning consisting of senior officials from key departments such as environment, agriculture and finance.

3.9.1.2. Awareness Creation for National Governments and Other Stakeholders

Awareness programmes are critical to showcase the relevance of R/LBOs activities to national governments and civil society. There is a clear need for the involvement of civil society in R/LBO activities. The awareness programmes need to be based on a thorough understanding of the stakeholder/national government needs. This analysis of the different R/LBOs did not explicitly highlight the strengthening of stakeholder relationships as a key operational function of R/LBOs. Key issues to be addressed include:

- Identification of stakeholders needs;
- National government satisfaction surveys; and

- Effective dissemination of operational activities and the role of water in the basin through awareness creation.

3.9.1.3. Financial viability of R/LBOs

All the basins rely extensively on external donor support to fund their activities. Reliance on this support endangers the sustainability and effectiveness of the R/LBOs. Member States need to meet their obligations in terms of contributions otherwise most of them will function as committees rather than properly constituted organizations.

3.9.1.4. International Agreements

The Agreements discussed in this report do not include specifications on water quantity or quality across international borders. The Orange-Senqu IWRM Project has determined water quality trigger parameters to initiate responses. However, none of the other Basins have these parameters. A clear minimum baseline (quantity, quality and environmental characteristics) should be determined for water entering and exiting Botswana borders.

3.9.1.5. Information Sharing

The most convenient form of information dissemination is one that utilizes the Internet as a platform for information exchange. The followings strategies are proposed:

- The establishment of a web portal to channel information on strengthening linkages between river/lake basin organizations and the respective national governments.
- Facilitate exchange visits and network meeting between the different R/LBOs e.g. the NBI's Eastern Nile Joint Multipurpose Program (ENJMP) undertook a Knowledge Exchange Study Tour to the Senegal River Basin during November 2-9, 2006.
- Facilitate knowledge sharing workshops on best practices and strategies to engage national ministries other than their reporting ministries.
- The knowledge dissemination activities must be implemented, especially the knowledge sharing workshops on best practices to engage national governments;
- Visits to the basins to engage Commissioners and National Representatives directly on the mechanisms for linking R/LBOs to national policies and programmes.

4.0. Appendix D: Review of International IWRM-WE Plans

Many countries are undergoing, or have already been through the process of developing IWRM/WE strategies to fulfil the agreement they made at the 2002 World Summit on Sustainable Development in Johannesburg. The planning process has been facilitated by international and regional assistance from donor agencies and technical support organisations, partnerships between governments and various institutions such as Global Water Partnership. The IWRM planning process involves the identification of a set of objectives based on existing water sector issues (GWP, 2004). These objectives are then translated into targeted activities and means of operationalizing those (institutional responsibilities, funding, monitoring and evaluating progress).

The IWRM/WE planning process has resulted in new national policies, strategies and laws for water resources development and management; water reform processes and changes in institutional roles for more effective water management. Many of these are in the implementation stage or ready for implementation. The 2008 UN-Water survey shows that 22% of developed countries have IWRM/WE Plans in place and they are fully implemented while 3% of developing countries have IWRM/WE Plans and are being fully implemented. In Africa, countries such as Burkina Faso, Mali, Senegal, Uganda, Kenya and Zambia have developed their plans and are in the process of being implemented while some such as Swaziland and are waiting for approval. At International level, progress has been made in countries such as Costa Rica, Brazil, Kazakhstan, China, Philippines and Lao PDR.

This appendix summarises IWRM/WE plans from the SADC region as well as those selected at international level. The selected countries from the region include Zambia, Namibia, Malawi while at the international level; focus is on Kenya, Jordan, Spain and Kazakhstan. It should be noted that in some countries, plans are developed at basin level and some consider their water policies and national water master plans to be equivalent to a national IWRM/WE plan.

4.1. Malawi (Shorter version of the plan)

Malawi has endorsed her IWRM-WE Plan for the period 2008 to 2012. The plan is premised on the IWRM concept as it strives to effectively address both national and international water resources challenges by promoting coordinated and integrated management of natural resources as well as enhancing participation of various stakeholders in water and water related sectors (Government of Malawi, 2008). The plan therefore is seen as a crucial direction towards attaining the water related MDGs and improve people's livelihoods.

The countries major water resources are described and these are highly crucial for socio economic development of Malawi. However, the description is brief and there is no indication of climatic conditions, for instance, as these have a bearing on the availability of the resources

within a given area. The report is silent on the water challenges of Malawi and does not give a situational analysis of Malawi's water sector in terms of water supply and demand, policy and legislative environment, water quality and transboundary water issues to mention a few.

The Malawi IWRM/WE Plan has a Vision, Goal and strategic objectives. Its Vision is "Water and Sanitation for All, Always" (pp. 12) and is in line with the country's policy of poverty reduction and economic prosperity. The main goal of the plan is therefore "to improve people's livelihoods through sustainable development, use and management of water resources" (pp.12)

The seventeen strategic components of the IWRM/WE Plan form the *strategic framework* for implementation of the plan with each having targeted objectives and interventions (Annex 7.2). These thus form the basis for the plan.

In May 2003, the Canadian Government committed to support the Partnership Programme for Sustainable African Water Development with the Global Water Partnership (GWP-PAWD). In 2004, through the PAWD project, the Malawi IWRM/WE planning process was started and was facilitated by the Malawi Water Partnership (Government of Malawi, 2008). This process was externally funded through Canadian International Development Agency (CIDA) while GWP granted technical support. It was led by a team of multidisciplinary parties from various stakeholders with the Government as the main stakeholder. The process involved dissemination of IWRM/WE planning process through the media and the media representatives were initially sensitized about IWRM so as to be better placed to properly disseminate information.

In line with the GWP IWRM planning process, the development of the plan involved seven interlinked steps.

- The first step deals with *establishing status and overall goals*. This is a very crucial step as it lays the foundation for the plan. Through participation of stakeholders, key issues to be addressed by the plan were identified.
- Secondly, *building commitment to the reform process* involved consultations with high-level decision making bodies such as Members of Parliament and cabinet members and directors of various government departments.
- *Gap identification and analysis* was undertaken through multi stakeholder meetings.
- *Preparation of the strategy and action plan*. A root cause analysis was used to select the key issues and this resulted in five strategic issues to focus on. These were further scrutinized through another analysis of Malawi's water challenges. This process allowed the stakeholders to tease out real strategic root causes of the major challenges. Furthermore, interventions and activities were then identified so as to address the priority issues that the plan should focus on. The interventions were thus on the basis of existing or on-going initiatives, creation of synergies and new initiatives. The five key priority issues addressed in the plan are:

- Integrated catchment management
 - IWRM institutional capacity building
 - Enabling environment
 - Coordinating and managing the implementation
 - Sustainable water resources utilisation
- *Building commitment to actions* was ensured through stakeholder participation at all stages of the planning process. This resulted in the development of project concept notes for each strategic area and interventions for IWRM mainstreaming.
- *Implementation Frameworks* -The IWRM plan would be implemented through integration into the country's national development planning framework (Malawi Growth and Development Strategy). Other implementation strategies include Infrastructure development Strategy, National Water Development programme and envisaged Water Resources Authority and Catchment Management Agencies. The Ministry of Irrigation and Water Development is the overarching institution responsible for overall implementation.
- *Monitoring and Evaluation* –To assess and track progress and ascertain as to whether the various targets are being met, a set of indicators were thus developed and were categorized into: impact indicators; process indicators as well as performance indicators. It was envisaged that the monitoring process would not culminate in new structures but would build on existing structures through the Ministry of Finance. However, it is stated that the Ministry of Water will be the lead institution to ensure monitoring and evaluation of the implementation plan. These would undergo a mid-term review as a way of monitoring and assessing progress.

Comments

The Malawi IWRM Plan was formed in-line with the requirements of the GWP IWRM planning process and the country's central policy on poverty reduction and economic prosperity. Its objectives therefore strive to address socio-economic and development challenges in the country and are directed towards achieving sustainable development of the country's water resources. The plan recommends building on on-going interventions to avoid establishing and implementing totally new activities which might be complex and often time and resource consuming as funding and expertise would be required.

The plan is premised on a strategic framework that encompasses a number of components. In addition to these strategic components, key IWRM issues are also identified. The plan proposes interventions for all these components and issues. It

seems the strategic components are mostly long-term while the five priority key areas will require immediate attention.

The plan¹⁰ does not explicitly describe the financial situation or how the implementation plan will be funded. It is assumed that funding will be sought to implement the plan activities. It is however important to give an indication of how funding would be sought and the potential sources of funding. Furthermore, the plan is silent on the development of a Communication Plan/Strategy which is equally significant as it would give a clear indication of how the plan would be disseminated to ensure ownership and acceptance by all. Continuous and effective communication with stakeholders is therefore key for implementation of the proposed interventions.

The Malawi plan differs with the proposed plan for Botswana (Structure) as it does not comprehensively show an assessment of the country water situation and does not give an indication of the funding requirements and a detailed financial strategy for the plan implementation. The other difference is the lack of communication strategy. Cross cutting issues are also not adequately analyzed and how the plan intends to address these as they have a major impact on use and management of water resources. Poverty is however comprehensively alluded to.

4.2. Zambia

In 2008/9, Zambia launched its medium-term IWRM/WE Plan (2007-2030)¹¹. The Plan supports the country's 2006-2010 Fifth National Development Plan (FNDP)'s priority economic drivers: agriculture, tourism, mining and industry/manufacturing (Republic of Zambia, 2008). The plan was also developed in line with the National Vision 2030. The plan development process began in 2004 spearheaded by the Ministry of Energy and Water Development and Zambia Water Partnership with support from PAWD and CIDA as is the case with Malawi.

The Plan's Vision is *"to achieve equitable and sustainable use, development and management of water resources for wealth creation, socio economic development and environmental sustainability by 2030"* (pp. 61). This Vision is therefore within the context of the country's national development planning framework and long-term national Vision 2030.

The goal of the implementation plan also strives to achieve the goals stipulated in Vision 2030 and is in line with the overall objectives of the National Water Policy. This goal is *"to support economic growth and improving livelihoods through sustainable water resources development*

¹⁰ This analysis is based on the abridged version of the plan, perhaps more details are entailed in the bigger plan. The detailed plan has not been accessed.

¹¹ The plan covers the medium term period (2007-2010) but intends enhance achievement of the National Vision 2030 goals.

and management with equitable provision of water in adequate quantity and quality to all competing groups of users, at reasonable cost, with security of supply under varying conditions”(pp. 61).

The specific objectives of the implementation plan are based on the priority issues and strategic focal areas. These objectives were developed through a consultative process with stakeholders and considered the water related recommendations and interventions of the FNDP (Republic of Zambia, 2008).

The plan preparation process drew upon various processes that were taking place in Zambia’s water sector. Notably, the country commenced its water sector reform process in the 1990s that sought to address Zambia’s water challenges (Republic of Zambia, 2008). At that point, the Government endorsed the Water Resources Action Programme (WRAP) which also aimed at addressing the water sector issues particularly those related to institutions and policy environment. As such, the WRAP process was harmonized with the PAWD process (IWRM planning) to develop one encompassing IWRM/WE plan since they both strive to address similar issues.

National stakeholder workshops were conducted to facilitate the consultation process for developing the plan. The consultations’ process was carried out at different levels of the planning process. Initially, a discussion document was produced and discussed at high level and reviewed during consultations for the FNDP. For identification of critical priority issues for the IWRM plan, a bottom up approach was used where consultations were held stakeholders at the catchment, district, provincial and sectoral levels. Stakeholders at the catchment level included traditional authorities, civil society, government departments, ordinary citizens and water sector advisory groups (SAGs) (Republic of Zambia, 2008).

The IWRM /WE planning process took cognizance of a number of plans and programmes from various sectors (pp.4) such that the water management issues and actions raised in these initiatives could be harmonized into the national IWRM plan. This was also inclusive of regional initiatives, notably the SADC Regional Strategic Action Plan and SADC’s Water Vision.

The key priority issues identified by stakeholders were analysed within GWP’s IWRM change areas (Toolbox) (enabling Environment, institutional roles and management instruments). An additional IWRM change area has been included as it is one of the major water development challenges in the country: Infrastructure for water resources management and development.

The **situational analysis** (Chapter 2) gives an indication of issues and challenges in the water sector. The analysis is detailed and covers areas such economic and development conditions, poverty issues/MDGs, geography, natural resources and demographics. The water sector is comprehensively analysed including matters relating to transboundary use and management of

shared water and natural resources management. Water related sectors such as mining, agriculture and tourism are also analysed and this is a commendable effort. The report also reviewed the governance situation and did not only focus on water policies and laws but also analysed legislation and policies from other sectors that have a bearing on water resources management. An attempt is also made to address human resources issues in the water sector and possible interventions. The analysis also considers the finance and funding issues related to the water sector. The review points out the main financing institutions and gives detailed information about these organisations. Zambia's water sector is thus financed from three main sources including government budgets, international agencies and revenues from water charges. Although briefly addressed, monitoring and evaluation systems in the water sector are mentioned, giving an indication of the current situation and what is required to enhance these systems.

Identification of priority issues and gaps (Chapter 3) to be addressed by the implementation plan follows the situational analysis. This was particularly done through a consultative process where relevant stakeholders were brought on board. The key issues have been categorized into those related to governance, water resources information, water demand, supply and infrastructure, economic and financing matters, water and environmental, capacity building and participation of stakeholders as well as transboundary water issues. These key issues were further analysed and this process resulted in the identification of strategic focal areas and priority issues. Therefore the plan focuses on the following four strategic focal areas: water resources management, water resources infrastructure development, water supply and sanitation as well as monitoring & evaluation and capacity building.

Preparation of IWRM Plan strategies (Chapter 4) – This process involved developing strategic objectives on the plan as per the strategic focal area. In order to achieve these objectives, prioritized projects and key activities were agreed upon (Table 14 and 15, pp. 62). The projects are categorized into medium and long-term activities. An indication of the cost of the projects is also given. There is a clear indication of the stakeholders/institutions that will be responsible for implementation of the proposed projects.

Financing the plan (Chapter 5) - for the plan to be implemented, stakeholders need to collaborate and budget for the interventions. The plan will be financed through a number of sources such as domestic resources, community financing mechanisms, external loans and grants, private sector, regional and international financing initiatives like NEPAD. Financing public infrastructure will however remain the responsibility of government in partnership with other partners. It is commendable that there is an intention to source funding from various mechanisms. Notably, the strategy to encourage communities to establish committees so as to set up village water funds that would be used to finance operating and maintaining village water supply schemes. Zambia will also explore the possibilities of charging for managing shared rivers,

benefits and costs sharing of these waters. This would be done under the existing catchment and river basin organizations.

Institutional frameworks for implementing the plan (Chapter 6) - The plan proposes that new frameworks be established because the previous ones were fragmented and responsibilities were overlapping between the different institutions. The proposed framework will be dynamic, gender sensitive, integrated, interactive and will be participatory such that all relevant stakeholders are brought on board. Coordination of the IWRM plan would be undertaken through the Water Sector Advisory Group. This group will also facilitate monitoring and evaluation of proposed activities. The intention is to adopt a decentralized approach for data collection that would be used in the monitoring and evaluation process. This will ensure that the group does not do all the work but rather act as facilitators and coordinators of the process. An IWRM Unit has been proposed and will act as the secretariat for plan implementation and will also be the main driver of the process. There is a Water Sector Monitoring unit within the Ministry of Water, therefore this would be strengthened to become the IWRM Unit.

Monitoring and evaluation (Chapter 7) – it is envisaged that the monitoring & evaluation framework for the IWRM plan will be linked to that of the FNDP. Monitoring will be done on three levels: project level; portfolio level and national level. With regards to evaluation, three types will be considered: project, impact, cross-cutting/thematic and overall performance evaluations of the policy, plan strategies and projects. M&E will be undertaken at all levels of implementation of the plan. The plan thus stipulates the institutions that will be responsible for M&E. Furthermore, key performance indicators are also defined. These will assist in focusing efforts and resources for sector performance evaluation.

The plan identifies the expected risks associated with implementing the plan as well as the assumptions that this plan will be based on.

Communication Plan (Chapter 8) – this is meant to guide the dissemination of information on the IWRM Implementation Plan, raise awareness and build support for and ownership of this plan. The strategy is to target IWRM related stakeholders especially the ones who have been assigned tasks of implementing the proposed programmes and strategies. Activities for this initiative and cost implications are clearly stipulated in the plan document (pp.100)

Comments

Zambia's IWRM Plan is dynamic, detailed and informative. The plan is linked to the country's important development planning frameworks notably the FNDP and Vision 2030. Its objectives are therefore in-line with the mentioned frameworks with poverty eradication and sustainable development at the core. The linkage to FNDP will enhance mainstreaming of IWRM in development planning which is crucial for operationalisation of IWRM.

Development of the plan was an intensive consultative process where multidisciplinary, multi-sectoral and various stakeholders were brought on board. Spatially, consultations covered five catchments and four provinces so as to gather as much information as possible on the issues, options and strategies. This also enhanced future commitment and ownership to planned projects and programmes. To support participation and commitment to the plan, a Communication Plan is clearly inscribed in the IWRM plan and indicates target groups as well as the expected costs of planned activities as well as the responsible institutions.

A comprehensive financing strategy for the plan has been laid out. The plan will use domestic funding sources and external funding from various organizations such as NEPAD. In addition, it is worthy to note that communities will also be encouraged to establish their own funding mechanisms so as to finance some of the rural water supply schemes. There is a plan to exploit virtual water and transboundary water charges as a means of financing the activities of the plan especially those that are related to use of international waters. This will bring catchment managers and river basin organizations on board in implementing the IWRM Plan. This is a commendable strategy that Botswana could also learn from. Therefore, Botswana could also exploit the possibilities of using such mechanisms.

Although the Plan will be implemented through the leadership of the Ministry of Energy and Water, an IWRM Unit will be established particularly to coordinate implementation of the plan. Botswana could also suggest the establishment of such a unit within the Department of Water Affairs or MMEWR. This Unit will ensure that planned initiatives are being undertaken and that institutions are acting on their roles.

4.3. Namibia

Namibia highly recognizes the need to implement IWRM in the management of the available water resources. As a prerequisite from the 2002 WSSD and in-light of water issues and challenges, fragmented and ad-hoc nature of various interventions adopted in addressing water issues in the country, an IWRM Plan for Namibia was developed in 2009-2010. The plan is aligned to the country's Vision 2030 and strives to address the MDGs and SADC regional goals inscribed in the SADC Protocol on Shared Water Courses. The overall long-term goal of Namibia's IWRM plan is to "*enable Namibia to achieve sustainable water resource management regime contributing to social equity, economic efficiency and environmental sustainability*" (IWRMPJVN, 2010 pp. 5).

Namibia's approach to developing the plan followed the preparation of eight thematic reports which are illustrated in Figure A1. These thematic reports are comprehensive and very descriptive. The first theme gives an overview of the *existing situation* focusing on the assessment of the governance situation at national, local and international levels; baseline data for surface and groundwater resources, their sources and areas where improvements could be made; assessment of stakeholders, their capacity and participation in the water sector and how

information is passed onto the users; gender issues; planning and investment in water services. The planning assessment does not give an indication of the national development planning frameworks in place and how they relate to the water sector.

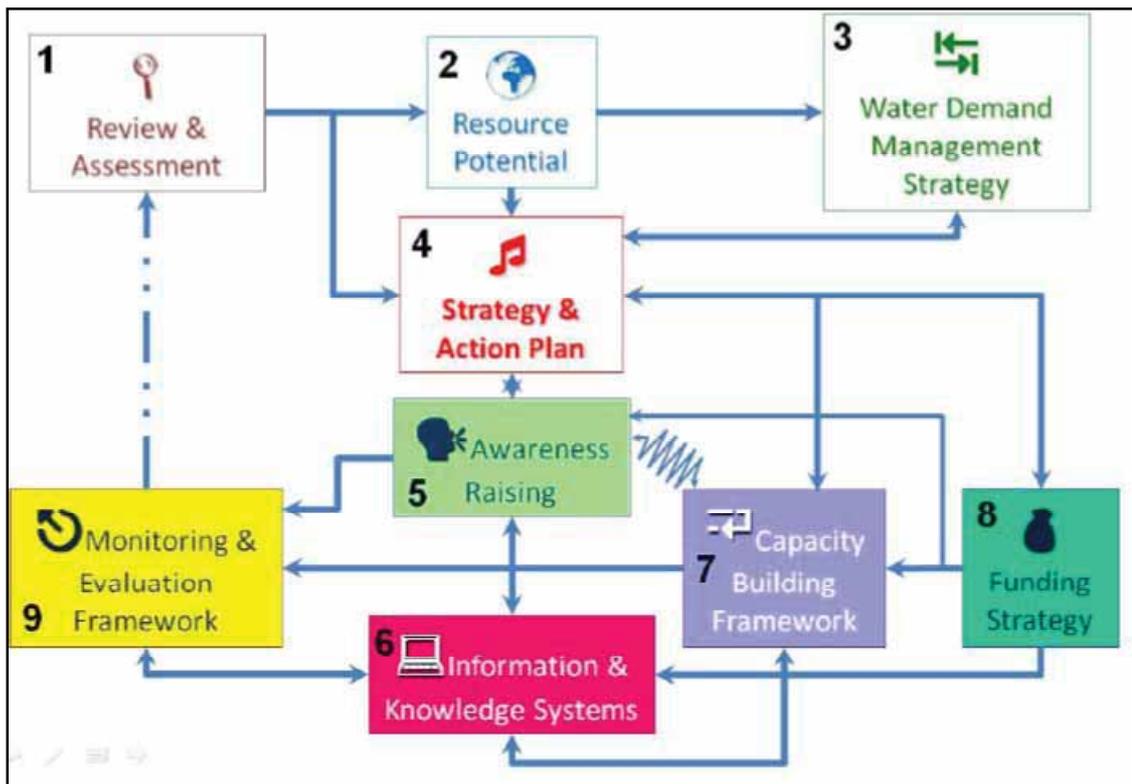


Figure 17: Diagrammatic illustration of the key components of Namibia's IWRM Plan

Theme two relates to the *assessment of resources potential and development needs*. This theme assesses water supply in Namibia in terms of the available resources and their potential for further use in the future (especially at basin level). It is indicated that about 88% of Namibia's water potential is largely associated with perennial rivers particularly located on the northern and southern borders, while more than 80% of the land areas relies on groundwater sources. Water quality issues are also highlighted indicating the status of water and wastewater treatment facilities, determinants of water quality and the availability of data concerning this aspect. Furthermore, issues of climate variability and its impacts on the Namibian water sector under present conditions and predicted scenarios of climate change are assessed. Such assessment would contribute to increased knowledge and understanding of Namibia's climate and impacts on the water resource and enhance better and informed decisions regarding water planning, development, use and management. Water supply and demand situation is assessed

for all the water use sectors. This shows the current water consumption patterns and expected growth in demand under each user sector. Agriculture is the largest water user in Namibia and accounts for about 66% of total water use. This is largely due to the irrigation sector which is expected to grow to 64% by 2030 (out of 772Mm³/a). There is therefore a greater opportunity for Namibia to enhance water use efficiency and water demand management in the irrigation sector. There is an opportunity to also assess the ecological flow requirements of Namibia's rivers as this has not been adequately determined.

Namibia is one of the countries that have made significant progress in developing and utilizing non-conventional sources of water particularly through water re-use and recycling and plans exist for developing desalination plants (IWRMPJVN, 2010). Consideration of other water alternatives and expansion of current use of non-conventional water sources in Namibia will be carried out in the near future taking heed of the social, economic and environmental costs associated with such activities. The theme further stipulates several strategies and water management considerations for ensuring adequate water supply from the mentioned sources as well as enhanced water security.

Theme three specifically deals with *water demand management and strategies* to enhance demand management. Therefore the status and potential for WMD is analysed highlighting among others natural resources accounting, enabling policy environment and tariffs and subsidies in the water sector. The strategies for each sector (irrigation, bulk water supply, tourism, rural and urban water sectors, livestock and mining) as well as performance indicators. This was done in consultation with water service providers and representatives from the water user sectors in all 13 regions of Namibia. The strategies considered therefore include those related to governance, capacity building, financial and technical requirements as well as consumer care. It is concluded that an enabling policy and legal environment that prioritises water use efficiency is critical in implementing water demand management strategies.

The first three themes mentioned above led to the formulation of Strategy and Action Plan. The document was taken through a robust process of consultations country wide. This was meant to ensure that the views and issues of stakeholders are considered in the planning process. Parallel to the development of the Strategy and Action Plan, the remaining theme reports were prepared.

Information and knowledge management systems thematic report gives an assessment of the status of baseline data, information and knowledge systems in Namibia's water sector including the status of monitoring and evaluation activities in the sector. In essence, data availability, stakeholders responsible for collection, analysis, storage and dissemination to other institutions and the public are also reviewed. The report also identifies gaps in data, information and knowledge managements and proposes a strategy for how to strengthen the information and knowledge management in the sector.

A result-based *Monitoring and evaluation framework for IWRM* has been developed for the National IWRM plan. The objective of this framework is to help stakeholders to respond to monitoring and evaluation needs defined in the Plan. These include methodology, standards and indicators as well as mechanisms to meet national objectives for result-based monitoring and evaluation of the plan.

The framework adopts a monitoring and evaluation system as developed by the World Bank (2008) and it consists of ten steps. These steps are:

- Readiness assessment;
- Agreeing on outcomes to monitor and evaluate;
- selecting key performance indicators to monitor outcomes;
- Setting baselines and gathering data on indicators;
- Selecting results targets;
- Monitoring for results;
- Evaluation of data/information;
- Reporting findings;
- Using the findings; and
- Sustaining the M&E Framework.

Using the above mentioned ten step approach, the lead institution (Department of Water Affairs-DWA) will develop and implement the monitoring and evaluation of the IWRM plan. The department will not perform this task solely but will collaborate with other stakeholders in the water sector. A diagram indicating how information for monitoring and evaluation will flow among stakeholders is shown in Figure 2. As per the Water Resources Management Act, a Water Regulator will be formed and this body will thus be responsible for evaluation of charges, fees and tariffs in the water sector; set targets in line with performance indicators and evaluate the performance of water service providers. This body will thus be better placed to be in charge of M&E of the IWRM Plan and will be housed in DWAF. In addition, it is proposed that a permanent M&E unit be established within DWAF and the mandate will be to collect, evaluate and manage data and information needed for monitoring and evaluation of the IWRM Plan. This unit will be part of the Regulator.

Institutional development and capacity building: These are critical for the implementation of the IWRM Plan and hence recognize the importance of having all stakeholders in the water sector on board in driving implementation. The plan therefore proposes strengthening and establishing the following:

- Revised WRM Act and Regulations in terms of the Act;
- Water (and Sanitation) Advisory Council (WaSAC);
- Performance Support Teams (PSTs);
- Water Regulator (WR) function;
- Water Research Council (WRC);
- National Irrigation Water Efficiency Group (NIWEG);
- Basin Management Committees (BMCs); and
- Water Point Committees (WPCs)

To improve knowledge and understanding of water management policies and strategies and also to increase managerial and technical skills, training modules will be produced to support organizational capacity. The complexity of IWRM is acknowledged therefore there is need for development of a broad skills mix to operationalise this concept. In so doing, the plan identifies four basic capacity levels for IWRM and these include:

- System level – it focuses on key requirements in relation to policies and legislative framework;
- Organizational level- looks into the effectiveness of managers particularly in decision making and responsibility allocation;
- Individual level – for knowledge and skills development;
- Technical level – addresses integrated resources planning, demand management and maintenance management among others.

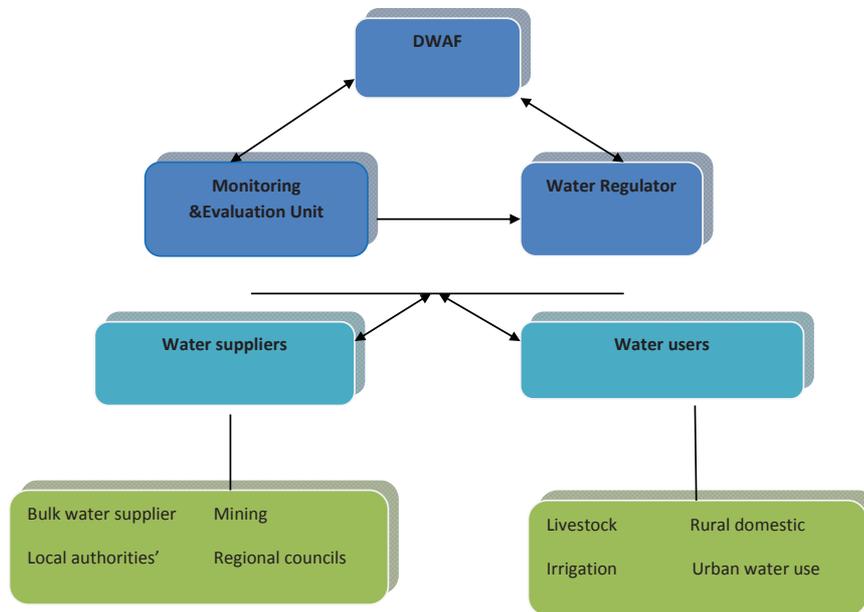


Figure 18: Flow of M&E information among stakeholders.

The major stakeholder responsible for technical education and capacity building in IWRM is the Polytechnic of Namibia and will therefore be used to support human resource development and capacity building in IWRM. The Polytechnic is one of the key institutions facilitating the WaterNet Regional IWRM Masters' programme. Outreach and awareness activities will be facilitated through developing and using various, existing materials so as to reach stakeholders in urban and rural areas. All these activities will require significant financial resources and therefore responsible stakeholders/institutions need to budget for such. Capacity building should lie with all stakeholders in the water sector particularly in the area of funding and sharing of costs. The report proposes a proportion of 30% for the state and 70% for the private sector. The report also indicates the number of people needed in different disciplines to be trained per year.

The report seven deals with the *Funding Strategy for the Plan*. Investment and funding gaps have thus been identified in the areas of: governance; resource development; water supply; sanitation and capacity building. The total requirements amount to N\$19.4 billion for the period 2010 to 2012. It is highlighted that Namibia's major funding problem is related to the ability to effectively manage and use the available financial resources hence availability is not a key issue. It is therefore required that a regulator be established who will be responsible for overseeing financial aspects of the sector development of a sustainable pricing policy to guide water service providers and users. In addition, there is need to address the underperformance of water service providers who are clouded by financial mismanagement and insufficient maintenance of facilities. There is also need to foster education and raise awareness among communities about water management and the importance of treating water as an economic good. The funding

strategy is based on six key principles and also stipulates the framework or steps to follow when developing an effective and sustainable strategy. These are outlined in Table 1.

It should be noted that these are just recommendations for the plan therefore the overall implementers will need to decide and agree on how they would best suit the country's water sector needs and aspirations.

Table 17: Principles and steps to follow when developing a funding strategy for an IWRM plan

Key principles in developing a funding strategy	Steps to follow
<ul style="list-style-type: none"> • Full cost recovery; • Use of public funds for public goods while private funds should be utilized for private goods; • Users to pay for productive services. This should however not consider the basic human right to water; • Sub-sovereign bodies at the lower level should have financial powers; • Increased self financing by service providers such as local authorities; • Optimization of external grant funding 	<ul style="list-style-type: none"> • Create conducive governance mechanisms and set financing principles; • Assess and estimate the needs of the costs of water development and management, potential cost recovery and affordability; • Decide on which government structures to use especially for public goods and services; • Consider targeted subsidies; • Explore external aid; • Decide on how much commercial funding needs to be taken up and the appropriate funding to be considered; • Explore all possible options for private sector participation.

Strategy and Action Plan

Fives thematic areas or priority issues have been identified and are considered in the S&AP. These thematic areas cover the following:

1. Policy and legislative support;
2. Institutional support and capacity building (with three sub-themes)
 - Capacity building for management of IWRM and WDM;
 - Technical skills and management for IWRM;
 - Financial skills and management for IWRM and WMD.
3. Stakeholder involvement and awareness;
4. Resources for IWRM (six sub-themes);
 - Knowledge management;
 - Water resources management;
 - Climate and climate change;
 - Water supply;
 - Water demand management and water use efficiency;
 - Sanitation, pollution control and protection
5. Investment for IWRM.

All these thematic areas have objectives, strategies, actions, activities and initiatives, responsible institutions, indicators and time lines. The S&AP is largely based on the findings and recommendations from the other seven theme reports discussed earlier in this report.

Comments

Namibia's IWRM Plan is detailed as indicated by the number of theme reports produced. Theme reports 1 to 7 give more or less a situational assessment of Namibia's water sector as per a particular component. Theme 1 (Existing situation) feeds on to the other six theme reports and these are discussed in more detail. As such, there is somewhat duplication of issues. It is however commendable that after completing the first three reports, a draft Strategy and Action Plan was prepared and taken for a round of consultations with stakeholders country wide. This was in the form of workshops and focus group discussions focusing on the major water user sectors, government, private sector and civil society. Consultations are critical so as to ensure that the views and issues of sectors and areas that require prioritization are discussed and considered for the plan. This also enhances greater support and ownership of the IWRM plan. Botswana will also adopt a similar strategy in terms of consulting stakeholders in the plan development process.

IWRM Plans should have goals, objectives and a vision. Namibia's IWRM Plan goal is clearly indicated and the objectives are in-line with the thematic areas. However, there is no clear indication of its vision. This is different from other countries' plans and from what Botswana is proposing for the national IWRM plan. A Vision is important as it guides a countries programmes and strategies towards a particular direction into the future. It however indicates that it strives to achieve the aspirations of the National Vision 2030.

It seems the plan's conceptual framework is based on IWRM, WDM and Sustainable Development although this is not immediately and clearly articulated. The Plan does not give an indication of how the plan will be mainstreamed into existing planning frameworks.

Cross cutting issues such as gender and climate change are considered in the plan. It is noted that through stakeholder participation and awareness, women and youth will be equitably involved in IWRM in Namibia. This would be undertaken by establishing tailored information for them, advocating for participation in committees at all levels and will be trained thus improving knowledge and skills in IWRM. This is commendable as it is what IWRM strives to achieve. With regard to climate change, the plan will ensure that water resources are managed with full consideration of climate variability and change. As a semi arid country and prone to droughts and floods, climate change will definitely put pressure on the country's limited water resources.

The plan however lacks issues around water and HIV/AIDS and how mainstreaming could be enhanced. This is an important area which should be considered as it has significant impacts on

sustainable water utilization and management. The water sector is highly vulnerable to the HIV/AIDS scourge.

The plan is also thin on environmental water requirements. One of the theme reports however does make an assessment of the current situation with regard to ecosystem water requirements and its importance in the management of water resources. It is however not clear in the S&AP as to how this would be addressed and who will be responsible for implementing strategies towards this. There is need to prioritise ecological water requirements or be recommended for policy as this would aid in decision making on allocation and management of water resources

Funding and investment for implementation of the plan is essential. The Namibian IWRM plan has adequately assessed the gaps and needs of the water sector in terms of funding and a strategy towards this is emphasized. Interestingly, the plan recommends that an investment strategy should be linked to monitoring and evaluation systems so as to support timely feedback. Furthermore, Botswana could assess the use of principles and steps identified for the funding strategy and also ensure that the available resources are utilized efficiently for the intended purposes.

4.4. Kenya

The Government and the Water Resources Management Authority of Kenya developed a national IWRM-WE Plan in 2009 (Government of Kenya & WRMA, 2009). The development of the IWRM and WE Plan was prompted by continuing water scarcity, diminished water storage, climate change and increasing rainfall variability. Kenya is classified as a water scarce country with an annual renewable fresh water supply of only 647 m³ per capita (Government of Kenya & WRMA, 2009). This figure is based on an estimated average annual water availability of 20.2 billion cubic meters and an estimated population of 31.2 million (2002).

The IWRM-WE Plan was developed to ensure that:

- National policies and priorities take water resources implications into account, including the two-way relationship between macro-economic policies and water development, management, and use;
- There is cross-sectoral integration in policy development;
- Stakeholders' participation in water planning and management, with particular attention to securing the participation of women and the poor is assured;
- Water-related decisions made at local and river basin levels are in line with, or at least do not conflict with, the achievement of broader national objectives such as the country's Poverty Reduction Strategy, and

- Water planning and strategies are integrated into broader social, economic, and environmental goals.

The Plan contains actions towards addressing key cross-sectoral water related challenges in the areas of:

- Policy and institutional framework (governance) of water resources;
- Knowledge gaps on quantity, quality and level of service in water;
- Water supply and demand;
- Integrated catchment management;
- Climate variability and change;
- Trans-boundary waters;
- Sustainable and reliable financing for water management, and
- Monitoring and evaluation of progress.

The Plan preparation was preceded by critical milestones, including the adoption of the National Water Policy in 1999; enactment and operationalisation of the Water Act 2002; water sector reforms – from 2003; and development and finalization of the WRMS (first edition 2007); and finalisation of the Catchment Management Strategies (Government of Kenya and WRMA, 2009). The IWRM Plan was developed through a participatory process by all stakeholders and benefited from lessons learnt from similar processes in other countries.

As with plans from other countries, the Plan's vision is "*...water resources protected, harnessed and sustainably managed to ensure availability and accessibility to all water uses for present and future generations*" (Government of Kenya and WRMA, 2009; pp. 6) and it is in-line with the country's policy on water resources management and development. Its overall aim is to "*achieve optimum, long-term, environmentally sustainable social and economic benefits from the nation's water resources*" (pp. 7). Interestingly, the plan has both overall short and long term objectives (pp. 7) and will be achieved through the following six strategies:

- Improve water governance through policy and institutional reforms;
- Enhance knowledge of current and future water uses;
- Rehabilitate and conserve water catchments;
- Understand climate variability and change and ensure adaptation measures;
- Establish trans-boundary agreements;
- Establish sustainable and predictable financing mechanisms and procedures

Strategies and projects that will address groundwater as well as surface water management are improved resources assessments including data collection and monitoring, analysis of droughts and floods, capacity building, infrastructure development and maintenance, and investment. The following interventions are proposed:

- Capacity building to improve surface and groundwater assessment capabilities;
- Developing, mapping and managing a geo-referenced database system containing both point and spatial data layers;
- Establishing optimum water resources monitoring networks and standard data reporting protocols
- Assessing national surface water and groundwater potential and classifying and setting the Resource Quality Objectives;
- Developing a national groundwater utilization and management policy;
- Develop measures to mitigate droughts and floods; and
- Determining the reserve water for sustaining ecosystems.

4.4.1. Strategic area: trans-boundary water resources

Kenya shares several water bodies with neighbouring countries. These shared water resources support important ecosystems and sectors such as including fisheries, hydropower production and water supply for major urban centres.

Issues addressed by the IWRM plan regarding transboundary waters include environmental management as well as water use, specifically regarding the following immediate challenges:

- Ecosystems approach to environmental challenges such as catchment degradation and siltation of water bodies; pollution, eutrophication and invasion of the water bodies by alien species; encroachment on the water bodies;
- Potential water use conflicts through equitable and reasonable water utilisation;
- Research, data and information sharing arrangements; and
- Harmonization of transboundary water policies and coordination of management initiatives including establishing consultative protocols,

4.4.2. Strategic area: Closing the gap between water demand and supply

The interventions to resolve the growing water demand and supply gap include:

- Improved water resources assessment and data accuracy, especially with respect of groundwater;
- Increase water storage to capture flood waters;
- Prioritisation of water demand and utilisation. Water use rights may be re-allocation if necessary; and
- Increasing water supply from on-conventional sources such as rain harvesting, treated wastewater and storm water.

Comment

The IWRM Plan having been developed through a participatory process by all stakeholders and also having benefited from lessons learnt from similar processes in other countries is a good example of how other IWRM plans could be prepared across the region. Like Kenya, Botswana cannot escape the strategy of trans-boundary water resources. Botswana also faces the challenges related to transboundary water resources management that include potential water use conflicts, water pollution and catchment degradation occurring outside the borders. In order to close the existing gaps between water demand and supply, Botswana as a country needs to focus more on water resources assessment and data accuracy mainly with regards the groundwater resources and accounting for how much water resources are available in the country, including wastewater. The water use rights especially for boreholes need to be monitored with regards to water abstraction amounts since excessive abstraction may deplete the resources. This needs to be considered in the implementation of the IWRM plan.

4.5. Jordan

Jordan does not have an official national IWRM-WE Plan but has a number of initiatives, policies, strategies, programmes and plans which all together correspond to a National IWRM plan. Noteworthy ones include the Water Policy (2003), National Water Master Plan (2004) and the national Water Strategy (2008-2022). Therefore through these initiatives, the country is addressing, though partially, the key components and principles of IWRM. The elements of these strategies and plans are discussed in the next section including a brief overview of Jordan's water situation.

Jordan is a semi arid country and one of the most water scarce countries in the world and is also regarded as the fourth water poorest country globally (Kashman, 2010). The country is facing a constant imbalance between the total sectoral water demands and the available supply of freshwater. Total water resources amount to 800Mm³ and It is indicated that water demand never goes below 1 600 Mm³ and the average annual per capita of water availability declined from 3600m³/year in 1946 to 145 m³/year in 2008. Surface water supplies contribute approximately 37% to Jordan's total water supply (Jordan Water Strategy 2008-2022).

Developed surface water was estimated at 295 Mm³ in 2007 and is projected to be 365 Mm³ by 2022. Groundwater is an important resource and accounts for 54% of the total water supply. However, the resource is being exploited at about twice its recharge rate exacerbated by unsustainable water abstractions for agricultural expansion and rising population. In addition, there are hundreds of illegal wells hence some of the water abstractions are not known therefore this reduces the availability of the resource. Agriculture is among the highest water consumers and irrigation utilizes 71% of the water demand (2007) and 64% of all available water (2007). Therefore, water is unevenly allocated among the water user sectors.

Despite the rising costs of water supply, the level of service provision is fairly high, with service to 97% of the population in the urban areas and 83% in the rural areas. However, there are inefficiencies in the distribution systems and these are far from being optimal. The Water Strategy indicates that unaccounted for water in the distribution systems of municipalities was estimated to be 55% of the quantity supplied in 1995. In terms of transboundary waters, Jordan shares rivers like the Jordan river, Yarmouk river in the Jordan valley, groundwater basins such as the Basalt aquifer shared with Syria and yields 70Mm³ per annum and the Dissi fossil ground water shared with Saudi Arabia. Most of these resources have been the subject of many water conflicts in the region which have affected management of the water resources.

Bearing these challenges in mind, water management has become the key focus of Jordan's water sector. This has led to a realisation that good governance is one of the critical elements required in-order to ensure adequate water supplies for the rising water demand and effecting water management. Jordan is therefore fast tracking the development of policies, laws and institutional structures to address water problems and enhance overall economic development.

4.5.1. 2004 National Water Master Plan

The full document is not available for review. This plan aims to implement IWRM so as to address current water demands and future water shortages. It consists of nine volumes including:

1. Main report;
2. Planning framework;
3. Water uses and demands;
4. Surface water resources;
5. Groundwater resources;
6. Non-conventional water resources;
7. Water and environment;
8. Water sector economics;
9. Water balances and allocations.

The plan adopts the concept of IWRM as its guiding framework for the water sector. The plan therefore establishes a framework dealing with availability of information,

coordination, policy development, planning, legal framework and human resources development as per the requirements of IWRM. Notable recommendations of the plan are indicated as follows:

- Demand on water – It is indicated that by 2020, the total demand for water will increase to 1,685 Mm³ due to the large increases in population, improvements in living standards and growth in economic activity. While the new sources of water supply are expected to increase the water availability to 1,289 Mm³ per year by 2020, a shortfall of 396 Mm³ representing 24% of total demand will remain and will have to be managed through IWRM and water demand measures. The proposed demand management measures include rehabilitation of the water distribution system through infrastructure development and it is expected that this would lead to savings of between 15 and 20% of the current water loss by 2020. Water losses from the systems are estimated around 50% country wide therefore savings will be about 100Mm³ per annum. Water conservation among users will be enhanced and stringent public awareness efforts will be enhanced particularly to change people's attitudes and perception about water use and management.
- Reclaimed water – Giving priority to reclamation of municipal and industrial treated wastewater through wastewater treatment works. In addition to 22 operational treatment facilities, it is expected that 17 more will be established and fully operational by 2015. Treated wastewater will continue to be used primarily in the irrigation sector. The effluent should meet the water quality standards therefore water quality will be monitored.
- Desalination – as an attempt to avail water for various purposes and reduce over-abstraction of groundwater, non-conventional water use is encouraged. One of these is treating and utilizing sea water. There are more than 25 desalination plants in Jordan and the water is mostly used for irrigation purposes. The Water Authority of Jordan also operates some plants to produce drinking water. More plants will be constructed in the future.

Jordan is also implementing a digital National Water Master plan which is based on a water information system. This plan would permit easy and regular updating as new information becomes available. It would thus allow for flexibility in responding to recent challenges in the water sector. Some of the outputs of this system are the digital water balancing tools that enable assessing the country's water balances given new information and data. This is a commendable way of supporting efficient water sector planning.

4.5.2. Water for Life: Jordan's Water Strategy 2008-2022

This strategy is based on the vision-driven change efforts for the country. It identifies plans for future water and the actions that will be undertaken so as to ensure that water is made available for the various uses including the environment. It therefore outlines a strategic and integrated approach to sustainable water management and plans for future water developments. It considers all aspects of the water and adopts effective water demand management, an efficient water supply and an institutional reform of the sector.

The strategy is premised on the following concepts:

- A deeper knowledge of the available amounts, actual quality and natural protection of Jordan's water resources is the foundation for effective decision making;
- Raising awareness on the limited available water resources;
- Efficient and effective utilization of water resources by all including non-conventional water use.
- Cost reflective tariffs;
- Introduce a new Water Law, Water Regulatory body and a Water Council;
- Efficient private sector participation in the development and implementation of IWRM strategies. However, all stakeholders in the water sector should assume and share responsibilities for water management and work towards a common goal;
- Balance between drinking water needs, industrial and irrigation water needs;
- Healthy aquatic ecosystems are vital to a high quality of life for the people and therefore must be protected;
- Enforce laws to conserve and protect groundwater and surface resources;
- Drinking water quality will have priority and standards will ensure that users have safe and secure drinking water;
- Regulations for use of grey water.

The strategy therefore addresses water demand, water supply, institutional reform, water for irrigation, wastewater and alternative water resources. Under each component, current issues, expected future challenges, goals and strategies are highlighted. These are summarised in Table 6. It should be noted that interventions indicated in the table are not the only ones that the country intends to promote.

Table 18: Challenges, goals and strategies for Jordan's water sector

Strategy component	Future challenge	Goals	Approaches
Water demand	Meeting demand amid rising population growth, food security and economic developments	<ul style="list-style-type: none"> Cap agricultural water use; Efficient water tariffs and incentives to promote water use efficiency in the water sector particularly irrigation; Increased awareness on water availability; To reduce non-revenue water to 25% by 2015 	<ul style="list-style-type: none"> Target all including public and private sectors and general public; Disseminate technical and non-technical information for the targeted recipients including schools; Set up a water regulator to enforce laws and efficient tariff structures; Develop policy to provide incentives for farmers to improve their products and profits. This will enhance their use of better technology and affordability for paying tariffs; Encourage groundwater basin water users associations; Establish and implement groundwater management plans; Revise the bulk tariff setting mechanism to reflect the real value of water; Enforce building and plumbing codes for buildings that set maximum water flow limits and minimum quality standards for plumbing fixtures; Implement regulations to encourage rainwater harvesting; New technology for efficient use and re-use of water; Expand use of treated wastewater;
Water supply	<ul style="list-style-type: none"> Traditional water resources will not meet future water demand. Improving the quality of groundwater resources; Need to increase use of reclaimed water 	<ul style="list-style-type: none"> Safe and secure drinking water supply achieved; Improve water supply from desalination; Protection of water resources from pollution; Surface water is efficiently stored and utilized; Treated effluent is efficiently and cost-effectively used. Groundwater management plans 	<ul style="list-style-type: none"> Invest in technology for removal of sediments in large storage facilities; Monitoring and assessment program for surface water quantity, quality, uses and protection and update and enforce water standards; Implement a program that sets out legal and financial measures to control groundwater withdrawals; Provide standards, guidelines for design and best management practices for potentially polluting activities; Exploring productive uses in agriculture, industry, and urban areas and aquifer recharges;

Strategy component	Future challenge	Goals	Approaches
		<ul style="list-style-type: none"> Use of grey water and rainwater is fully embedded in the codes and requirements of buildings; Protection of shared water rights. 	<ul style="list-style-type: none"> Assess the potential of brackish water resources in terms of sound technical, economic and environmental feasibility; Improve water distribution efficiency through improved planning, better O&M and strengthened capacity among relevant departments; Water development and allocation will be based on economic, social and environmental considerations; Adhere to bilateral and multilateral agreements on the use and management of shared waters; Monitoring of performance of water systems;
Institutional reform	<p>As in many countries, the institutional framework of Jordan is fragmented hence the need for IWRM. Therefore greater efficiency within the institutional structure is required.</p>	<ul style="list-style-type: none"> Enact and enforce water laws; Strong policy development and water resource planning strategies; Separate governance functions and operational functions; Establish a Water Council and regulator; Commercial principles to drive water management while the needs of the poor are supported; Capacity building and optimization of staff numbers; Institutionalization of National Water Master Plan 	<ul style="list-style-type: none"> A new Water Law that will define the structure and function of the institutional framework of the water sector; Establish water resources protection legislation to legally implement water resources protection zones for drinking water resources; Balance traditional water rights with state rights while moving towards market based allocation systems; Restructure the water sector (institutional reform); A Ministry body will collect and analyze data, monitor sector performance, project and plan for future growth in water demand; Provide for a link between water sector planning and national development planning; Establish a Water Council and Regulator; Use best commercial practices within a regulated water market. However, it will be necessary to apply targeted subsidies to strengthen the social safety net of the poor Set municipal water and wastewater charges with aim of covering the cost of O&M; Encourage and enhance indigenous water research targeted at the improvement of water management, resource economics, and adapting research findings to

Strategy component	Future challenge	Goals	Approaches
Water for irrigation	<ul style="list-style-type: none"> Water use efficiency and increased value added of irrigation water use; Increase the economic return of irrigation water; Drought management and climate change adaptation 	<ul style="list-style-type: none"> Reduction of annual water allocated to irrigation Efficient bulk water distribution and on-farm irrigation systems; Use of treated wastewater in the sector; One service provider for irrigation water while the retail function for irrigation water will be privatized and/or done able farmers' associations. Water tariffs and incentives in the irrigation sector. Explore large scale rainwater harvesting for irrigation 	<p>Local conditions.</p> <ul style="list-style-type: none"> Enhance on-farm irrigation efficiency; Promote the use of rainfall harvesting methods; One organisation responsible for bulk water supply in the Jordan Valley; Metered irrigation water at strategic locations. Digital meters shall be installed for volumetric measurement of in-flowing water; Encourage automation of irrigation networks to reduce water losses through leakages;
Wastewater	<ul style="list-style-type: none"> Safe use of treated wastewater in activities that provide more economic return; Ensure that all major industries have their own wastewater treatment plants 	<ul style="list-style-type: none"> Provision of adequate wastewater collection and treatment facilities; All major industries and mines have WWTWs; Protection of aquifers from contaminated wastewater The quality of and industrial WWTWs meets national standards and is monitored regularly; Tariffs for wastewater collection are rationalized; 	<ul style="list-style-type: none"> Manage treated wastewater as a perennial water source of water and integrate it into the national water balance/budget; Regular monitoring of the quality of the effluent from every WWTW; Conduct EIAs for new projects; Prioritize the use of treated wastewater for the activity that generates the highest social, environmental and economic return; Develop wastewater collection and treatment facilities taking into consideration protection of water resources from pollution by wastewater; Develop a Wastewater Master Plan; Design and implement projects to store the excess treated effluent in reservoirs; Establish a re-use unit with well qualified staff to be responsible for the planning, design, construction and

Strategy component	Future challenge	Goals	Approaches
Alternative water resources	<ul style="list-style-type: none"> Possible negative environmental impacts of large desalination projects; Budgeting for desalination plants – costly activity; Limited expertise regarding desalination 	<ul style="list-style-type: none"> Desalination projects at the Red Sea are operational; Re-use of treated effluent, rainwater harvesting are promoted; Infrastructure for desalination of sea and brackish water is sufficient; An alternative energy source to keep the cost of desalination as low as possible is available 	<p>management of treated wastewater.</p> <ul style="list-style-type: none"> Implement wastewater and sludge effluent standards. Establish a program to desalinate brackish and sea waters on a short, medium and long-term basis; Put in place a comprehensive risk management system to monitor the re-use of treated effluent; Enforce buildings codes to use grey water, storm water storage and water saving fixtures; Explore suitable sources of energy to keep the cost of desalination bay.

Source: Kingdom of Jordan, 2009.

Comments

Jordan does not have an encompassing National IWRM-WE plan in place. There are however a number of activities and initiatives that are somewhat equivalent to the Plan. Most of these (policy, strategy and master plan), do address water management issues and challenges of Jordan and adopt the concept of IWRM. The aim is therefore to enhance sustainable utilisation and management of the scarce natural water resources in light of current and future water needs including the environment also in line with the continuous in living conditions of the population. Despite the lack of a formal and comprehensive IWRM plan, Botswana could draw from their experiences particularly with regard to the strategy.

The strategy is driven by a vision and clear objectives in response to the country's water challenges. It is currently under implementation. Participation of all stakeholders in the planning, development and management of water resources is encouraged and most importantly, government should not bear all the cost of water supply. In this regard, private sector participation is essential. It is recognised that lack of capacity among water managers and planners is a challenge exacerbated by fragmented governance structures. The country therefore strives to address this challenge through robust awareness campaigns, and restructuring of water sectors (institutional reforms). In Botswana, this process is currently taking place as a recommendation of the National Water Master Plan of 2006.

The pricing strategies are mentioned and the aim is to operate under the marginal cost pricing. The country therefore strives to charge water so as to recover mainly operations and maintenance costs. Overall, the costs of water should reflect the true value of water. However, in setting up a cost reflective pricing system, the rights and affordability of the poor segment of the society will be considered. It is unfortunate that the strategy does not clearly elaborate as to how this will be carried out.

Irrigation is an important sector and utilises the bulk of Jordan's water supply. There is therefore need to encourage water use efficiency in the sector hence the strategy is very detailed in addressing this aspect. Among this is monitoring safe use of water for irrigation, and increasing the value added per cubic water used in the sector. In addition, use of treated wastewater for irrigation is promoted and future possibilities for capturing rainfall so as to use in this sector. Such interventions would enhance food security and management of the water source.

Although the strategy supports stakeholder participation, it is silent on gender issues and mainstreaming in the water sector. This is one of the critical aspects of IWRM which need to be addressed.

Jordan should also be commended for encouraging use of non-conventional water sources such as treated effluent. The country has invested in developing wastewater treatment facilities and plans to construct additional ones in the future. Although effluent re-use is largely practiced in the agricultural sector, the plan is to expand to other uses as well especially in industries. There are plans to consider storing good quality treated effluent in light of future water needs, however the feasibility of this is yet to be explored. Unlike Botswana, Jordan does not have a

National Wastewater Master plan which is useful in guiding wastewater management and use. A Master plan would also allow for implementation of the identified strategies.

4.6. Spain

Spain is among the countries that do not have an encompassing IWRM-WE plan but have devised plans for river basin management. Among these river basins is the Tagus River shared with Portugal. This river, located in the centre of the Iberian Peninsula, covers an area of 80 100km² and is 1,038 km long (716 km in Spain and 275 km in Portugal). It is one of the main water sources in the two countries and serves mostly urban (domestic and industrial) and agricultural water needs. Overall, the Tagus River faces a number of complex problems among them increasing water demands, transboundary reservoir management and protection of the resource mainly from pollution.

The riparian countries have jointly devised a River Basin Management plan and have both established basin plans for their respective sections of the catchment, prepared in a collaborative way. Spain has developed a Hydrological Plan for the basin. This plan is guided by the 1985 Water Law that recognises hydrological planning as a mechanism that would address and fulfil water demands and would ensure increased water availability and protection of the resource. Other guiding documents include the Water Framework of 2000, National Hydrological Plan and the Actions for the Management and Use of Water (A.G.U.A.) programme. The hydrological plan has the following specific objectives:

- Ensure present and future water demands by improving a rational and effective use of water;
- Assess and establish a better territorial and sectoral balance;
- Implement efficient water management that takes advantage of technical innovations in order to increase water resource availability through the rationalization of use;
- Protect the water resource altogether with the environmental needs and other natural resources;
- Ensure water quality for each use and for the environmental conservation;
- Protect the users against hydrological extreme events;
- Preserve hydraulic infrastructures and the hydraulic historic heritage.

The Plan does not fully comply with IWRM principles. Emphasis is mainly on hydrological aspects of water use and management. Socio-economic and environmental concerns are not fully covered but a number of socio-economic and environmental challenges need to be addressed. These include sectorial biasness in water decisions (urban water service providers and hydro-electric power stations have more leverage said in decision making); inadequate ecological discharges, excessive use of fertilisers; inadequate water treatment, indiscriminate waste disposal and exotic aquatic resources.

The plan follows strategies to define hydrological units and priority water uses, water quality thresholds, priority river reaches, characterisation of wetlands, aquifer perimeters, reservoirs water quality, flood and drought management. It is indicated that the mentioned objectives and goals are harmonised with other national policies and strategies.

A plan of such nature has to fully describe the basin covering availability of water resources, other natural resources such as vegetation since they have a bearing on the hydrologic units of the basin, geology, socio-economic factors and governance issues. However, this plan is limited on some of these aspects particularly description and impacts on the biodiversity, geological features and impacts, changes in river flows, sedimentation and groundwater resource, water quality and pollution sources. The socio-economic situation is hardly provided for in the plan but considers various water uses such as agriculture, industries, domestic and recreational use. It designates water supply for each water use system on Spain's side of the basin.

In terms of water allocation, where potable drinking water is scarce, the plan caters for limitation of water use where changes are mainly made regarding priority of use. Some of the measures include recycling of water for agricultural purposes during droughts.

In terms of stakeholder participation, the planning process involved various stakeholders in the water sector and related sectors at national, regional and municipal levels particularly in identifying issues and gaps. However, this process did not take into consideration the views of the poor and marginalised groups as they were not consulted.

Regarding governance, it is indicated that the objectives and strategies of the plan are linked to the current institutional and legal framework of the water sector.

In conclusion, the Hydrological Plan for Tagus is more concerned with the hydrological aspects of the river basin. It does not implicitly consider IWRM principles. It should however be commended for attempting to include a wide array of stakeholders in the planning process. There are not many significant lessons for Botswana could learn from this plan except that The Botswana IWRM Plan should advocate for preparation of comprehensive hydrological plans for the main rivers. These plans should however make considerable efforts in covering all aspects of IWRM.

4.7. Kazakhstan

An IWRM –WE programme (2008-2025) for Kazakhstan has been drawn up in an attempt to improve water management and ensure sustainable development of the country as it identifies priority steps that must be taken to meet IWRM goals and principles (Government of Kazakhstan, 2007). The programme seeks to formulate and develop an IWRM and water efficiency system to ensure environmental safety and sustainable development in the country. In order to achieve this objective, several tasks are would be undertaken (in phases). These tasks are centred on a) improvement of water resources management system and b) increasing water efficiency.

As with other IWRM-WE plans, Kazakhstan's plan document assesses the current water situation where several issues regarding water use and management are analysed. Examples of identified priority issues include:

- Insufficient national water policy;
- Fragmented organizational framework;
- Inefficient implementation and enforcement;
- Limited application of modern governance instruments such as environmental economic instruments, water resources assessments;
- Biasness towards the water supply approach;
- No consideration for ecosystem/environmental management;
- Inadequate water quality management system at river basin level;
- Limited participation of civil society in the water sector;
- Lack of accountability and responsibility for operation of water infrastructure;
- Poor and lack of accessibility to national information system;
- Transboundary water management issues not being addressed and no harmonization of international commitments into national policy framework;
- Expected impacts of climate change on water resources;

The IWRM Plan as mentioned earlier focuses on two overriding interventions related to improvement of water resources management system and increasing water efficiency in two phases (2008-2010 and 2011 – 2025).

Phase 1	Phase 2
<i>Improvement of water resources management system</i>	
<ul style="list-style-type: none"> ● Development and implementation of National Water policy; ● Enhance organizational capacity of the National Committee for Water resources and RBOs; ● Establish river basin councils ● Develop basin IWRM/WE plans ● Develop and enforce economic instruments and laws to control water use and pollution; ● Implement payment for ecosystem services; ● Improve information system and its accessibility to stakeholders; ● Enhance public awareness and involvement of stakeholders in decision making; ● Training and education and establishment of training centres. 	<ul style="list-style-type: none"> ● Strengthening institutional capacity in use and protection of water resources; ● Development of mechanisms on sector-wise cooperation; ● Provision of water management planning at inter-state, national, riverbasin and regional levels of management; ● Development and introduction of economic mechanisms for sustainable water use; ● Development of system for environmental norms and standards to enhance environmental management; ● Development of monitoring system of water bodies/ecosystem and quality of nature water; ● Development of education and training system for staff involved in water

	<ul style="list-style-type: none"> management; Implementation of agreements on exchange of information and establishment of data base on complex use and protection of transboundary waters
<i>Increase water efficiency</i>	
<ul style="list-style-type: none"> • Make provision for the establishment of water user associations in legislation; • Economic incentives and technological innovations; • Water demand management; • Action plan on prevention and liquidation of consequences caused by harmful impact on water; • Feasibility studies on effective methods in irrigation and train farmers; • Develop and implement programmes to enhance water resources management and water efficiency. 	<ul style="list-style-type: none"> • Establishment of water user associations and rural consumptive cooperatives at local level; • Improvement of payment system on water use counting; • Establishment of WUAs and their services on water delivery; • Improvement of monitoring system on use of water, water economy systems and facilities at local level; • Development of system on response and prevention plan due to harmful impact caused by water at local level; • Development and implementation of pilot projects on water efficiency improvement; • Campaigns and training on sustainable use and conservation of water.

Therefore in implementing the above mentioned tasks, actions will be taken in the following fields:

- Improving and strengthening organizational structure, institutional capacity building and inter-sectoral partnerships;
- Improvement and harmonization of water legislation to include new IWRM concerns, instruments and norms;
- An IWRM programme that is compliant with ecosystem approach and enhanced water quality management. This includes enforcement of polluter pays and consumer pays principles as well as development and implementation of standards.
- Water caused and harmful impact response and prevention plan;
- Improvement of water efficiency and water accounting system;
- Water and land resources monitoring system;
- Improved and strengthened information system, information exchange and management. This includes among others development of an information centre particularly for water resources management. The information system would be directly linked to the various water institutions to make information flow easy and convenient. In addition, the media will take part in dissemination of information on IWRM in the country.
- Education and training of water resources planners and managers;
- International Cooperation and improvement of transboundary water management.

Implementation of these interventions will lie with various stakeholders with government as the lead coordinator. For each activity, the plan indicates the responsible institution (pp 49 to 94).

Resources are required to implement the IWRM plan and the intention is to source funding from primarily local and central government budgets. Other sources include fund of legal entities, fund of nature users, international donor agencies and donor countries.

The plan does not however clearly indicate how monitoring and evaluation of activities will be undertaken or who will be responsible for such. It should however be commended for aligning the interventions with the goals of national development. This is a way of ensuring mainstreaming of IWRM in national planning programmes.

4.8. Israel

In response to a severe drought and serious water shortages¹², Israel has developed a range of strategic water documents, including a transitional Master plan for Water Sector Development (2002 – 2010; Water Commission, 2002), The State of Israel: National: Water Efficiency Report (Rejwan, 2011) and Israel 2020: Master Plan for Israel in the 21st century (Mazor, not dated). Moreover, the OECD reviewed the water sector as part of its environmental performance review. The summary below is mostly based on these documents.

Israel relies on the water largely contained within three aquifers and the Sea of Galilee watershed. The average annual 'natural supply' of potable water (mainly precipitation) that replenishes Israel's natural water bodies is 1249 Mm³. In the period 1993-2010, the average natural supply fell to 1 155 Mm³/yr. This water supply is augmented by 500 Mm³ desalinated seawater, 150 Mm³ brackish water and 509 Mm³ of re-used or recycled treated effluent. These figures imply that Israel water supply originates for 50% from rainwater and the other 50% from alternative sources (desalinated seawater, brackish water and treated effluent). The country has heavily invested in water infrastructure (treatment plants, desalination plants, metering and monitoring systems). Virtually all water use is metered. Meter reading, monitoring and analysis of water consumption and quality are estimated to cost around US\$ 20 million/annum.

The National water efficiency plan sets ambitious targets for the period 2010-2050 based on a mixture of greater use efficiency by sector (stimulated by economic instruments) and greater use of alternative water resources, in particular seawater:

- A decrease in reliance on potable water for irrigation in the agricultural sector from 42% currently to 26% by 2050; there should be an increase in use of effluent for irrigation; more than double the quantity of effluent provided for irrigation in the agricultural sector by 2050.

¹² The annual water consumption exceeds the natural potable supplies by 300 Mm³, a situation that has led to depletion of aquifers and partial drying up of the Dead Sea (the surface area has been reduced by a third since 1930). Shortages are compounded by a decrease in annual rainfall of 9% since 1993, and climate change models predict a further rainfall reduction of 10-15% over the period 2015-2035 (OECD, 2011).

- Continue national investments in research, development, training, and demand management incentives to increase conservation and use-efficiency in the agricultural sector;
- Cap domestic per capita water consumption at or below 100 m³/person/year (in 2009, the figure was 90 m³ per capita).
- Maintain natural potable water consumption rates at or below the average natural supply rate;
- Replace natural potable water use with alternative sources such as desalinated sea water, effluent, and brackish water;
 - More than double the contribution of desalinated water to the national potable water supply from 20% (307 MCM) in 2010 to 46% (809 MCM) in 2020.
 - Increase water recycling in the industrial sector by approximately 10% by 2035.

Water conveyances are associated with water losses of 10-12% p.a., which need to be reduced. In the domestic and tourism sectors, wasteful use needs to be reduced and more treated effluent re-used or recycled. Already 84% of Israel's domestic wastewater is re-claimed for irrigation in the agricultural sector. The capacity for agricultural re-use will be increased. Domestic use is controlled by the automatic reading system and a steep block tariff. During droughts, media and awareness raising campaign have proven very effective (10% reduction in consumption in 2009). Furthermore, a steep tariff increase has been introduced (40% increase in January 2010!) and municipal garden are metered and monitored with specific consumption quota. The latter led to a drop in water consumption by more than half. Desalination of seawater is expected to contribute more to domestic use in future. Desalinated water is expected to provide approximately 70% of the domestic water demands by 2025. Demand management policies in the agricultural sector are designed to accomplish two objectives: 1. maximize efficiency in the overall use of water for irrigation, and 2. irrigate with non-potable water (effluent or brackish water) wherever possible. The target is to maintain irrigation of 200 000 ha country wide. Use of effluent and brackish water is encouraged by lower tariffs (\$0.26/m³ and 0.28/m³, respectively) than the tariffs on potable water (\$0.44/m³). Moreover, each farmer is provided with a restricted amount of potable water per year. If the farmer exchanges part of this volume for effluent or brackish water, an extra 20% by volume of effluent is provided for free. The State of Israel also provides the funding for 60% of pipe-installation costs that are necessary for conveyance of wastewater or brackish water from the source locations to each of the agricultural plots. For the industrial sector, the strategy emphasizes reduced wastage and increased use of treated effluent and brackish water in order to reduce competition for fresh water sources.

Israel aims to achieve full cost recovery and this goal has largely been achieved. However, 35% of agricultural water use is still subsidized, but farmers and government have agreed to full cost recovery by 2017 (OECD, 2011). Another financial concern could be rising desalination costs because of rising energy costs of desalination and long distance transport of water.

A total of 60 Mm³ of (50 Mm³ of treated waste) water have been reserved for environmental use. The allocation is targeted to grow to 95 Mm³ in 2020. The basis for this allocation is not fully explained. Water pollution and deteriorating water quality have given rise to water quality improvement programmes, which have had successes over the last five years (OECD, 2011).

Table 19: Water consumption by sector and source (2010; Mm³)

	Fresh water & desalinated seawater	Brackish water	Treated effluent	total
Domestic use	886	0	0	886
Industry	110	44	13	167
Agriculture	530	96	496	1 122
Exports	116	0	0	116
Environmental water requirements	50	0	0	50
Total	1 692	140	509	2 341

5.0. Appendix E: Consultancy to Review, Develop Training Materials and Pilot the Liquid Waste Management Guidelines In Ngamiland District (Okavango Delta Ramsar Site)

REVIEWED GUIDELINES

PREPARED FOR

THE INTEGRATED WATER RESOURCES MANAGEMENT / WATER
EFFICIENCY PROJECT

BY



P. O. Box 403975, Gaborone

Plot 182 Unit 1 GICP

Phone: 3180216

Fax: 3180218

Email:

info@aqualogic.co.bw

5.1. Introduction

5.1.1. Background

Following a call for tender by the Integrated Water Resource Management / Water Efficiency Project to provide consultancy services for Review, Development of Training Materials and Piloting of Liquid Waste Management Guidelines for Ngamiland District (Okavango Delta Ramsar Site) and subsequent tender evaluation, Aqualogic (PTY) LTD was awarded the consultancy. The guidelines under review were developed in the last quarter of 2011, during the time which the North West District Council (NWDC) was mandated as the authority responsible for managing waste water. The proposed review of the guidelines follows consultations with various stakeholders who identified the need for the evaluation on the basis of on-going water sector reforms in which there has been institutional re-alignment in the water sector. The responsibility to manage wastewater has largely been assigned to Water Utilities Corporation with the Department of Waste Management and Pollution control providing the policy and regulatory framework.

The aims of this consultancy are:

- i) To review the developed Liquid Waste Management Guidelines for Ngamiland in order to make them applicable/replicable to the rest of the country and in line with the changes brought about by the water sector reforms;
- ii) To develop training materials based on the liquid waste management guidelines to be used in training of the various district implementation teams;
- iii) To train the Ngamiland District implementation team for them to be able to pilot the implementation of the guidelines and identify gaps and areas of improvement;
- iv) To facilitate the piloting of the guidelines and utilize the information generated to finalize the liquid waste management guidelines.

5.1.2. Consultancy tasks and deliverables

The specific tasks of consultancy as per the terms of references (ToRs) are:

- i) Review the developed Liquid Waste Management Guidelines for Ngamiland in order to make them applicable and/or replicable to the rest of Botswana in line with the changes brought about by the water sector reforms. More specifically:
 - To conduct a desk study of the developed liquid waste management guidelines
 - To consult stakeholders, in a workshop setup in the review of the liquid waste management
 - To analyze the guidelines in terms of their suitability and ability to pro-actively prevent environmental degradation

- To review the institutional requirements of wastewater management as provided for in the water sector reforms
- ii) Develop training materials based on the reviewed liquid waste management guidelines to be used in training of the district implementation team(s):
- iii) Train the Ngamiland District implementation team for them to be able to pilot the implementation of the guidelines and identify gaps and areas that need improvement:
 - To identify relevant stakeholders to be trained as the implementation team that will oversee the implementation of the guidelines
 - To train the implementation team on implementation of the guidelines
 - Provide guidance and facilitate the piloting of the guidelines by the implementation team:
 - To provide guidance to the district implementation team in piloting the guidelines
 - To identify gaps in implementations of the guidelines with the assistance of the implementation team and use the collated information to finalize the guidelines
 - Prepare final Liquid Waste Management Guidelines for Botswana

The deliverables for the consultancy are:

- a) A report on the revised guidelines based on desktop survey and stakeholder workshop (This Report)
- b) Developed Training Materials and Report on Training of the district implementation
- c) Report on piloting of guidelines indicating gaps, challenges and lessons learnt in implementation of the guidelines
- d) Final Liquid Waste Management Guidelines incorporating all the issues and challenges identified during piloting

5.2. LITERATURE REVIEW

5.2.1. Introduction

This chapter reviews the body of knowledge both published and unpublished with respect to liquid waste management systems particularly in area of similar ecological sensitivity to the Okavango Delta Ramsar Site (ODRS). The literature review covers:

- Background information to liquid waste management systems in the ODRS.

- Technological options for wastewater management and their selection criteria
- Performance of wastewater systems in the ODRS
- Hazardous substances handling, transportation, storage and disposal protocols
- A review of institutional set-up for the wastewater subsector as proposed by water sector reforms
- A critique of the guidelines under review

The outcome of the review will by and large inform stakeholder consultation and input.

5.2.2. Background Information to Liquid Waste Management Systems in the ODRS

In the context of this report, liquid waste refers to any waste material generated by communities that is determined to contain 'free liquids' and shall include sewage from on-site systems and off-site systems (septic tank influent and effluent, conservancy tank influent). It will also cover hazardous wastes that occur in liquid form. This will include controlled waste that has the potential to have significant adverse effects on public health or the environment. But for purposes of this consultancy, hazardous wastes shall focus on fuel (diesel, petrol) and oil (lubricants).

5.2.3. Wastewater Management in the ODRS

McCarthy et al. (2004) established that most safari lodges in the Okavango Delta have been built on the densely forested islands. The majority of the lodges obtain their water from boreholes on the islands close to the lodges, and wastewater is treated and disposed of by means of septic tanks connected to soakaways, that are also close to the lodges. They estimated that lodges typically accommodate between 16 and 24 guests, and the ratio of staff to guests is usually about 2:1, so that at full occupancy, a lodge may entail a community of up to 75 people. The estimated quantity of wastewater generated from such lodges is 15m³/day, which is equivalent to a per capita wastewater generation rate of 200litres/day. Aqualogic (2008) established that wastewater generation rates in the ODRS ranged between 43 and 291litres/capita/day for lodges and cabin resorts, and between 62 and 150litres/capita/day for houseboats.

A study carried out in 2006 by Aqualogic (Pty) Ltd towards the preparation of Solid and Liquid Waste Strategy for the Okavango Delta Ramsar Site established that the wastewater disposal systems at these places are largely on-site, typically comprised of conservancy tank and septic tank-soakaway systems. The conservancy tanks and septic tanks are emptied by private contractors as and when the need arises. Conservancy tanks are also used by houseboats for black water storage, while grey water is directly disposed of into the river. Apart from the conventional septic tank soakaway systems, some establishments have installed a small scale physical/chemical package plant

designed by SIYAGEZA Technologies (Pty) Ltd which involves passing wastewater through a series of tanks that include a primary settling tank, aerobic digester, a secondary settling tank and a chlorination tank. Aqualogic (2008) established the distribution of wastewater management systems in the ODRS as summarized in Table 5-1. The table shows that the septic tank with soakaway system is the most dominant technology in the management of wastewater in the ODRS at 77.5% prevalence.

Table 5-1: Prevalence of wastewater management systems

Wastewater management system	No. of Establishments	% Prevalence of system
Septic tank with soakaway	31	77.5
Septic tank with evaporation pond	1	2.5
Mini activated sludge treatment plant	4	10
Mini activated sludge treatment plant with wetland	2	5
Mini activated sludge treatment plant with sprinklers	1	2.5
Conservancy tank	1	2.5
Total	40	100

5.2.4. Hazardous Wastes

The 2006 study by Aqualogic (Pty) Ltd (Solid and Liquid Waste Management Strategy for the Okavango Delta Ramsar Site) covered used oil as a liquid waste component. In relation to tourism establishments, the study found that the amount of used lubricating oil (engine and gearbox) generated on a monthly basis in lodges and camps varied from approximately 5 litres to 800 litres. The used oil was stored onsite in 20litre or 200litre containers or large overhead tanks until transport was available to take it to Maun for bulk storage and transportation to South Africa for recycling. It also established that, while there appears to be some control in storing the used oil, sand containment areas where used oil was stored, appeared saturated and substantial areas of ground at these sites was contaminated with oil and fuel spillage.

Another study by Aqualogic (Pty) Ltd in 2008 established that the majority of tourism establishments in the ODRS uses 21,400 litres/month of diesel, 9,600 litres/month of petrol and 316 litres/month of oil. At the time, the quantity of used oil generated in the ODRS was estimated at 1,356litres/month, which compared favorably with the quantity of oil brought into the area. The study also established that the main modes of transporting fuel and oil into the delta were road, air and boat. The distribution of transport modes for fuel and oil are summarized in Table 5-2.

Table 5-2:Quantities of fuel by mode of transportation

Mode of transportation	Type of fuel			Total (L/month)	Proportion (%)
	Oil (L/month)	Petrol (L/month)	Diesel (L/month)		
Road	1052.8	7680	17120	25852.8	80
Air	157.92	1152	2568	3877.92	12
Boat	105.28	768	1712	2585.28	8
Total	1316	9600	21400	32316	100

5.2.5. Technological options for wastewater management and selection criteria

The selection of an onsite technology is primarily influenced by site conditions. In addition to site conditions, the suitability of onsite technology will also depend on the expected wastewater generation rates, desirable effluent quality, construction costs and maintenance requirements. Site conditions, desirable effluent quality and construction costs are often the limiting factors on technology selection. For purposes of technology selection, site conditions are often classified into normal site, difficult site and adverse site (see Table 5-3). The NMPWWS developed an on-site sanitation decision making flowchart. While the flow chart is a useful guideline, it falls short of detailed characterization of site condition based the variables as tabulated in Table 2.3. This is important in this case since, the ODRS is an ecological sensitive environment and generic definition of the vulnerability of site conditions may not be suitable. A discussion of suitable technologies for different site conditions is presented below.

Table 5-3:Basic requirements of disposal sites falling into three major groups

Requirements	Normal site	Difficult site	Adverse site
Soil texture	Coarse to medium sand, fine sand, sand loams, porous silt loams	Silt clay, loam, porous silt loam, silt clay loam	Clays, colloidal clays, expansive clays
Flooding	None	Rare	Common
Slope (%)	0 - 8	8-15	>15
Depth to bedrock (m)	>2	1-2	<1
Depth of high water table below bottom of disposal field (m)	>2	1-2	<1
Permeability (cm/h)	5 - 150	0.5-5	<0.5

Source: Qasim (1999)

5.2.6. Normal site conditions

In the cases where the site conditions depict normal characteristics, the use of conventional septic tank and disposal of effluent by soakaway pit using gravity flow can be used. Table 5-4 gives typical design guidelines that should be followed for the septic

tank system to be effective. Generally the septic tank should be watertight and be fitted with proper inlet and outlet devices such as outlet tee and effluent vault. In cases where a screen vault is not used, it should have two compartments. In addition to specific requirements for the tank itself, fat traps (floatation tanks similar to septic tank) should be installed at heavy oil and grease containing streams. A detention time of 30 minutes is recommended for effective floatation of grease.

Table 5-4: Guidelines for design of septic tank

Design Parameter	Unit	Typical
Liquid Volume		
Minimum	m ³	2.5
1-2 bedrooms	m ³	2.5
3 bedrooms	m ³	4.5
4 bedrooms	m ³	5.7
5 bedrooms	m ³	5.7
Additional bedrooms	m ³	1.0
Number of compartments	No.	2
Volume distribution in compartments	% (total) 1 st , 2 nd	67, 33
Length to width	ratio	3:1
Depth	m	1.5
Clear space above liquid	cm	25
Depth of water surface below inlet	cm	8
Inspection ports	No.	2
Inlet and outlet devices	No.	1 each

Adapted from Qasim (1999)

Figure 5-1 shows a typical cross-section of a 2-compartment septic tank that could be used in the Okavango Delta. The 2-compartment septic tank provides an enhanced settlement of solids. The septic tank should be coupled with a gravity flow soakaway, constructed as per cross-section shown on Figure 5-2. The cross section profile is expected to control the rate of water infiltration into the soil, thereby providing further treatment of the effluent. In terms of operation and maintenance, the tank should be emptied regularly, depending on its capacity and amount of wastewater flowing into the tank. For properly designed tanks, emptying should be done approximately every three years. The sludge from the tank should be taken to a wastewater treatment facility.

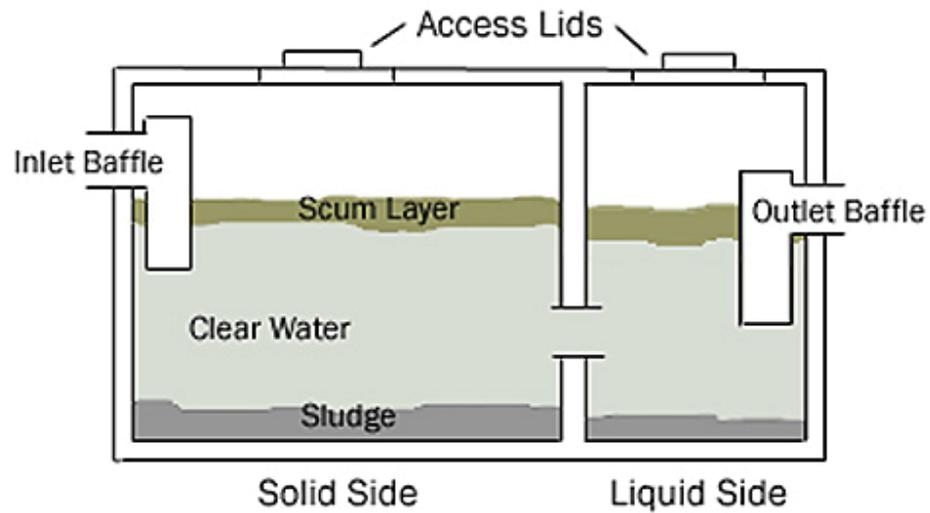


Figure 5-1: Typical 2-compartment septic tank

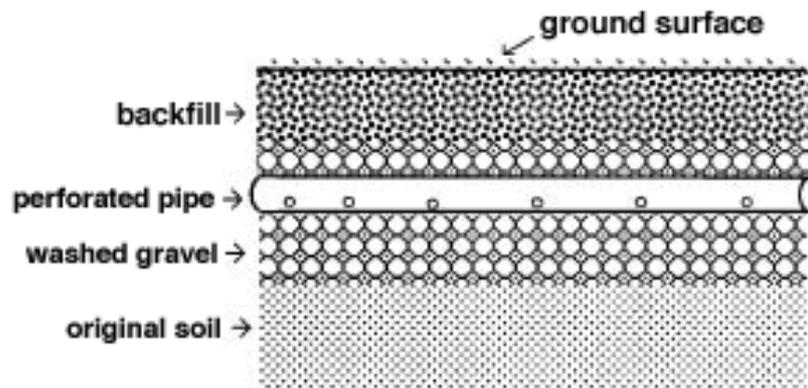


Figure 5-2: Typical cross-section of soakaway

5.2.7. Difficult Site Conditions

In cases where site investigation reveals difficult site conditions, the conventional septic tank coupled with a gravity fed soakaway pit is considered inappropriate. This is primarily because the effluent quality from the septic tank is not satisfactory for existing subsoil disposal. In such cases, further treatment of effluent will be necessary. The technological options that could provide further treatment of effluent in difficult site conditions are listed in Table 5-5 and their brief profile described in Appendix 1. A comparative analysis of the systems suitable for difficult sites based on relative costs, maintenance requirements and removal of potential pollutants is presented in Table

5-6. On the basis of the comparative analysis, a septic tank system coupled with a constructed wetland presents more opportunities for difficult site conditions.

Table 5-5: Applicability of alternative on-site wastewater treatment systems for difficult conditions

System	Site conditions					
	Normal	Low soil permeability	Shallow soil over impervious layer	Shallow soil over fractured bedrock	High soil permeability	High water table
Septic tank with conventional disposal field (soakaway)	Yes	Yes	No	No	No	No
Septic tank with conventional disposal field with pressure distribution	Yes	Yes	No	No	No	No
Septic tank with trench and bed or leaching chambers	Yes	Yes	Yes	Yes	Yes	Yes
Septic tank with intermittent sand filters	Yes	Yes	Yes	Yes	Yes	Yes
Septic tank with a mound system	Yes	Yes	Yes	Yes	Yes	Yes
Septic tank with evapotranspiration and absorption beds	Yes	Yes	Yes	Yes	Yes	Yes
Septic tank with re-circulating intermittent sand filter, using percolating trench	Yes	Yes	Yes	Yes	Yes	Yes
Septic tank with constructed wetlands	Yes	Yes	Yes	Yes	Yes	Yes

Adapted from Metcalf and Eddy (1991)

Table 5-6: Comparative analysis of on-site wastewater treatment systems

System	Cost Ranking*	Maintenance	Ability to remove					
			BOD	COD	TSS	P	N	Heavy metals
Septic tank with trench and bed or leaching chambers	2	minimal	x	x	√	x	√	x
Septic tank with intermittent sand filters	1	minimal	√	x	√	x	√	x
Septic tank with a mound system	3	regular/minimal	√	x	√	x	x	x
Septic tank with evapotranspiration bed	5	minimal	√	x	√	x	x	x
Septic tank with re-circulating intermittent sand filter, using percolating trench	4	regular/minimal	√	x	√	x	√	x
Septic tank with constructed wetlands	2	minimal	√	√	√	√**	√**	√

* The ranking of the cost is based on single family requirements and are dependent upon availability of materials (1 – relatively cheap; 5 – relatively expensive)
 ** Achieved with longer detention time
 Adapted from US EPA (2000).

Another possible option for difficult site conditions is small scale pre-fabricated treatment plants. These are commonly used for wastewater flows between 38,000 and 950,000 litres/day. Currently there are a number of establishments using and intending to use a physical/chemical package treatment plant. Even though the effluent from the package treatment plants already in situ does not meet the BOBS 93:2004 limits, the plants significantly remove BOD and TSS (Aqualogic (2008)). Apart from that, one of the advantages they present is that they could be incremental in construction depending on wastewater generation rates. The limiting factor to install these systems could be construction costs.

5.2.8. Adverse site conditions

In cases where site investigations reveal adverse conditions, subsurface disposal of effluent may be difficult or even impractical. The key guiding principle for adverse conditions is to reduce wastewater flow into the environment. In such cases, non-

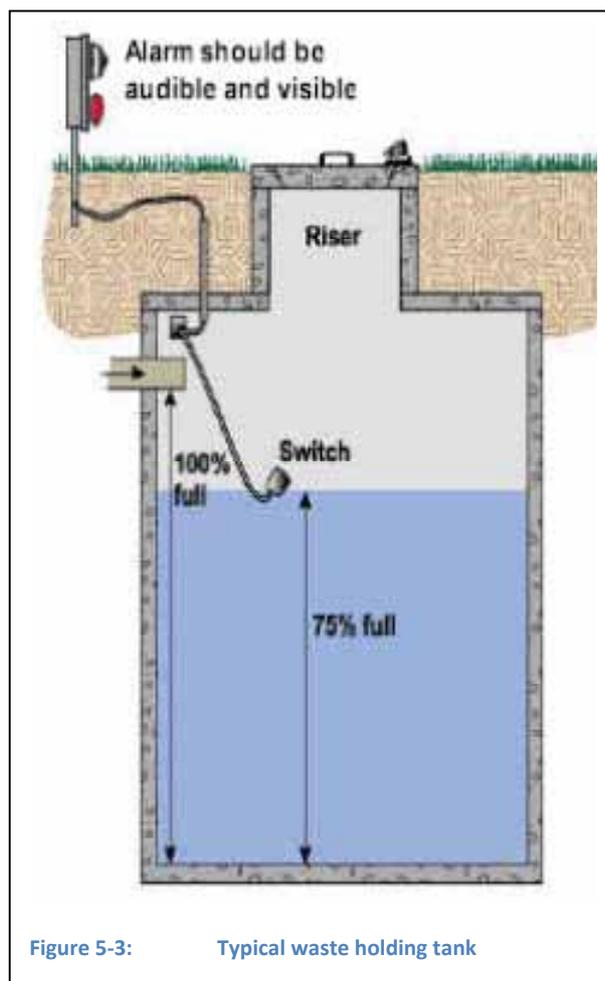


Figure 5-3: Typical waste holding tank

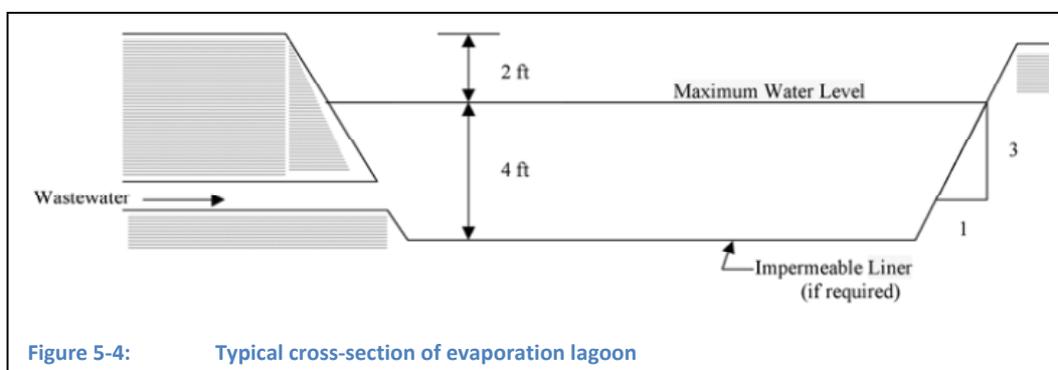
discharge technology is often applied to meet the basic needs of onsite disposal. Among the technologies suitable for adverse site conditions are holding tanks, evaporation lagoons and waterless toilets.

A conservancy or holding tank or vault receives water from an establishment and stores it until it is pumped out and hauled to a receiving/processing facility. It is watertight and has no outlet piping that allows effluent into the environment. The tank should be equipped with an audible and visible high-water alarm, which alerts the operator to the need for pumping. Figure 5-3 shows a typical wastewater holding tank. For effective use of the holding tank, there should be reliable transport to haul its contents from site.

Evaporation lagoon treatment

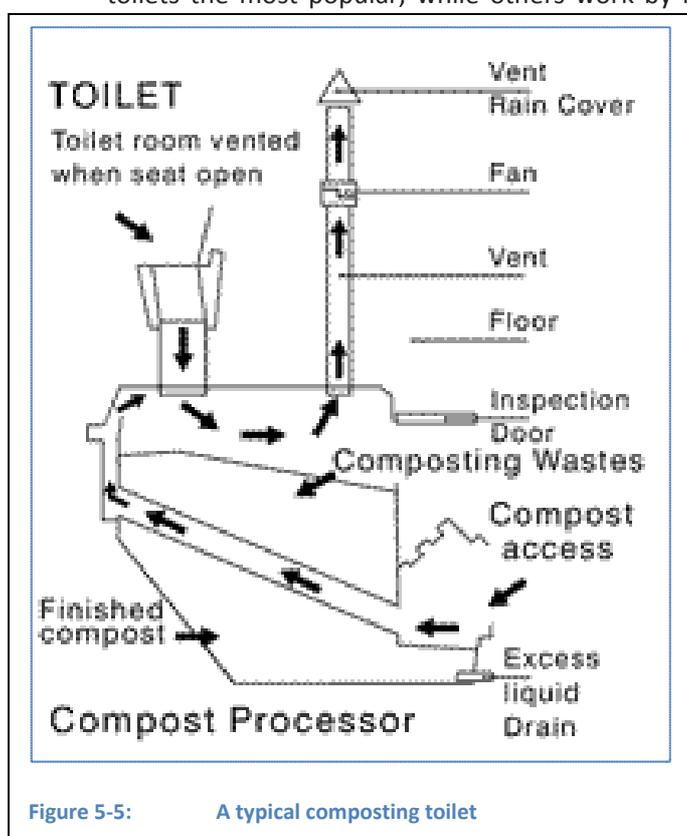
provides for a series of septic tanks or other treatment systems to discharge effluent into the lagoon. Sunlight and long

storage time support the natural breakdown of the waste and kill off harmful organisms. In some cases water can be allowed slowly to seep into the soil, while in others an impermeable membrane could be provided to prevent seepage into the ground and



only allow for evaporation. The disadvantage with this type of technology is that it requires a large space, depending on the quantity of influent to be managed. Figure 5-4 shows a typical evaporation lagoon.

Waterless toilets are a common technology often promoted by proponents of ecological sanitation. Various waterless toilets are currently being marketed with composting toilets the most popular, while others work by incinerating fecal matter. Because the



systems do not require water, they reduce the quantity of wastewater to be disposed of onsite. They also pose little contamination risk for groundwater. Their main disadvantage is that removing the end product is often difficult if they are not properly installed and maintained. Apart from that, the system cannot dispose of grey water. In the case of the Okavango Delta, one of the limiting factors for their use could be the market for the final compost. Figure 5-5 shows a typical composting toilet.

5.2.9. Performance of Wastewater Management Systems in ODRS

A study by Aqualogic (Pty) Ltd in 2008 assessed the performance of the installed wastewater management systems of physical/chemical package treatment plant and the various septic tank systems. Analysis of efficiency was based on generic information on influent quality from various wastewater sources (Metcalf and Eddy 1991; Qasim 1999). Table 5-7 shows the removal efficiency of various pollution parameters by the two dominant systems in the ODRS. The table shows that the two technologies of conventional septic tank and physical/chemical package treatment plant have the potential to remove up to 100% of nitrates. On the other hand, physical/chemical treatment plant achieves relatively high removal rates of BOD and TSS and septic tank achieves over 50% removal of BOD, COD and Total P. The removal efficiencies of the septic tank for BOD and TSS are comparable to theoretical expectations. Apart from that, the conventional septic tank significantly increases COD, TSS and Ammonia-N in some cases. This characteristic weakens its competitive edge over the physical/chemical treatment plant. However, both the septic and the physical/chemical treatment plant offer significant removal of some pollutants in wastewater. The differential between the two technologies could mainly lie in the quantity of influent to be treated and/or the cost.

Table 5-7: Removal efficiency ranges from different systems

Parameter	Average concentration (raw sewage) mg/L	Physical/chemical package plant		Septic tank	
		Highest (%)	Lowest (%)	Highest (%)	Lowest (%)
BOD	370	95	84	57	19
COD	500	18	8	52	-84
TSS	419	73	64	48	-64
Total P	9	15	-18	98	-45
Ammonia-N	35	23	-9	-17	-531
Nitrate	<1	100	98	100	60

5.2.10. Hazardous Substances Handling, Transportation, Storage and Disposal Protocols

Box 1 shows best practices for transportation, handling and storing hazardous substances. These practices have been adapted from international best practices around the world. The expectation is that all people who handle these substances should be aware of these procedures and precautions.

5.2.11. Contingencies for Fuel Spills

Transportation of fuel, particularly on difficult roads such as the ones in the Okavango delta, has the potential to result in leakages and spills. Apart from transportation, vehicle service areas and/or leaking storage facilities have the potential to contaminate the surrounding environment. In order to minimize potential environmental harm, it is important that spills are contained and areas affected be treated. The following procedure should be followed in case of spillage.

Box 1: Best practices for transportation, handling and storing hazardous substances

Transportation

- i) Drums and truck-box fuel tanks are acceptable methods of transporting oil and fuel;
- ii) All vehicles carrying fuel should have at least one 20 B:C rated portable fire extinguisher;
- iii) Drums and fuel tanks should be filled to a recommended level of 90%;
- iv) The load should be secured in a manner which ensures that;
 - It does not escape from the vehicle
 - It does not shift or sway in a manner that may affect the operation of the vehicle

Storage

- i) Fuel storage tanks, whether aboveground or underground should be located down slope from water sources;
- ii) Locate aboveground tanks over an impermeable liner made of concrete or other synthetic materials;
- iii) All underground tanks should be coated with fiberglass to prevent corrosion or use fiberglass tanks instead;
- iv) Aboveground tanks should be made of high quality steel;
- v) Fuel tanks should have spill and overfill protection
 - Spill protection typically consists of a catch basin for collecting spills when the tank is filled;
 - Overfill protection is a warning, such as a buzzer or an automatic shutoff, to prevent an overflow when the tank is filled.
- vi) Store hazardous substances such as paints and wood preservatives in the original container;
- vii) Store similar products together to reduce any danger from reactions in case of leakage or spill;
- viii) Store substances in a well-ventilated area;

Handling and disposal

- i) All containers storing hazardous substances should be in a good condition and clearly labeled
- ii) Containers and tanks should be closed and sealed except where a hazardous substance is being added or removed from the container;
- iii) Storage tanks at marine fuel dispensing stations must be located 4.5m horizontally from the normal annual high-water mark;
- iv) Solid piping must be used between storage tanks located on shore.
- v) Use a funnel when transferring substances between containers;
- vi) Provide a stable platform for fueling;
- vii) Follow the directions for storage on the label;
- viii) Used oil should not be mixed with other hazardous substances;
- ix) Never burn, dump or bury hazardous waste;
- x) Do not flush wastes down sink or toilet
- xi) Do not pour hazardous waste into ditches, storm drains or gutters
- xii) Completely drain all oil filters to ensure that they do not contain hazardous substances

- Stop the spill: Turn off the nozzles or valves from the leaking container, if it can be done safely. Use a wooden plug, bolt, band or putty on a puncture-type hole.
- Contain and retain the spill: If the spill or leak cannot be stopped, catch the flowing liquid using a pan, shovel, bucket or whatever is available. Spread sorbent material such as wood chips or Peat Sorb to stop the flow and soak up the fuel.
- Collect the contaminated sorbent: Brooms can be used to sweep up the sorbent material and put it into buckets, garbage cans. In addition, fresh granular sorbent such as sand can then be re-spread on a roadway to control residual slipperiness.

Transporters of fuel should carry fuel spill kits all the time they are transporting hazardous substances to enable them to contain fuel and oil spills immediately they occur.

5.2.12. Risk assessment for fuel storage facilities

Fuel (diesel and petrol) is the most common hazardous substance transported and stored in the Okavango Delta. In order to avert some of the risks that its storage poses, Aqualogic (2008) recommended that a minimum risk assessment should be undertaken by the operators. The objective of the risk assessment was to help the operators understand the level of risk they are taking in managing their fuel facilities, for purposes of taking appropriate risk control measures. Table 5-8 provides a simple risk-ranking framework adapted from Ministry of Water, Land and Air Protection, British Columbia (2002). A risk-rank value (3 for high, 2 for medium and 1 for low) is assigned for each of the risk identification categories indicated in the left column of Table 5-8. After assigning the risk ranking values, the values are added to arrive at the total risk-ranking value for the fuel storage facility.

In order to establish if risk control measures are necessary, the Total Risk Rank Value determined in Table 5-8 is used to establish appropriate levels of effort to mitigate the risks at the fuel handling facility by using the recommended risk control measures in Table 5-9.

Table 5-8: Risk-ranking framework for hazardous substances

Risk identification category	Risk Rank High	Risk Rank Medium	Risk Rank Low	Assigned Risk Rank Value
Numerical Value	3	2	1	
Environmental				
Distance to the nearest water course	< 50m	50m – 100m	> 100m	
Characteristic of the soil at the fuel facility	Porous or unknown	Semi-porous	Non-porous (Clay or bedrock)	
Slope of terrain surrounding the fuel facility	> 6%	2% - 6%	< 2%	
Operational				
Site designation or description	High traffic road	Low traffic road	No through traffic	
Duration of facility operations	> 6 days	2 – 6 days	< 2 days	
Volume of fuel stored at the facility	>4500L	500L – 4500L	< 500L	
Number of times the fuel facility is used per day	> 12 times/day	6 – 12 times/day	< 6 times/day	
Amount of traffic around the fuel facility	> 15 people on site	5 – 15 people	< 5 people	
Prevention/Preparedness				
Distance to additional spill cache	> 60 minutes	15 – 60 minutes	< 15 minutes	
Additional spill control	Tank with no secondary containment	Tank with secondary containment	Tank with secondary containment & additional spill control	
Last spill training session for those handling fuel	Operator not trained in > 2 years	Operator not trained in 1 - 2 years	Operator not trained in the last year	
Total Risk-Rank Value (Total of the assigned Risk Values)				

Adapted from Ministry of Water, Land and Air, British Columbia (2002).

Table 5-9: Recommendations on Risk Control Measures

Numerical Value	Risk Ranking	Recommendations on Risk Control Measures
< 12	Low risk	No control measures are necessary
12 - 23	Medium Risk	Additional control measures should be considered to reduce risk
> 23	High Risk	a) Additional controls are necessary to reduce risk b) Consider moving the fuel facility

Adapted from Ministry of Water, Land and Air, British Columbia (2002).

5.2.13. A review of institutional set-up for the wastewater subsector as proposed by water sector reforms

The National Water Master Plan Review of 2005/06 proposed a four tier institutional setup for the water sector that is to consist of:

- Government represented by Department of Water Affairs (DWA) and charged with the responsibility of developing water resources;
- Water Resources Council (WRC) that is responsible for water rights and discharge permits;
- The regulatory authorities consisting of Department of Waste Management and Pollution Control (sanitation), Price Regulator, National Water Resources Manager (secretariat to WRC) and Local Community Organizations (advisory);
- Service Delivery Agencies (Water Utilities Corporation (WUC) and Urban Village Water Corporation for towns and major villages, Local Authorities and Other Holders of Water Rights and Discharge Permits.

The proposed institutional setup quite distinctly provides for the establishment of resource development as well as regulatory and service delivery institutions. The local authorities such as North West District Council have also been given a service delivery role as they are currently set-up in the area of water supply and sanitation. The service delivery role given to local authorities is in small settlements and other areas that fall outside the Major Village categorization. However, provision of water and wastewater to settlements particularly those not gazetted has not been finalized between WUC, Ministry of Minerals, Energy and Water Resources and Ministry of Local Government. This would essentially include most settlements within the Okavango Delta Ramsar Site.

The new institutional structure provides for licensing for water rights and wastewater discharge. However, such licensing has been located at the level of the Water Resources Council and the Tourism Industry Licensing Board that have an indirect link with service providers, particularly local authorities. This may create a disjuncture in that the local authority may not directly monitor compliance of the wastewater generators to the set conditions in the discharge permits. At a practical level, the licensing and discharge permits should as well as monitoring for compliance with the license conditions be located within the same institution. The appropriate institution in this case would be the Department of Waste Management and Pollution Control (DWMPC), which may have delegated licensing responsibility from the Water Resources Council. This is further buttressed by that DWMPC have established some level of expertise within the area of wastewater management. To enhance its role in its licensing and monitoring mandate, it may be necessary to improve both infrastructure and human resource capacity. But more importantly, this new role should be supported by an appropriate legislative regime. The Botswana National Master Plan for Wastewater and Sanitation (GoB 2003)

proposed a Wastewater and Sanitation Management Bill of 2003 to deal with among others issues of licensing and regulating wastewater management facilities. The draft bill was done in 2003 but has not reached parliament. This report could further enhance the draft bill in terms of refining the licensing requirements.

5.2.14. A critique of the guidelines under review

The guidelines under review were completed in September 2011. They are very comprehensive and at times the level of detail and scenario options provided may make them difficult to comprehend and apply, hence undermine their intended purpose. To facilitate their effective implementation, they may require simplifying. They are mainly steeped in establishing a regulatory regime of licensing and monitoring. The main objective of the guidelines is to provide a framework for managing liquid waste in the Okavango Delta Ramsar Site to mitigate possible environmental damage. The framework is expected to:

- Determine appropriate liquid management systems in the ODRS taking into consideration site characteristics and liquid waste volumes.
- Regulate and give guidance to various stakeholders who operate or may want to operate liquid waste management facilities in the ODRS.
- Designate the overall authority responsible for the implementation of the guidelines.

Any critique of the guidelines for purposes of their review should address the three elements, as stated above, of technology selection, regulation and monitoring and institutional responsibilities.

5.2.15. Technology selection

Technology selection was based on two major considerations of: volume of wastewater generated and site conditions classification. Three categories of wastewater generation rates of Small (<5m³/day), Medium (5 -200 m³/day) and Large (>200m³/day) have been proposed, with facilities generating higher wastewater generation rates requiring rigorous obligations. This categorization is considered appropriate for technology selection and regulation.

However, the guidelines under review have adopted a different nomenclature for site conditions classification from that commonly used in literature (Qasim, 1999). Sites have been classified into Wetland upstream, Wetland delta, Wetland downstream and Non Wetland for site classification (referred in the guidelines as habitat types) for purposes of setting procedural requirements and technology selection to avert risk to the environment. The primary consideration for such classification was the level of pollution threat posed by disposal of waste effluent into the environment. If we consider that the

categorization of site conditions into normal, difficult and adverse is also based on the level of pollution threat, with normal site characterized by low level of pollution risk and adverse characterized by high level risk, it is logical to merge the two site conditions classification systems as summarized in Table 5-10 to take into consideration the conventional practice in the ODRS.

Table 5-10: Site conditions classification

Convention classification	Classification in the ODRS	Level of threat
Normal site	Non wetland	Moderate risk due resilience of land systems to wastewater pollution
Difficult site	<ul style="list-style-type: none"> • Wetland upstream • Wetland delta 	<ul style="list-style-type: none"> • Medium risk due to high dilution rate • Medium due to capacity of wetlands to absorb nutrients
Adverse site	Wetland downstream	High due to low dilution rate hence justifying the need for stringent controls

An application of two variables of volume of wastewater and site condition classification was used to identify the different wastewater management technologies that may be suitable for each situation. The proposed menu of proposed technologies is considered appropriate. However, the presentation of technology selection procedure in tabular form as presented in the guidelines looks rather complicated and not readily usable. It is proposed that a decision algorithm presented by way of a flow diagram should be used to simplify and guide technology selection.

5.2.16. Regulatory proposals

The guidelines propose that large wastewater management facilities generating in excess of 5m³/day of wastewater should be licensed. The object of the licensing exercise is mainly to:

- Allow the regulatory body to assess the conditions of the suitability of the wastewater management technology for the site;
- Assess the adequacy of the proposed wastewater management system in terms of design, construction, operation and maintenance;
- Enable compliance to license conditions through continuous monitoring of effluent quality, sludge levels and management.

Licensing of wastewater management facilities is normal practice in other jurisdictions. However, it is understandable that the smaller facilities generating under 5m³/day of wastewater, which are predominantly individual households, are exempted from such licensing because the Development Control Code regulations already have provision for such facilities in areas declared planning areas. Apart from that, the process of licensing

them could overwhelm the licensing authority because of the sheer numbers of applications that may arise from this requirement. Furthermore, the proposal for licensing appears to be targeting new establishments, which raises the question of what happens to existing establishments in terms of compliance to the set guidelines. There appears to be no recognition in the guidelines that existing establishments have established environmental management plans, with wastewater management being one of the issues addressed by the plans. More importantly, there is no legislative regime that supports the licensing of wastewater management facilities.

In addition, the proposals for monitoring place emphasis on the effluent quality meeting BOS 93:2004 standards. Previous work by Aqualogic (PTY) LTD referred to in this report indicates that most of the effluent from facilities in the ODRS does not meet BOS 93:2004 requirements, which themselves appear stringent compared to standards in other jurisdictions. A strict requirement to comply with BOS 93:2004 may not be practically feasible. Apart from that, there is limited capacity in Maun for laboratory work to carry out effluent analysis.

5.2.17. Institutional responsibilities

The majority of institutional responsibilities have been assigned to the Water and Wastewater Department (WWD) of North West District Council. The responsibilities include:

- Discretionary opinion on site selection;
- Approval of wastewater technology management system;
- Approval of system design;
- Approval of construction;
- Approval of system operation and maintenance plan;
- Monitoring effluent quality and its adherence to BOS 93:2004
- Regular inspection to ensure compliance with license conditions
- Approval of surrender of license.

Clearly, these responsibilities require streamlining. Some of them should fall within license conditions. Apart from that, WWD does not have capacity to carry out some of the enumerated responsibilities. For instance, it would be extremely difficult for WWD to monitor effluent quality when they do not even have an operational laboratory. While WWD has been given the responsibility to approve surrender of license, the guidelines propose four different authorities of NWDC, Department of Water and Wastewater (WWD) of NWDC, Water Utilities Corporation and Department of Waste Management and Pollution Control (DWMPC) playing one role or the other in licensing:

This arrangement could limit clarity of roles and impede the licensing process. It is important that there should be a single authority responsible for licensing and monitoring of compliance to the set license conditions. In this case, the Department of Waste Management and Pollution Control with their set mandate appears to be the appropriate authority. They are already seized with enacting legislation that will regulate wastewater management. If anything, they may delegate some of their responsibilities to WWD on the basis of practicality such as regular inspections to assess compliance with the license conditions.

5.2.18. Guidelines on Hazardous Waste

Guidelines on managing hazardous waste appear comprehensive. They address almost all the key issues of:

- Transportation
- Handling and
- Storage

However, they could also be presented in a more abridged form to enhance clarity.

5.3. STAKEHOLDER CONSULTATION

The stakeholder consultation workshop was conducted on 8th October 2012 at Maun Lodge in Maun. The minutes of the workshop and list of attendees are attached in Appendix 1. Preliminary observations were that while the purpose of the workshop was to review the guidelines, the majority of stakeholders at the workshop never saw them, which raised issues of broader dissemination. Furthermore, those who were aware of the guidelines never used them. It was also reported that, the majority of stakeholders who participated in developing the guidelines under review were not at the workshop, mostly having moved to other career responsibilities. In order to bridge this gap, the consulting team highlighted the key issues in the guidelines to generate informed input and dialogue. That notwithstanding, it would have been ideal to review the guidelines after they have been put to use after a period of about a year or so.

5.3.1. Outcomes from stakeholder consultations

From the ensuing discussion after the presentation of the guidelines, the following issues could be discerned:

- That the guidelines were too voluminous, stringent and complicated to not readily lend themselves for easier application. It was suggested that they should be simplified and made more applicable by reducing the amount of detail.

- That the guidelines seem to be primarily geared towards those establishments that intend to install new wastewater management facilities. It was proposed that the guidelines could also be used to audit the existing facilities for purposes of taking appropriate remedial action where necessary. Secondly, establishments that already have existing wastewater management facilities would be expected to comply with the guidelines on renewing their tourism leases. This proposal however would not be applicable to government institutions since they have no leases to renew, may require a separate dispensation for compliance.
- There was a general concern particularly from the tourism industry that another type of license may not be necessary because they already have Environmental Management Plans (EMP) for their establishments dealing with issues of wastewater management and would prefer a situation where a single authority deals with all issues on licensing their operations. This point of view was rather contradicted by representatives of government institutions, who were more in favour of the guidelines being compulsory and supported by legislation. It was proposed that there should be reference to how the guidelines will link with the existing EMPs.
- The responsibilities assigned to the Water and Wastewater Department (WWD) of NWDC as the licensing and monitoring authority was considered misplaced since the regulator authority in wastewater issue is the Department of Waste Management and Pollution Control (DWMPC). Furthermore, WWD was considered to have limited capacity to carry out some of the assigned responsibilities. It was proposed that DWMPC be given the licensing and monitoring responsibilities.
- It was also proposed that if it should be considered that most government institutions do not have capacity to carry out regular monitoring, it would be better for the establishments to do self-monitoring and reporting. The frequency of such reporting should be specified. DWMPC could then randomly select certain establishments for monitoring, say once in a year for purposes of quality assurance of the established self-monitoring regime.
- While the guidelines were more steeped on licensing and ensuring compliance to license conditions, it was observed that there is no legislation to support licensing.
- That the guidelines appear contradictory as to the licensing and monitoring facilities that generate less than 5m³/day of wastewater. The meeting agreed that these facilities should be exempted from licensing since they are already regulated by the development control code.
- That it was not clear if the transportation of hazardous waste into the ODRS was regulated other than just ensuring that the transporting vehicles are roadworthy as is the convention requirement for any vehicle that uses the roads.

5.3.2. SYNTHESIS AND CONCLUSION

There appears to be a convergence of the issues identified by the consultants and the stakeholder workshop. In particular:

- The voluminous and detailed nature of the guidelines that made them difficult to comprehend and use;
- Simplifying the process of technology selection;
- Unclear mandates, roles and responsibilities
- Creating synergy between using the guidelines for new and existing facilities
- Creating linkages between the guidelines and existing environmental management protocols such as EMPs.
- Streamlining the issue of licensing and refining the issues that will form the license conditions.

The reviewed guidelines should focus on addressing these issues.

5.4. LIQUID WASTE MANAGEMENT GUIDELINES

The fundamental requirement for managing liquid waste to minimize environmental pollution is to select the appropriate liquid waste management technology that could effectively reduce the pollution load in influent. The selection of the appropriate technology depends on two main considerations of:

- Quantity of liquid waste generated and;
- Site conditions where the liquid waste management facility is to be constructed and effluent discharged underground or into receiving water bodies.

By and large, these considerations for technology selection should also be used to determine whether the construction of such a facility needs to be regulated and the nature of mechanisms that are required to effect such regulation.

In reviewing the guidelines, a major consideration was to consider the objectives that each set of requirements is intended to achieve. In particular the reviewed guidelines seek to:

- Identify the pollution risk of constructing the liquid waste facility on the basis of quantity of liquid waste generated and site classification based on sensitivity.
- Select the appropriate liquid waste management technology based on liquid waste generated and the existing site characteristics.

- Establish whether a license is required for construction of liquid waste management facility and set out the procedure for such application where required.
- Establish key components of a license application report where it is required.
- Set out license conditions to be complied with for liquid waste management.
- Establish liquid waste parameters that are to be reported and monitored.
- Monitor adherence to the set license conditions.
- Establish self-monitoring procedures for existing liquid waste management facilities.
- Establish liquid waste management protocols for mobile safaris and houseboats
- Assign institutional responsibilities for managing liquid waste.
- Establish precautionary protocols for transportation, storage and emergency spillage response for hazardous waste
- Streamline responsibilities institutional responsibilities for managing hazardous waste

Figure 5-6 presents the conceptual framework for the reviewed guidelines. The framework details process links, defines the role of the actors and identifies areas where remedial measures may be required. It is anticipated from the framework that operations applying for new tourism licenses or renewals should submit along their application an approved liquid waste management facility license.

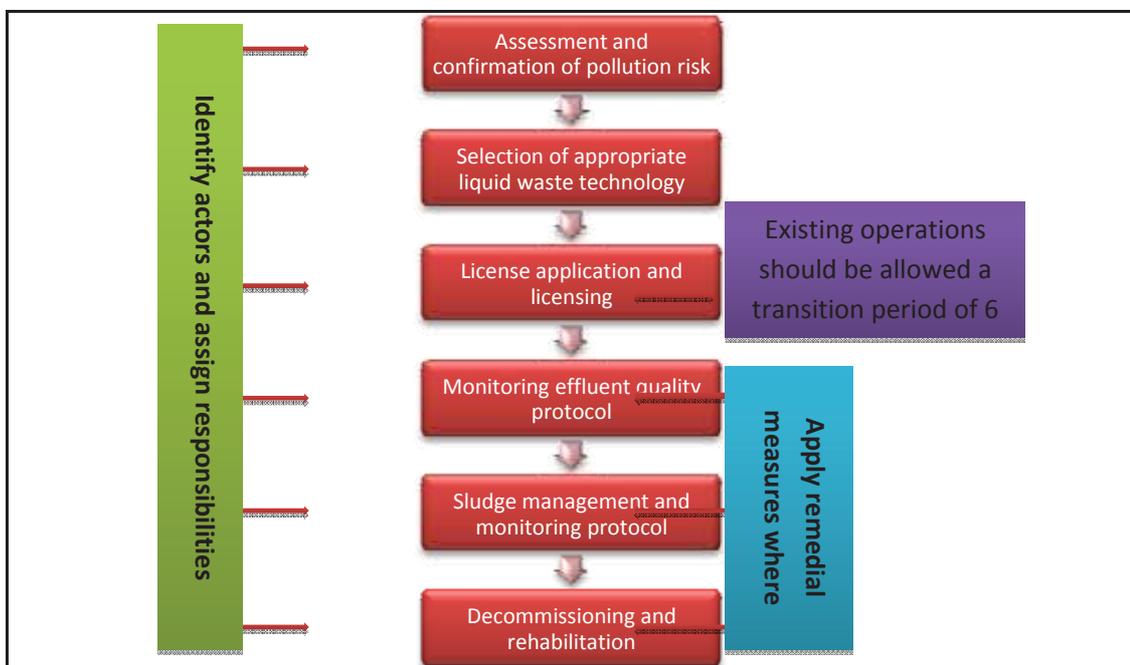


Figure 5-6: Conceptual framework of the reviewed guidelines

5.4.1. Guidelines for Assessing Pollution Risk

Table 5-11 shows a cross-tabulation of the quantity of liquid waste generated and site classification based on its ability to neutralize a contaminant. The cross-tabulation enables generation of a matrix that objectively assesses pollution risk potential. The tables shows that where the volume of liquid waste generated is high, there is an enhanced possibility of a high pollution load, hence an increased risk of pollution. The risk would even be higher if the site conditions are vulnerable and/or unable to effectively neutralize the contaminant. The robustness of such site conditions would often be based on evaluating indicators such as soil texture, vulnerability to flooding, slope, depth of bedrock, depth of ground water table below bottom of disposal filed and permeability (see Appendix 2). The matrix in Table 5-11 shows that the emphasis on site selection, licensing, monitoring and reporting should be where the risk for pollution is medium to high. This is mainly where the liquid waste generation rate is greater than 5m³/day and the sites are either classified as difficult or adverse. In the case where the pollution risk is considered low all technologies are considered suitable.

Table 5-11: Pollution risk based on quantity of liquid waste generated and site classification

Liquid Waste Generation Rate (m ³ /day)	Site Classification		
	Normal (Non Wetland)	Difficult (Wetland Upstream and Wetland Delta)	Adverse (Wetland Downstream)
<5 (Small)	Low	Low	Low
5 – 200 (Medium)	Low	Medium	High
>200 (Large)	Medium	High	High

Summary of guidelines for risk assessment

Guideline 1: Assess the level of risk based on Table 5-11

Guideline 2: Confirm the level of risk by obtaining coordinates of the site and superimposing them on groundwater vulnerability map

5.4.2. Guidelines for technology selection

The primary considerations for technology selection are the quantity of liquid waste generated and site classification. Figure 5-7 shows a flow diagram that should guide technology selection based on consideration of the two parameters. The emphasis of the flow diagram is where the pollution risk is considered medium to high (see Table 5-11). While a number of technologies are deemed suitable under most circumstances,

construction and operations costs would influence the final choice of the technology from the perspective of the developer.

Summary of guidelines for technology selection

Guideline 1: Follow the flow chart (Figure 5-7) to identify suitable technologies for the site under consideration on the basis of the possible pollution risk.

Guideline 2: Where the risk is considered low, all technologies are considered suitable.

Guideline 3: In the case where a conservancy tank is used, there must be provision for vacuum tanker services

Guideline 3: Final decision on technology will depend on affordability to the developer.

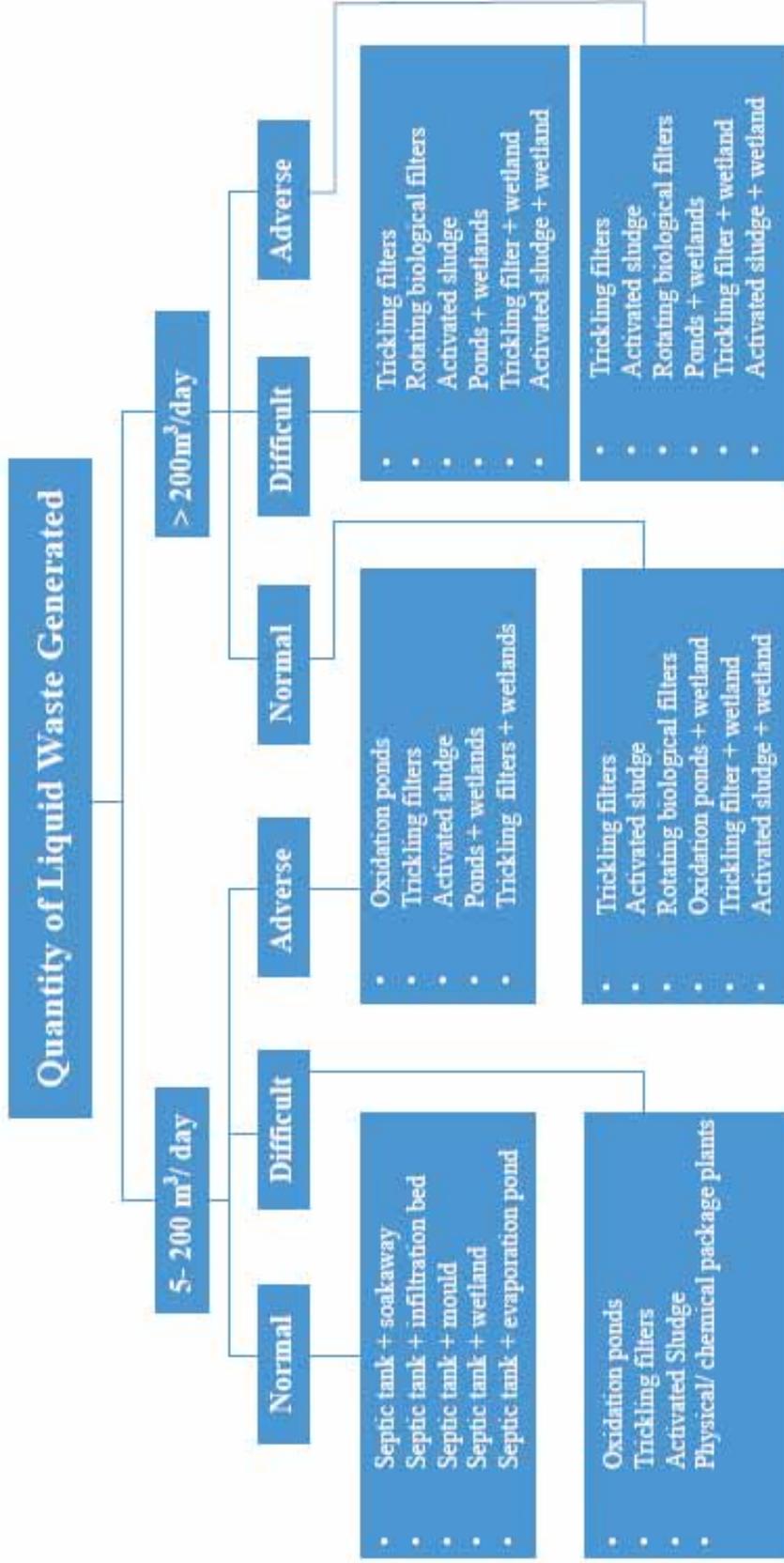


Figure 5-7: Flow diagram for technology selection for medium to high pollution risk

5.5. Guidelines for Licensing of Liquid Waste Management Facilities

Licensing of liquid waste management facilities allows for setting out control measures and for assessment of suitability of such facilities in different sites and monitoring of their performance. The decision on whether a facility requires licensing will depend on the potential risk of pollution (see Table 5-11).

Summary of guidelines for licensing

Guideline 1:	All liquid waste management facilities posing a medium to high risk to the environment need to be licensed by a competent authority.
Guideline 2:	Two types of licenses should be applicable, License A for medium risk and License B for high risk
Guideline 3: license A or B	In applying for a license, the applicant should indicate whether they are applying for license A or B
Guideline 4:	Each license application should be accompanied by an EMP.
Guideline 5:	Each application for a license should be accompanied by a license application report.

5.5.1. Components of a License Application Report

- i) Projected quantity of liquid waste to be generated
- ii) Name(s) of designated staff for liquid waste management
- iii) Site conditions (i.e. normal, difficult and adverse)
- iv) Coordinates of the proposed site for constructing the liquid waste management facility
- v) Selected technology
- vi) Detailed design of the technology by a qualified person that include construction drawings.
- vii) Monitoring plan (**for License B**)
- viii) Sludge management plan (**for License B**)

5.5.2. System Design Considerations

Most of the liquid waste management systems currently used in the ODRS are the septic tank system and its different variations. Due to their dominance as a liquid wastewater treatment technology, it is logical to set out some their design consideration as presented herein.

- i) Estimate the average daily flow rate on the basis of water used
- ii) Determine the average detentions time in septic tank at peak flow
- iii) Determine the required length of the soil absorption system
- iv) Prepare a typical layout for the proposed system with respect to accessibility and location of disposal field
- v) Provide a treated effluent sampling access point to enable sampling and monitoring

- vi) All septic tank systems should be fitted with effluent filter to prevent sludge and scum from leaving the tank (see Appendix 3).
- vii) All kitchens should be fitted with a fat trap to reduce the fat content discharged into the septic tank system that might interfere with the bio-degradation process.

5.5.3. Procedure for License Application to Competent Authority and its Response

- i) Prepare a license application report
- ii) Complete a license application form (see Appendix 4)
- iii) Submit license application form and report to the competent authority
- iv) The competent authority assesses the application using the requirements of these guidelines.
- v) The competent authority should evaluate the application and give the applicant feedback within 30 calendar days.
- vi) The feedback could be issuance of a license with set out license conditions or deferred application with suggested improvement or rejection with advice for re-submission.
- vii) All existing establishments should be given a transition period of six months once the guidelines are in effect to allow them to apply for licensing of their liquid waste management facilities.

5.5.4. License Conditions

License A: Medium risk

- i) Designate the responsible person for liquid waste management.
- ii) The license holder shall monitor effluent quality for levels of pH, TSS, BOD₅, Nitrates and Phosphates, -- and submit reports to the competent authority bi-annually.
- iii) Monitor water quality for level of pH, TSS, BOD₅, Nitrates and Phosphates within a 20metre radius of the receiving water body and submit a report annually to the competent authority
- iv) The levels should be within those set out in BOS 93:2004
- v) Ensure that untreated influent does not overflow out of the liquid waste management facility by carrying out regular inspections.
- vi) The competent authority should routinely sample effluent quality of selected wastewater facilities once a year to verify the results of the license holder

License B: High risk

- i) Designate the responsible person for liquid waste management
- ii) The license holder shall monitor effluent quality for levels of pH, TSS, BOD₅, Nitrates, and Phosphates - and submit reports to the competent authority quarterly.
- iii) Monitor water quality for level of pH, TSS, BOD₅, Nitrates and, Phosphates within a 50metre radius of the receiving water body and submit a report quarterly to the competent authority
- iv) The levels should be within those set out in BOS 93:2004
- v) Ensure that untreated influent does not overflow out of the liquid waste management facility by carrying out regular inspections.
- vi) The competent authority to routinely sample effluent quality of selected wastewater facility once a year to verify the results of the license holder

5.6. Monitoring of Liquid Waste Management Systems

Monitoring is intended to achieve five main objectives of:

- Identifying potential environmental problems and evaluating the need for remedial actions or mitigating measures.
- Supporting license revision and/or renewal based on new data.
- Detecting, characterizing and reporting unplanned releases by the facility or establishment.
- Determining the impact to the receiving media (water body, groundwater and land).
- Determining the effectiveness of the waste minimization/cleaner technologies adopted by the establishment/facility.

In order to realize these objectives, a monitoring plan, a report that describes how effluent will be monitored and how the effluent quality will be measured, is required.

5.6.1. Components of a Monitoring Plan

- i) Objectives of monitoring
- ii) Type of liquid waste facility
- iii) Monitoring stations/points
- iv) Effluent quality parameters to be measured
- v) Frequency of monitoring
- vi) Water quality sampling and Test methods
- vii) Quality assurance and quality control measures
- viii) Any variation of the monitoring plan should be approved by the competent authority.

5.6.2. Self-monitoring Procedure of Existing Establishments

The proposed monitoring protocol detailed in the monitoring plan as proposed in paragraph 5.5.1 applies mainly to new facilities. In the case of existing facilities, the following procedure is proposed:

- i) Designate the responsible person for liquid waste management
- ii) The designated person should ensure that effluent quality for levels of pH, TSS, BOD₅, Nitrates and Phosphates are monitored and reports submitted to the competent authority twice a year.
- iii) The designated person should ensure that water quality is monitored for level of pH, TSS, BOD₅, Nitrates and Phosphates within a 20metre radius of the receiving water body and submit a report bi-annually to the competent authority
- iv) The levels should be within those set out in BOS 93:2004
- v) Remedial action should be taken when effluent quality parameters exceed the requirements of BOS 93:2004

- vi) Ensure that untreated influent does not overflow out of the liquid waste management facility by carrying out regular inspections.

5.7. Sludge Management

Most liquid waste treatment facilities generate some level of sludge. Such sludge often contains pathogens and heavy metals and becomes a challenge for disposal before stabilization and treatment. However, sludge can be a useful resource as a soil conditioner post treatment and stabilization. It could be also be disposed of at landfills or be used as cover material. Appropriate sludge management system options should be based on the classification of the results of its analysis. Such classification is often done to identify appropriate sludge disposal options. Only the sludge that has been determined to be within the maximum level of microbial characteristics should be used as a soil conditioner. Figure 5-8 can be used to determine the utility or suitable disposal method for the sludge on the basis of its classification. The Botswana National Wastewater and Sanitation Planning and Design Manual Part 6 – Guide to the Beneficial Use and Disposal of Sludge is a useful guide in classifying and determining the acceptable limits for microbial and heavy metal limits for disposal of sludge on land and agricultural use. The competent authority and sludge generators should refer to the manual for acceptable metal and microbial content.



Figure 5-8: Botswana sludge classification system

5.7.1. Components of the Sludge Management Plan

- i) Monitoring objective
- ii) Type of liquid waste management facility
- iii) Projected quantity of sludge to be generated
- iv) Classification of the sludge
- v) Parameters to be measured and monitored to prevent environmental nuisance
- vi) Frequency of monitoring
- vii) A proposal for the appropriate end use or disposal of the sludge
- viii) Description of any onsite containment facility for the sludge
- ix) Any variation of the monitoring plan should be approved by the competent authority.

5.7.2. System Operation and Maintenance

For liquid waste management facilities to function efficiently and effectively, it is important that they are properly operated and maintained. The following guidelines should be used for the operation and maintenance of the liquid waste treatment facilities.

- i) Sludge levels should be monitored regularly
- ii) Pump out the sludge and remove floating scum regularly
- iii) Inspect the liquid waste treatment facility for leaks
- iv) Maintain effluent filter regularly
- v) Reduce influent flow into the treatment facility by conserving water usage
- vi) Use high efficiency toilets
- vii) Use high efficiency shower heads
- viii) Do not grow plants over disposal field
- ix) Do not drive over disposal field
- x) Inspect treatment systems for failure symptoms i.e. pooling water, muddy soil around system and toilet back flow

5.7.3. On-land Mobile Operator Camping Grounds and Houseboats

These two operations generate both black and grey water. The common practice for on-land mobile operator camping grounds is to use long drop holes for black water, while houseboats use conservancy tanks onboard the boats.

Summary of guidelines for on-land operator camping grounds and houseboats black water management

Guideline 1:	Ensure that long drop holes used by the operators are dug on organic soil.
Guideline 2:	The dimensions of the long drop must not exceed 30cm square by 1.5 metres deep
Guideline 3:	The hole should be filled in with soil when it is 30cm from full.
Guideline 4:	There must be one toilet per eight persons.
Guideline 5:	Locate long drop holes at least 100m from water sources to avoid contamination.
Guideline 6:	Avoid high concentration of long drop holes around campsites.
Guideline 7:	All houseboats shall be equipped with at least 2 liquid waste tanks of adequate capacity to handle liquid waste for the duration of the trip.
Guideline 8:	All liquid waste tanks should be leak and overflow proof.

Guideline 9: Offshore tanks used for transferring liquid waste from houseboats should apply for **License A**.

Guideline 10: HATAB and BOGA should ensure that their members comply with these protocols

Summary of guidelines for on-land operators camping grounds and houseboats grey water management

Guideline 1: No grey water should be discharged into the receiving water bodies including the delta without prior treatment.

Guideline 2: Grey water should be retained on board the houseboats for disposal into land-based systems.

Guideline 3: HATAB and BOGA should ensure that their members comply with these protocols.

5.7.4. Decommissioning and Rehabilitation

Where a liquid waste treatment facility is to be decommissioned, appropriate action must be undertaken to ensure that environmental harm is avoided during and after the decommissioning phase. The license holder should inform the competent authority of his intention to decommission the facility and prepare a decommissioning plan. The decommissioning plan that should be submitted to the competent authority for approval should include:

- Landscape and re-vegetation proposals
- Soil and vegetation monitoring
- Frequency of monitoring

Upon approval of the decommissioning plan by the competent authority, the operator should surrender the license for the facility.

5.7.5. Institutional Responsibilities

The competent authority in terms of liquid waste management shall be the Department of Waste Management and Pollution Control (DWMPC). The department shall be responsible for:

- Licensing liquid waste management facilities that are deemed to require a license.
- Monitor compliance to license conditions.

- Monitor effluent or grey water quality that is discharged into receiving water bodies or delta waters
- Delegate monitoring responsibilities to any local authority as it deems necessary
- Build sufficient internal capacity to enable it to deal with licensing and monitoring responsibilities both in terms of human and laboratory infrastructure.
- Facilitation of the promulgation of the necessary legislative framework that will anchor its licensing and monitoring responsibilities.
- Facilitate the review of the guidelines in line with the promulgated Act.

5.8. Hazardous Liquid Waste Management and Guidelines

For purposes of these guidelines, hazardous liquid waste specifically refers to:

- Fuels (diesel, petrol)
- Lubricating oil (engine and gear)
- Used oil

The objective of the guidelines is to set out best practices for handling, transportation, storage and disposal of hazardous liquid waste and to assign institutional responsibilities. The best practices documented in the literature (see paragraph 2.5) and contained in the guidelines under review are considered appropriate for the ODRS and are reproduced herein.

Summary of guidelines for transportation of hazardous waste

Guideline 1:	Vehicle transporting hazardous waste should be certified road worthy by the Department of Road Transport and Safety every 6 months
Guideline 2:	Drums and truck-box fuel tanks are acceptable methods of transporting oil and fuel;
Guideline 3:	All vehicles carrying fuel should have at least one 20 B:C rated portable fire extinguisher;
Guideline 4:	Drums and fuel tanks should be filled to a recommended level of 90%;
Guideline 5:	The load should be secured in a manner which ensures that; it does not escape from the vehicle nor shift or sway in a manner that may affect the operation of the vehicle

Summary of guideline for storage of hazardous liquid waste

Guideline 1:	Fuel storage tanks, whether aboveground or underground should be located down slope from water sources.
Guideline 2:	Aboveground tanks should be located over an impermeable liner made of concrete or other synthetic materials.

Guideline 3:	All underground tanks should be coated with fiberglass to prevent corrosion or use fiberglass tanks instead.
Guideline 4:	Aboveground tanks should be made of high quality steel;
Guideline 5:	Fuel tanks should have spill and overflow protection Spill protection typically consists of a catch basin for collecting spills when the tank is filled; Overflow protection is a warning, such as a buzzer or an automatic shutoff, to prevent an overflow when the tank is filled.
Guideline 6:	Store similar products together to reduce any danger from reactions in case of leakage or spill;
Guideline 7:	Store substances in a well-ventilated area;

Summary of guidelines for handling and disposal of hazardous liquid waste

Guideline 1:	All containers storing hazardous substances should be in a good condition and clearly labeled
Guideline 2:	Containers and tanks should be closed and sealed except where a hazardous substance is being added or removed from the container;
Guideline 3:	Storage tanks at marine fuel dispensing stations must be located 4.5m horizontally from the normal annual high-water mark;
Guideline 4:	Solid piping must be used between storage tanks located on shore.
Guideline 5:	Use a funnel when transferring substances between containers;
Guideline 6:	Provide a stable platform for fueling;
Guideline 7:	Follow the directions for storage on the label;
Guideline 8:	Used oil should not be mixed with other hazardous substances;
Guideline 9:	Never burn, dump or bury hazardous liquid waste;
Guideline 10:	Do not flush wastes down sink or toilet
Guideline 11:	Do not pour hazardous liquid waste into ditches, storm drains or gutters
Guideline 12:	Completely drain all oil filters to ensure that they do not contain hazardous substances

5.8.1. Contingencies for fuel spills

Transportation of fuel, particularly on difficult roads such as the ones in the Okavango delta, has the potential to result in leakages and spills. Apart from transportation, vehicle service areas and/or leaking storage facilities have the potential to contaminate the surrounding environment. In order to minimize potential environmental harm, it is important that spills are contained and areas affected be treated. The following procedure should be followed in case of spillage.

- Stop the spill: Turn off the nozzles or valves from the leaking container, if it can be done safely. Use a wooden plug, bolt, band or putty on a puncture-type hole.
- Contain and retain the spill: If the spill or leak cannot be stopped, catch the flowing liquid using a pan, shovel, bucket or whatever is available. Spread sorbent material such as wood chips or Peat Sorb to stop the flow and soak up the fuel.
- Collect the contaminated sorbent: Brooms can be used to sweep up the sorbent material and put it into buckets, garbage cans. Fresh granular sorbent such as sand can then be re-spread on a roadway to control residual slipperiness.

Transporters of fuel should carry fuel spill kits all the time they are transporting hazardous substances to enable them to contain fuel and oil spills within 30 minutes from their occurrence.

5.8.2. Risk assessment for fuel storage facilities

Fuel (diesel and petrol) is the most common hazardous substance transported and stored in the Okavango Delta. In order to avert some of the risks that its storage poses, it is recommended that a minimum risk assessment should be undertaken by the operators. The objective of risk assessment is to help the operators understand the level of risk they are taking in managing their fuel facilities, for purposes of taking appropriate risk control measures. Table 5-12 provides a simple risk-ranking framework adapted from Ministry of Water, Land and Air Protection, British Columbia (2002). A risk-rank value (3 for high, 2 for medium and 1 for low) is assigned for each of the risk identification categories indicated in the left column of Table 5-12. After assigning the risk ranking values, the values are added to arrive at the total risk-ranking value for the fuel storage facility.

In order to establish if risk control measures are necessary, the Total Risk Rank Value determined in Table 5-12 is used to establish appropriate levels of effort to mitigate the risks at the fuel handling facility by using the recommended risk control measures in

Table 5-13.

Table 5-12: Risk-ranking framework for hazardous substances

Risk identification category	Risk Rank High	Risk Rank Medium	Risk Rank Low	Assigned Risk Rank Value
Numerical Value	3	2	1	
Environmental				
Distance to the nearest water course	< 50m	50m – 100m	> 100m	
Characteristic of the soil at the fuel facility	Porous or unknown	Semi-porous	Non-porous (Clay or bedrock)	
Slope of terrain surrounding the fuel facility	> 6%	2% - 6%	< 2%	
Operational				
Site designation or description	High traffic road	Low traffic road	No through traffic	
Duration of facility operations	> 6 days	2 – 6 days	< 2 days	
Volume of fuel stored at the facility	>4500L	500L – 4500L	< 500L	
Number of times the fuel facility is used per day	> 12 times/day	6 – 12 times/day	< 6 times/day	
Amount of traffic around the fuel facility	> 15 people on site	5 – 15 people	< 5 people	
Prevention/Preparedness				
Distance to additional spill cache	> 60 minutes	15 – 60 minutes	< 15 minutes	
Additional spill control	Tank with no secondary containment	Tank with secondary containment	Tank with secondary containment & additional spill control	
Last spill training session for those handling fuel	Operator not trained in > 2 years	Operator not trained in 1 - 2 years	Operator not trained in the last year	
Total Risk-Rank Value (Total of the assigned Risk Values)				

Adapted from Ministry of Water, Land and Air, British Columbia (2002).

Table 5-13: Recommendations on Risk Control Measures

Numerical Value	Risk Ranking	Recommendations on Risk Control Measures
< 12	Low risk	No control measures are necessary
12 - 23	Medium Risk	Additional control measures should be considered to reduce risk
> 23	High Risk	c) Additional controls are necessary to reduce risk d) Consider moving the fuel facility

Adapted from Ministry of Water, Land and Air, British Columbia (2002).

5.9. BIBLIOGRAPHY

Aqualogic (PTY) LTD (2008) Consultancy for the Assessment of Liquid Waste Systems of Tourism Establishments in the Okavango Delta and Transportation, Handling and Storage of Hazardous Substances in the Okavango Delta. BiOkavango Project, Maun.

Aqualogic (PTY) LTD (2006). Management of liquid and solid waste in the Okavango Delta Ramsar Site Strategy Document. North West District Council, Maun

Botswana Bureau of Standards (BOS 93:2004). Water Quality –waste water – physical, microbiological and chemical requirements– Specification.

Botswana Tourism Board (2007) Botswana Tourism Board Accommodation, Maun, Okavango Delta and Moremi. <http://www.botswanaturism.co.bw>

Ecosurv (2011) Consultancy to Develop Guidelines for Liquid Waste Management in the Ngamiland District (Okavango Delta Ramsar Site). Final Report. Integrated Water Resource Management/Water Efficiency Project. Gaborone.

Government of Botswana (1992) Tourism Act. Government Printer, Gaborone.

Government of Botswana (1996) Study on the Oil Management of Oil Containing Wastes. Report No: NCS/GTZ 5/96

Government of Botswana (GoB)(2003) National Master Plan for Wastewater and Sanitation, Department of Waste Management and Pollution Control, Gaborone.

Government of Botswana (2005) National Water Master Plan Review, Volume 1 – Main Report. Government Printer, Gaborone.

Government of Botswana (2009) Technical Assistance for Reform of the Water and Sanitation Sector. Report by the World Bank on Phase I, Final Report. Volume I – Main Report. Department of Water Affairs, Gaborone.

Greenlaw L. and Corriveau M. (2003) Design for a Waste Management System: Tourist Camps in the Okavango Delta, Final Report. HOORC, Maun.

Metcalf and Eddy, Inc. (1991). Wastewater Engineering: Treatment, Disposal and Reuse, 3rd Edition, McGraw-Hill, Inc, New York.

McCarthy T.S., Gumbicht T., Stewart R.G., Brandt D., Hancox P.J., McCarthy J. and Duse A.G. (2004) Wastewater disposal at safari loges in the Okavango Delta, Botswana. Water SA 30(1): pp 121-128

McCarthy T.S. and Mclver J.R. (1991) Groundwater evolution, chemical sedimentation and carbonate brine formation on an island in the Okavango Delta swamp, Botswana. Applied Geochemistry (6): 577-595

Ministry of Water, Land and Air Protection, British Columbia (2002) A Field Guide to Fuel Handling, Transportation and Storage, 3rd Edition.

Nowatzki J., Seelig B., and Scherer T. (1998) Assessing Your Petroleum Product Storage Practices. <http://www.ag.ndsu.edu/pubs/h2oqual/watgrnd/ae1078w.htm>

North Carolina Farm-A-Syst Publication. Improving Fuel Storage. <http://www.soil.ncsu.edu/assist/fuel>

North Carolina Home-A-Syst Publication. Improving Storage and Handling of Household Hazardous Waste. <http://www.soil.ncsu.edu/assist/hazardl>

North Carolina Septic Tank Farm-A-Syst Publication. Spill Prevention and Response Procedures. <http://www.soil.ncsu.edu/assist/septic>

Qasim S.R. (1999) Wastewater Treatment Plants: Planning, Design and operation. CRC Press

Schachtschneider K. and Winter K. (2000) A Water Demand Management Strategy for the Namibian Tourism Sector. 1st WARFSA/Waternet Symposium, Maputo, 1-2 November 2000.

The World Bank Group (1998) Pollution Prevention and Abatement Handbook-Toward Cleaner Production in collaboration with UNEP and UNIDO. Washington, D.C. ISBN 0-8213-3638-X pp457

US EPA (2000) Decentralized Systems Technology Fact Sheet: Septic System Tank. EPA 832-F-00-040, Office of Water Washington, DC

APPENDIX 1: Stakeholder Consultation Minutes

Minutes of the workshop for the consultancy to review, develop training materials and pilot the liquid waste management guidelines in the Ngamiland District (Okavango Delta Ramsar site).

Project Name	Consultancy to review, develop training materials and pilot the liquid waste management guidelines in the Ngamiland District (Okavango Delta Ramsar site)
Client	Kalahari Conservation Society
Consultant	Aqualogic (Pty) Ltd
Date/time of workshop	08 October 2012; 0900hrs – 1400hrs
Reason for workshop	Review of the liquid waste management guidelines
Venue	Maun Lodge Conference Room
Recording	Aqualogic

<i>Ref</i>	<i>Agenda</i>
1	Registration
2	Opening remarks (Mr M. Ramaano of KCS)
3	Presentation of the liquid waste guidelines (Prof. B. Bolaane of Aqualogic)
4	Break
5	Feedback from stakeholders
6	Summary and way forward (Mr. T Molebatsi and Prof. B. Bolaane of Aqualogic)
7	Closing remarks (Mr M. Ramaano of KCS)

Attendance list

Name	Organisation	Phone	email	Positions
Sehenyi Tlotlego	Kwando Safaris	6814449	maintenance@kwando.co.bw	Maintenance manager
Keitumetse A. Thupiso	Department of Tourism	6860492		Licensing Officer

Name	Organisation	Phone	email	Positions
Shearly Boopi	Sankuyo Trust	6800664	marketingstw@botsnet.bw	Marketing Officer
Oreeditse Masilo	NWDC	6860325	nwdc-env.h.rasmasilo@yahoo.com	Environmental Health Technician
Seabe Sedireng	Water & Wastewater	6862556		Principal Technical Officer
Segametsi Monnamorwa	Wilderness Safari	6860086	segametsi@wilderness.co.bw	Environmental Coordinator
BK Manyepedza	Dept of Water Affairs	6860452	bknyeps@gmail.com	Technical Assistant
Dikgang Otsile	DEA-Maun	6801237	ondikgang@gov.bw	Natural Resource Officer
Khotso C Sebeke	DWMP-C-Maun	6801244	kcsebek4@gov.bw	Senior Environmental Engineer
AK Kgomotso	DWMP-C-Gaborone	3934479	akgomotso@gov.bw	Environmental Engineer
Allison Mangena	Maun SS School	6860285	all-mangena@yahoo.com	Financial Controller / Projects Coordinator
K Moleleke	PROF.TS-Maun	6862752	kmoleleke@gov.bw	Inspector
K Baraedi	PROF.TS-Maun	6862752	kbaraedi@gov.bw	Admin/Accounts
K Mphusa	BTO-Maun	6861056	kmphusu@botswanaturism.co.bw	
B Batsile	DWNP-Maun	6860368	research@gmail.com	Senior Wildlife Warden
T Matladi	DWNP-GABS	3934479	tmatladi@gov.bw	Environmental Engineer
D Romai	Sankuyo Trust	680065		Accountant
Dinyando Romai			Prof.omai38@gmail.com	
Oesi Phendu			ophendu@yahoo.co.uk	
Bathusi Batsile			dwnp.maun.research@gmail.com	
M. Ramaano	KCS			

1. The meeting started with welcoming remarks and a brief project introduction from Mr Ramaano. He gave a background on the project and mentioned that in the Okavango Ramsar site, there are many different types of liquid waste systems and that some of them are not effective. He mentioned that the systems that are not effective would result in pollution of both the surface and subsurface water. He mentioned that the liquid waste guidelines were developed to ensure that due process is considered before a liquid waste system is setup and that the setup system would reduce the risk of pollution. He also mentioned that even though the guidelines have been developed, they have not been tested and it appears that they have not been used anywhere else in the country. He also mentioned that there have been changes to the service delivery institution structure and that as a result the Water Utilities Corporation has taken most of the mandate from the Department of Water Affairs and the District Councils. He mentioned that the idea of reviewing the guidelines was to ensure that they can be applicable and also that they could be applied to the rest of the country. The key question that he raised was; how best we can use the guidelines and how could they help the institutions to monitor the quantity and quality of both influent and effluent. He made it clear that the role of the IWRM, with regard to the review of the liquid waste guidelines, was to facilitate.
2. Prof. B. Bolaane presented the guidelines. In his detailed presentation he covered the following key issues: In summary he mentioned that some aspects of the guidelines were contradictory. For instance while on the one hand they propose exemption from licensing of facilities that generate less than 5m³/day of wastewater, on the other hand they are expected to comply with certain monitoring requirements. He also mentioned that the tabular check list that was used in the guidelines was complex. He suggested that a flow chart be used, as was common practice in selecting suitable sites for liquid waste management systems. Another issue that he highlighted was that the common classification model of classifying sites as *normal; difficult or adverse* that is based on easily determined parameters such as: likelihood to flooding; permeability; slope, depth of bedrock and depth of ground water table be used as opposed to the less common classification model of *Wetland upstream, Wetland delta, Wetland downstream and Non wetland*. He questioned whether it would be practical for a high level institution such as the Water Research Council (WRC) to administer licensing of the liquid waste management systems, as proposed in the institution reform. And whether this institution would be able to go to the rural areas. Another issue that he highlighted was that the guidelines put a lot of liquid waste licensing responsibility on the WWD. This, he mentioned, would mean that the WWD would have to be sufficiently resourced.
3. During the feedback session Mr Sebeke commented that the guidelines seemed to be developed for siting of new liquid waste management systems and asked how the guidelines would apply to existing liquid waste management systems that may not comply to the requirements of the new guidelines. He also mentioned that both institutions that are earmarked, as per the guidelines, for licensing and monitoring were misplaced. In discussing the issue of the guidelines being developed for new systems, it was suggested since the guidelines outlines monitoring then the monitoring part would apply to the existing liquid management systems. It was also noted that the guidelines did not specify the frequency of monitoring. It was suggested that existing systems would need to be upgraded if monitoring results showed that they were ineffective. It was also suggested that retrospective applications may need to be made if the existing liquid management systems are to apply to the guidelines.
4. The question of who should be responsible for monitoring was raised with Mr Masilo suggesting that it would be better for Government to monitor the quality and quantity of effluent. However, most of the attendants were of the view that the facility (i.e. liquid waste management system)

owners should monitor and that the Government or authorising organisation would have to do random verifications.

5. Mr. Mphusu wanted to know what was new in the guidelines since it is common requirement that an EMP be developed before a liquid waste management system is developed. The response was that the guidelines were specifically for liquid waste management and that the new requirement was that an application will have to be approved before new liquid waste management systems can be developed. Mr Mphusu also mentioned that the guidelines were complicated and wondered if most people would understand them. He also noted that there were not enough laboratories to deal with the sample analyses. He suggested that ways of conducting monitoring on site be considered.
6. Mr Sebeke and Ms Kgomotso expressed that it was important that organisations have people who can deal with all aspects of monitoring. They also said that self-monitoring was critical for preservation of the environment.
7. Mr Tlotlego noted that the tourism industry was inadequately represented and suggested that many others in the industry be consulted with. He also mentioned that, in general, the tourism industry has been carrying out monitoring and that this also helps them to get better ranking. He suggested that it would be best to have a one-off regulating authority so that the whole licensing and monitoring process can be efficient. He mentioned that as it is the tourism industry has to account to many institutions. He also mentioned that one of the challenges at the Delta is that of difficult access and that it may be challenging to implement some liquid waste management systems in the delta. He also said that there has been many projects, appearing to deal with similar issues and that there appears to be disconnect.
8. Mr Dikgang suggested that one way of introducing the guidelines would be when the tourism leases are due for renewal.
9. Mr Tlotlego suggested that the guidelines needed to be mandatory. It was stated that the guidelines were supported by the law. It was also mentioned that the liquid waste management act was still being formulated
10. Mr Ramaano stated that it is typically easier for the tourism organisations to adhere to the guidelines because they would not want their operating licenses to be revoked. He mentioned that the problem seem to be with Government institutions since they are not required to renew their operations. He also mentioned that self-monitoring was critical and suggested that government institutions that do not have the capacity to monitor would have to seek support from those that have the capacity. He suggested that a way of simplifying the guidelines is to have them summarised for quick perusal.
11. Mr Mphusu mentioned that most of the liquid waste management systems, in the Delta, were installed by companies from South Africa and that it was expensive to maintain the systems. The question of including households in the new guidelines when they were already covered by the local authorities such as is the case with the building control code was raised.
12. Mr Matladi wanted to know why cleaning chemicals were left out and not included as hazardous waste. He also mentioned that the spill response should be reduced. It was mentioned that in the Delta it is common to use bio-degradable cleaning chemicals. It was also mentioned that cleaning chemicals may have been left out in order to narrow the scope of investigation

13. Prof. Bolaane mentioned that the guidelines were silent on fat traps.
14. Mr Sebeke repeated that there was need for roles and mandates of the authorising institutions to be clarified. He wanted to know if the transport of hazardous waste was regulated and if so which institution did that. He also wanted to know if the current project will also consider optimal capacity for the new authorising institutions.
15. Mr Bareedi mentioned that the Department of Transport is responsible for making sure that trucks that transport hazardous waste are roadworthy and that it is required that the truck driver is trained to manage the situation in-case problems such as spillage arise.
16. Although aqualogic was of the view that the site classification needed to be consistent with that in the literature both Mr Sebeke and Mr Dikgang were of the view that the classification that is used in the guidelines was acceptable.
17. Prof. Bolaane presented the way forward and mentioned that part of the project was to train the implementers of the guidelines.
18. Mr T. Molebatsi motioned that the review project was brief, only forty days and that it also included piloting the guidelines.
19. In closing, Mr Ramaano noted that the previous stakeholder members did not attend the workshop. In acknowledgement that most of those who attended were not familiar with the guidelines, he offered to email the guidelines to them. The attendees were also allowed additional two days from the date of the workshop so that they could study the guidelines and send written comments. The comments were to be sent to Mr Ramaano. Mr Ramaano also acknowledged that more stakeholders needed to be consulted.

In summary the key issues from the workshop were that:

- The roles and mandates of the authorising institutions needed to be clarified
- The guidelines needed to be simplified

The workshop closed at 13hrs20.

APPENDIX 2: Site classification Criteria

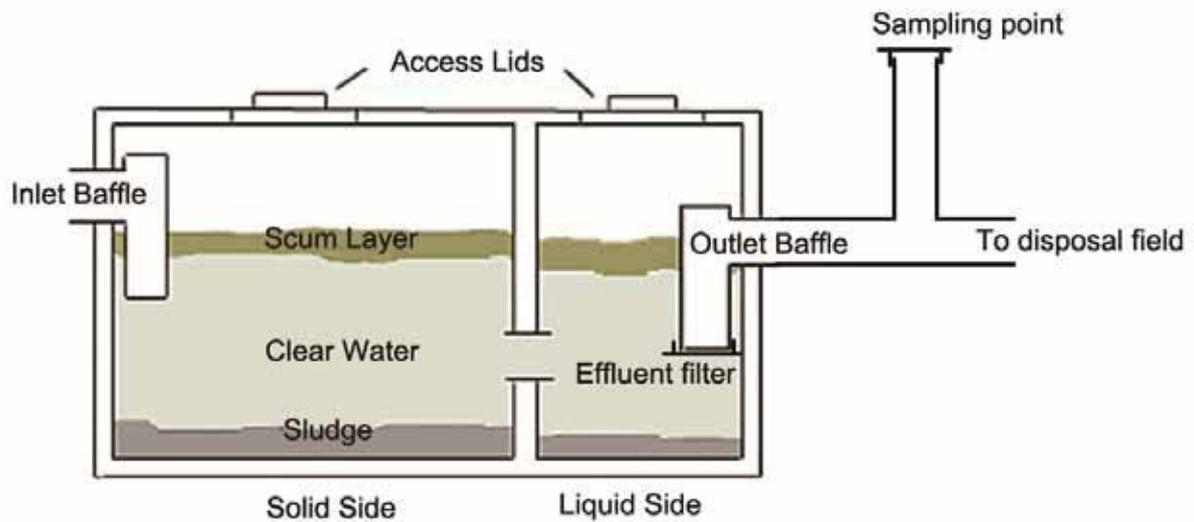
Basic requirements of disposal sites falling into three major groups

Requirements	Normal site	Difficult site	Adverse site
Soil texture	Coarse to medium sand, fine sand, sand loams, porous silt loams	Silt clay, loam, porous silt loam, silt clay loam	Clays, colloidal clays, expansive clays
Flooding	None	Rare	Common
Slope (%)	0 - 8	8-15	>15
Depth to bedrock (m)	>2	1-2	<1
Depth of high water table below bottom of disposal field (m)	>2	1-2	<1
Permeability (cm/h)	5 - 150	0.5-5	<0.5

Site conditions classification

Convention classification	Classification in the ODRS	Level of threat
Normal site	Non wetland	Moderate risk due resilience of land systems to wastewater pollution
Difficult site	<ul style="list-style-type: none"> • Wetland upstream • Wetland delta 	<ul style="list-style-type: none"> • Medium risk due to high dilution rate • Medium due to capacity of wetlands to absorb nutrients
Adverse site	Wetland downstream	High due to low dilution rate hence justifying the need for stringent controls

APPENDIX 3: Typical two chamber septic tank with sampling point and effluent filter



APPENDIX 4: Typical liquid waste facility license application form

Form LWM1

Application for Liquid Waste Management Facility

Name of Applicant	
Contact details	
Type of facility	
Type of license applied for (tick appropriate)	a) License A
	b) License B
Location of facility (tick appropriate)	a) Non Wetland
	b) Wetland upstream
	c) Wetland delta
	d) Wetland downstream
Coordinates of proposed location of facility	
Estimated quantity of water to be generated	

Enclosures:

- i. Detailed design of the facility with detailed drawings
- ii. Monitoring plan (where required)
- iii. Sludge management plan (where required)
- iv. Environmental Management Plan

6.0. Appendix F: Project Proposal Note on Climate Change, Variability and the Water Sector in Botswana

This project proposal has been prepared as part of the GEF funded IWRM-WE Plan preparation project. Climate change is fully incorporated in the country's IWRM-WE Plan, and it is believed that this project could cement the cross cutting nature of climate change and variability (CC&V) in the Plan.

The Government of Botswana (GoB) and the United Nations Development Programme (UNDP) intend to develop a Climate Change Policy, Strategy and Action Plan in 2013 (1 year project). This project proposal needs to be finalised and implemented in close collaboration with this joint GoB/UNDP effort.

This proposal note has been developed by the Centre for Applied Research as part of its support activities for the IWRM-WE Plan. It needs to be further elaborated and finalised by water sector stakeholders, led by the department of Water Affairs. It is recommended that a small working group led by DWA finalises the proposal.

6.1. Climate Change and Variability (CC&V) and the Water Sector and Resources in Southern Africa

Climate change has a direct impact on the hydrological cycle and the water resources. Consequently, several countries have a water section in their Climate Change Adaptation Strategy (e.g. Namibia and South Africa; Government of South Africa, 2010) and/or a climate change section in their IWRM-plan (e.g. Namibia; IWRMPJVN, 2010). Details of the impacts of climate change on individual countries are often still uncertain, but the risks and stakes are high. Uncertainty applies in particular to the amount of rainfall. However, widespread agreement exists about the rise in temperatures and the increase in climatic variability. Application of the pre-cautionary principle dictates that despite the prevailing uncertainties and risks, adaptations are urgently required given the magnitude of the possible impacts and the costs of inaction.

In South Africa, climate change is expected to increase climatic variability with more run-off, increased incidences and severity of droughts and floods, accelerated sedimentation of dams, algae growth in dam water and increased evapo-transpiration. These factors combined compromise water security as South Africa is already water stressed. Proposed interventions include exploration and use of 'new' water resources (treated effluent, groundwater and saline water), research, monitoring and evaluation, water demand management and adoption of a water catchment area approach.

In Namibia, climate change poses is expected reduce the size of viable livestock rangelands and to lead to economic losses in the livestock sector of 1 to 6 percent of GDP by the year 2030 without mitigation and adaptation (Turpie *et.al.*, 2010). Climate change is generally expected to increase temperatures and potential evapo-transpiration as well as rainfall variability (by 5 to 10%) and to decrease rainfall (Forman *et.al.*, 2011). Forman *et.al.*, (2011) also mention that the rainy season is expected to become shorter, and groundwater recharge, as well as surface water storage in dams, is likely to decrease. The flooding of 2011 is an example of climate variability (possibly associated with climate change) with negative and positive impacts. Negative impacts include damage to infrastructure, a decline in charcoal production, and increased livestock mortality. Positive impacts included increased surface water availability for livestock and improved rangeland conditions.

Countries such as Namibia and South Africa have a climate change adaptation strategy. Botswana is in the process of preparing one by the end of 2013.

The GWP manual on climate change and the water sector adds that given the uncertainties associated with climate change impacts risk assessment needs to be fully integrated in water and development planning. Moreover, it prioritises increasing allocative water efficiency as a key component of IWRM for adaptation to climate change.

In response to the climate change challenges to the water sector, SADC initiated the SADC climate change adaptation (CCA) Strategy for the water sector (SADC, not dated). Mainstreaming CCA in the water sector and related major water-using sectors is critical while the overall goal of the strategy is to increase climate change resilience of the region and SADC countries. A Handbook on Climate Risk and Vulnerability for SADC has been prepared to facilitate countries such as Botswana to analyse the risks involved and reduce its vulnerabilities through appropriate adaptations (Davis, 2011).

6.2. Climate Change and Variability (CC&V) and the Water Sector and Resources in Botswana

The World Bank (2010) carried out a study of climate change in Botswana and investigated its potential impacts and the risks involved. The study included a historical analysis of climate variability based on internationally accepted indicators. As a (semi-) arid country, droughts have been common in the past and floods have also occurred, although less frequently. The historical analysis covering the period 1960 to 1990 shows that:

- Rainfall has historically been highly variable in space and in time (seasonal and annually);

- Droughts in terms of rainfall deficits are most common in northern Botswana, indicating that this area may be most affected by on-going climate change;
- Extreme droughts based on low rainfall and soil conditions are most common in south western Botswana; and
- High rainfall events with risks of floods are most likely in north eastern Botswana. Several large dams are located in this area.

The same study indicates that climate change will become an important additional water stress factor in future. Water resources will constrain development and growth more unless IWRM is successfully applied. Future growth requires emphasis on water demand management, efficient water allocation and use, reuse of wastewater, rainwater harvesting and desalination. Most Global Change Model predictions for Botswana are the same in terms of increasing climate variability. They predict an increase in drought frequency and severity, particularly in western and northern Botswana. The frequency of storms will increase in western and northern Botswana and aridity and PET will increase. In south-mid eastern Botswana precipitation is likely to decrease and flooding likely to increase, putting infrastructure such as roads and dams at risk; groundwater recharge is likely to decline. Analysis of the associated risk mitigation and adaptation will therefore be needed. Listed impacts of climate change include: higher temperatures and evaporation; greater rainfall variability (more droughts and floods); possible changes in the length of the rainy season and in the duration of the Okavango floods; changes in health conditions (e.g. spreading of malaria and possible changes in other diseases). Climate change is likely to pose additional food security challenges as well as challenges to the water sector. The country may become too dry and hot for some crops and livestock production may experience extra forage and water challenges. Water storage requirements for livestock and crop production/ irrigation are likely to increase. Wildlife and tourism may develop comparative advantages in larger parts of the country. The water sector will experience higher evaporation rates from dams (already very high); more variable inflows and lower safe yields and possibly lower groundwater recharge. The World Bank study (2010) further predicts that the economic impacts of climate change may be significant and diverse (without adaptation):

- Increased droughts will adversely affect the agricultural sector (crops and livestock);
- A decrease in groundwater recharge will reduce groundwater resources, affecting primary and secondary land productivity and ecosystem services; and
- Lower run-off and higher evaporation rates will reduce already low safe yields from dams and adversely affect major tourism attractions such as the Okavango Delta. Changes in run-off will affect water storage in dams and public infrastructure such as roads and bridges. Sedimentation of dams may increase.

Several adaptation measures have been recommended, including (World Bank, 2010):

- Strengthening of drought and flood risk monitoring and management based on verifiable indicators; early warning and risk management as important parts of adaptation and mitigation strategies.
- Increased investments in water storage (special attention for small dams) , connection/ transfer scheme and evaporation reduction strategies (e.g. conjunctive use) to increase safe yields;
- Increased investments in water efficient irrigation to increase food security;
- Implement water demand management measures; and
- Adjustment of design standards to maintain current levels of service.

The above has the following implications for the IWRM-WE Plan:

- Water use efficiency is critical to sustain development and adapt to climate change;
- There is need for additional investments in water storage (to capture extra run off and overcome drought periods) and interconnectivity between water storage infrastructure to increase safe yields;
- Vulnerability assessment to climate change in the water sector are needed;
- Greater attention for early warning systems, disaster preparedness and management (droughts and floods);
- Research and development on CC, its impacts on water resources and adaptations;
- Sector assessments (e.g. agriculture, industry, tourism) need to fully integrate the water resources management and climate change;
- Monitoring and evaluation of water resources is critical to improve understanding of the impacts of climate change;
- There is need for modification of building and operational standards for dams (including desiltation of dams), roads etc. to prevent flood damage; and
- WDM and use of non-conventional water sources are priorities.

6.3. The proposed project

The overall objective of the project is to promote adequate adaptations in the water sector to climate change and variability to ensure that the water sector continues to support improved livelihoods and sustainable growth and development in Botswana.

The specific objectives are to:

- Increase safe yields of the water infrastructure and water storage capacities;
- Increase re-use and recycling of treated effluent;
- Ensure water resources to improve food security and efficient irrigation;
- Reduce evaporation losses from dams and water transfer schemes.

6.4. Planned Activities

6.4.1. Water Infrastructure & Storage

- Economic assessment of the costs to water infrastructure from CC&V and adaptation/ mitigation options.
- Safe yield study and analysis:
 - What are the expected impacts of CC&V on the current water infrastructure in terms of safe yields (dams) and recharge (well fields)?
 - Analysis of the options exists to increase safe yields of the entire water infrastructure (e.g. increased storage and transfer schemes)?
 - Design of an integrated national water infrastructure optimisation system (the purpose is to increase safe yields throughout the country);
- Identification of small dam and water point opportunities to support rural development, in particular agriculture;
- Study of options to reduce evaporation losses (e.g. through conjunctive use and water transfers to dams with lower evaporation rates)

6.4.2. Treated Effluent

- Study of the costs and benefits of re-use and recycling for each WWTW.
- Integrated development of wastewater treatment works and irrigation schemes;
- Monitoring of the quantity and quality of WWTW outflows;
- Development of contract between farmers and WUC to ensure an appropriate supply of water for farmers and productive water use (at a charge).

6.4.3. Food Security

- Study of the damage costs of CC&V on food production (crops and livestock)
- Survey and review of small dam performance;
- Survey and review of irrigation sector (in terms of water use and productivity);

6.4.4. Water Demand Management

- Studies of the impacts of climate change and variability on major ecosystem

- Sector studies (irrigation, livestock, tourism and mining) to:
 - The impacts of climate change and variability on each sector and the consequences for sectoral water use;
 - Economic benefits and opportunities for increased sectoral water use efficiency.

6.4.5. Major Ecosystems

- Impacts of CC&V on the water resources and economic activities in the Okavango Delta with adaptation options
- Impacts of CC&V on the water resources and economic activities in the Makgadikgadi wetlands with adaptation options
- Impacts of CC&V on the water resources and economic activities in the Chobe Basin with adaptation options.

6.4.6. Improved Understanding of CC&V Impacts

- Preparation of stock accounts for dams and well fields, including primary data collection;
- Regular CC&V notification in terms of its occurrence, impacts and mitigation/adaptation measures.

6.5. Funding sources

Funding can be sourced inside Botswana and internationally. Within budget, funds can be obtained from government budget, universities and the private sector; internationally sources such as African Development Bank (ADB), Global Environmental Fund (GEF), Global Water Partnership (GWP). UNDAF could be another source of funding.

6.6. 4 Institutional set up and further proposal development

The DWA and the Climate Change Coordinator-MEWT should lead the further development of the proposal. A small working group with representatives from DWA, Water Utilities Corporation, Ministry of Agriculture, Department of Meteorological Services/ Ministry of Environment, Wildlife & Tourism (MEWT), KCS, the National Climate Change Committee and UB will support the process.

It is recommended that the project will be implemented through DWA and MEWT as part of the IWRM-WE Plan implementation in close collaboration with the National Climate Change Committee (NCCC).

The project should be implemented as a partnership between government staff from DWA and Meteorological Services and experienced researchers/ consultants from the private sector, universities (UB, BCA and BIUST). It is further recommended that an international partner will participate to bring in additional relevant international experience (e.g. Australia or Spain).

7.0. Appendix E: References

- Bahri, A, (2006). *Managing the other side of the water cycle: making wastewater an asset*. TEC Background Papers No.13.
- Bendsen, H. (2002) The dynamics of the land use systems in Ngamiland: Changing Livelihood options and Strategies, *Harry Oppenheimer Okavango Research Centre*, University of Botswana, Maun
- Bethune, S.(2004). *Defining the legal framework for the Okavango River Basin - Namibia*. A review prepared by the Sharing Waters Project.
- Brook,M. (2008). *Debswana's current and future water management challenges in Botswana*. Debswana, 2008. Water management at Debswana.
- Busani, B.T. (2005). *Water and residue: a medium to long term strategic management plan*. Debswana.
- Campbell, A.C. (1976) *Traditional Utilisation of the Okavango Delta*. In *Botswana Society, Symposium on the Okavango Delta and its Future Utilisation*, August 30th to September 2nd, 1976, Botswana Society
- Cap-Net (2009). *IWRM as a tool for adaptation to climate change*. Trainers and facilitators guide.
- Central Statistics Office (Statistics Botswana), (2012). *Report of the 2011 Population and Housing Census* (www.cso.gov.bw).
- Darkoh, M.B.K., and Mbaiwa, J.E., (2006). *Tourism and Environment in the Okavango Delta, Botswana*. Gaborone: Pula Press.
- Davis, C.L. (2011). *Climate change and vulnerability: a handbook for southern Africa*. CSIR, South Africa.
- Department of Environmental Affairs and Centre for Applied Research (2006). *Botswana Water Accounts 1990-2003*.
- Department of Environmental Affairs and Ministry of Environment Wildlife and Tourism (2006) *Botswana National Action Programme To Combat Desertification*.
- Earle,A. (2001). *The role of virtual water in food security in southern Africa*. SOAS, University of London.
- Earle,A.,G.Lungu and G.Malzbender (2008). *Mapping of integrity and accountability in water activities and relevant capacities in the SADC region*. UNDP/SIWI/Waternet and Cap-Net.
- Eckstein, G (1995). *Application of International Water Law to Transboundary Groundwater Resources, and the Slovak-Hungarian Dispute Over Gabčíkovo-Nagymaros*, 19 Suffolk

Forman,S., J.Arntzen & N. Morgan (2011). *Livestock competitiveness, economic growth and opportunities for job creation in Namibia. Policy Paper prepared for the National Planning Commission.* World Bank

Garrido A. and Llamas M.R. (2007), *Water Management in Spain: An example of changing paradigms; A Paper presented at the Engelberg Conference on Water, Switzerland*

Gender Links (2010). *Southern Africa Gender protocol 2010: Botswana Barometer.* Gender links, Johannesburg.

Global Water Partnership Technical Committee (2004). *Change: A handbook for developing integrated water resources management (IWRM) and water efficiency strategies.*

Government of Botswana and UNDP, (2011). *Botswana Millennium Development Goals: Status Report.*

Government of Botswana and World Bank, (2009). *Reform of the water and sanitation sector (vol 1 and 2). Draft final.*

Government of Botswana, (2001). *Botswana's policy for wastewater and sanitation management.*

Government of Kazakhstan (2007), *Integrated Water Resources Management and Water Efficiency in the Republic of Kazakhstan for 2008-2025 Astana City, Kazakhstan*

Government of Kenya and Water Resources Management Authority, 2009. *Integrated Water Resources Management and Water Efficiency Plan for Kenya.* Nairobi.

Government of Malawi, (not dated) *Integrated Water Resource Management and Water Efficiency (IWRM/WE) Plan (2008-2012) Abridged Version*

Government of South Africa (GSA) (2010). *National Climate Change Response Green Paper.*

Government of Zambia (2008). *Integrated Water Resources Management and Water Efficiency (IWRM/WE) Implementation Plan. Volume 1.*

GTZ (J. Muschauri and S. Makhoalibe).(2005). *Project progress review – Promotion of River Basin Organisations, Organisation development support to the Limpopo and Orange-Senqu River Basin Commissions, Reg. Div. 104 – Southern Africa II.*

GWP (2004). *Integrated Water resources Management and Water Efficiency Plans by 2005: why, what and how? TEC background paper no. 10*

GWP,(2003). *Effective water governance: learning from the dialogues.*

GWP, (2003). *Poverty reduction and IWRM. TEC background papers no. 8.*

GWP,(not dated). *Taking an integrated approach to improving water efficiency. Technical Brief No.4.*

Hart, T (2005). "The establishment of river basin secretariats in southern Africa: Lessons from ORASECOM. In Implementing the SADC Regional Strategic Action Plan for Integrated Water Resource Management (1999-2004)." *In Lessons and Best Practice*, by BE Hollingworth and T Chiramba, 28-32.

Heyns, P (2004). *Achievements of the Orange-Senqu River Commission in integrated transboundary water resource management. Paper presented at the General Assembly of the International Network of Basin Organisations*, 24 to 28 January 2004 in the Martinique.

Hollingworth, B (2007). "A strengthening river basin organizations (RBOs) in the SADC Region." Project CB-4 of the RSAP2 pp53.

Huntsman-Mapila, P., Mapila, T., Letshwenyo, M., Wolski, P., and Hemond, C. (2006). *Characterization of arsenic occurrence in the water and sediments of the Okavango Delta, NW Botswana*. Journal of Applied Geochemistry 21, 1376-1391.

ILC (2008). International Law Commission, *Report of the International Law Commission to the General Assembly on Its Sixtieth Session*, Chapter IV, Shared Natural Resources. Title and Texts of the Preamble and Draft Articles 1 to 19 on the Law of Transboundary Aquifers Adopted on Second Reading by the Drafting Committee, UN Doc. A/CN.4/L.724 (29 May 2008).

IWRM Plan Joint Venture Namibia, (2010), *Development of an Integrated Water Resources Management Plan for Namibia*, Theme Reports 1 to 8. Reports prepared for Ministry of Agriculture, Water and Forestry

Keshman, K. (2010). *Water governance in Jordan: National needs assessment and delineating UNDPs interventions in Jordan*. UNDPs water governance programme for Arab states.

Kgathi, D. L., Mmopelwa, G., Mosepele, K. (2005). *Natural resources in the Okavango Delta, Botswana: Case studies of some key resources*. Natural Resources Forum 29, 70-81. Blackwell Publishing, Oxford.

Khaleq R. A. A. (2008) *Water Demand Management in Jordan, Ministry of Water and Irrigation*, Amman, Jordan

Kingdom of Jordan (2009), *Water for Life, Jordan's Water Strategy 2008-2022*

Krantz, N., Interwies, E. and Vidaurre, R. (2005). "Transboundary river basin management regimes: the Orange basin case study." *Background report to Deliverable 1.3.1*, NeWater, pp 39.

Krantz, N., Interwies, E., Vorwerk, A., and von Raggamby, A.(2005). "Transboundary river basin management regimes: the Orange basin case study." *Background report to Deliverable 1.3.1*, NeWater, pp 39, 2005.

Krantz, N., Vorwerk, A. and Vidaurre, R. (2007). *"Towards adaptive water governance observations from two transboundary basins."*

Krantz, N., Vorwerk, A., Vorwerk, A., and von Raggamby, A (2007). *"Towards adaptive water governance observations from two transboundary basins."* NeWater.

Magole, L. (2008). *The feasibility of implementing an integrated management plane of the Okavango Delta, Botswana*, Physics and Chemistry of the Earth 33 (2008) 906-912

Magole, L., and DeMotts, R. (2007) *The Role of Universities in Community Development and Empowerment: The Okavango Delta Management Plan*, HOORC, Maun

Magole, L., and Magole, I.L. (2009). *The Okavango: Whose Delta is it?* Physics and Chemistry of the Earth, Volume 34, 874-880

Mbaiwa, J., Kgathi, D.L., Bendsen, H., Blaikie, P., Ngwenya, B.N., and Wilk, J., (2004) *Rural Livelihoods, Indigenous Knowledge Systems, and Political Economy of Access to Natural Resources in the Okavango Delta, Botswana*, HOORC Working Paper No 4, HOORC, Maun

Mekonnen, M.M. and A.Y. Hoekstra (2011). *National water footprint accounts: the green, blue and grey water footprint of production and consumption (vol 1 & 2)*.

Meyer, T. and Bendsen, H. (2003) *The Dynamics of the Land Use Systems in Ngamiland; Changing Livelihood Options and Strategies*, in Environmental Monitoring of Tropical and Subtropical wetlands. T. Bernard, K. Mosepele, L. Ramberg (Ed.). Okavango Report Series No. 1; Maun, Botswana; HOORC pp. 278-307

Mosepele, K., and Ngwenya, B.N. (2007). *HIV/AIDS, artisanal fishing and food security in the Okavango Delta, Botswana*, Physics and Chemistry of the Earth, 32, 1339-1349

Mosepele, K., and Ngwenya, B.N. (2008). *Socio-economic survey of subsistence fishing in the Okavango Delta, Botswana*, Okavango Report Series No. 6, Gaborone: Bay Publishing.

Namibia Nature Foundation (NNF) (2004). *Best practice guide for promoting shared river basin management. Experiences and methodology used by the Every Basin Has Its People Project as implemented in the Okavango River Basin from 1993-2003*. Solitaire Press.

OECD (2011). *Environmental Performance Reviews: Israel 2011*

Pegasys (2009). *IWRM Survey and Status report: summary*. GWP-Southern Africa.

Pietersen, K and Beekman, H.E. (2008) *A Comparative Study on the Linkages between River/Lake Basin Organizations and the Respective Cooperating National Governments in Seven Major African Basins*. GTZ.

Pietersen, K and Beekman, H.E. (2008) *A Comparative Study on the Linkages between River/Lake Basin Organizations and the Respective Cooperating National Governments in Seven Major African Basins*. GTZ.

Ramberg, L., Hancock, P., Lindholm, M., Meyer, T., Ringrose, S., Sliva., Van As., J., and VanderPost, C. (2006) *Species diversity of the Okavango Delta, Botswana*, Aquatic Science, 68, 310-337

Rejwan, A. (2011). *The State of Israel: National Water Efficiency Report*. Water Authority.

SADC (2010). *Joint Limpopo River Basin Study – Scoping Report*. Financed by SADC, GTZ AND DFID. BIGCON Consortium.

SADC, (2005). *“Regional Strategic Action Plan on Integrated Water Resources Development and Management, Annotated Strategic Plan – 2005 – 2010.”* pp 68.

SADC, (2001). *Revised Protocol on Shared watercourses*.

SADC, (2001a). *Regional Strategic Action Plan for IWRM in SADC (1999- 2004)*.

SADC, (2006). *Regional water policy*.

SADC, (2007). *Regional water strategy*.

SADC (not dated). *Climate change adaptation in SADC: a Strategy for the Water Sector*.

Sadoff,C and M.Muller, (2009). *Water management, water security and climate change adaptation: early impacts and essential responses*. TEC Background Papers No.14.

Scudder, T., Manley, R.E., Coley, R.W., Davis, R.K., Green, J., Howard, G.W., Lawry, S.W., Martz, P.P., Rogers, P.P., Taylor, A.R.D., Turner, S.D., White, G.F. & Wright, E.P. (1993). *The IUCN Review of the Southern Okavango Integrated Water Development Project*. Gland: IUCN Communications Division

SMEC and EHES, (2006). *Review of the 1991 Botswana National Water Master Plan*.

SMEC and Knight Piesold, (1991). *The National Water Master Plan*.

SMEC *et al.*, (2003). *National Master Plan for Wastewater and Sanitation*.

Thomas, A. (2003) *NGO’s Role in Limiting National Sovereignty over Environmental Resources of Global Significance: The 1990 Campaign Against the Southern Okavango Integrated Water Development Project*, Journal of International Development, Volume 15, 215-229

- Tlou, T. (1972) The Taming of the Okavango Swamps - the Utilization of a Riverine Environment $\pm 1750 - \pm 1800$. In: *Botswana Notes and Records, Volume 4*, Botswana Society, Gaborone. Pp 147-159
- Tompkins, R (2007). *Institutional Structures in the four Orange Basin States. Orange River Integrated Water Resources Management Plan.*
- Turpie, J. et. al. (2010). *Climate change vulnerability and adaptation assessment for Namibia's biodiversity and protected area system.* Ministry of Environment and Tourism, Windhoek.
- UN Water, (2006). *Gender, Water and Sanitation: A Policy Brief.*
- UNSD, (2006). *System of environmental-economic accounting of water (final draft).*
- UN-Water and GWP, (not dated). *Roadmapping for advancing IWRM Processes.*
- UN-Water, (2008). *Status report on IWRM-WE Plans. Prepared for the 16th session of the Commission on Sustainable Development.*
- VanderPost, C. (2006) *Pathways of Human Sprawl in Wilderness Buffer Zones*, Population and Environment, Vol. 27, No. 3, 285-306
- Vanderpost, C. (2007) *Protected areas in Ngamiland, Botswana: investigating options for conservation-development through human footprint mapping*, International Journal of Environmental Studies, Vol. 64, No.5, , 555-570
- Vision Council, (1996). *Botswana's Vision 2016*
- Water Commission (2002). *Transitional Master Plan for Water Sector Development in the Period 2002-2010.* Ministry of National Infrastructure
- WHO and UNICEF (2010) Progress on sanitation and drinking water: 2010 up-date.
- Wilk, J., and Kgathi, D. (2007) *Risk in the Okavango Delta face of social and environmental change*, GeoJournal, 70:121-132
- Wolski, P. (2005) *Waters of the Okavango Delta*, Fact Sheet, HOORC, Maun.
- Wolski, P., and Murray-Hudson, M. (2006) *Flooding dynamics in a large low-gradient alluvial fan, the Okavango Delta, Botswana, from analysis and interpretation of a 30-year hydrometric record*, Hydrology and Earth Systems Sciences, 10, 127-137

Wolski, P., and Murray-Hudson, M. (2008) *An investigation of permanent and transient changes in flood distribution and outflows in the Okavango Delta, Botswana*, *Physics and Chemistry of the Earth*, 33, 157-164

World Bank, (2009). *Technical advice for Reform of the Water and Sanitation Sector (vol 1 & 2)*. Government of Botswana.

World Bank (2010). *Botswana climate variability and change: understanding the risks. Policy Note prepared for the Government of Botswana*.



Botswana Water Partnership



Botswana Water Partnership Secretariat

Kalahari Conservation Society

P. O. Box 859

Gaborone

Botswana

Tel: +267 3974557

Email: ceo@kcs.org.bw