

An overview of key strategic issues in the Okavango basin

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Abstract

The Okavango basin, consisting of the Okavango River catchment plus the Okavango Delta, is an important and yet highly vulnerable component of the larger Makgadikgadi basin, which comprises portions of four southern African countries. Though the Okavango River and its tributaries are vital sources of water in an otherwise arid region, all plans to use water from this system have attracted intense local and international concern. The three underlying principles of state sovereignty, state responsibility and good neighbourliness between states are linked directly to the relationships between states and form the basis for transfrontier cooperation on all issues. In addition, several other strategic factors will also need to be considered by the basin states when a management plan is developed for the Okavango system. Ultimately, effective management of the Okavango basin and its water resources will depend on close collaboration and mutual trust between the states concerned.

Introduction

Water is an extremely precious and important resource in southern Africa, where all aspects of social and economic development are totally dependent upon the availability of adequate water supplies (Conley 1995; SARDC 1996; Ashton 2000a). Areas that possess sufficient water can attract and sustain a wide variety of human activities, while water-short areas are sparsely populated and inhospitable. In addition to directly supporting human life and economic activities, water also maintains all ecosystem components and functions that provide the basic life support systems for humans. Until recently, however, competing human and ecosystem needs for water in regions where water supplies were scarce or unpredictable were often resolved in ways that damaged or degraded the ecosystems concerned (Pallett 1997). This is being replaced by a growing awareness that many current methods of water resource exploitation cannot be sustained indefinitely and should be replaced by new approaches that avoid or minimise conflicts between human and ecosystem needs for water (Shela 1996; Ashton 2000b). This change in emphasis is particularly important for transboundary systems shared by more than one country.

The sustainable management of transboundary river systems shared by more than one country relies on the collective goodwill and collaborative efforts of all the basin states involved (Wolf 1999; Lundqvist 2000; Ashton 2002). The provisions of national and international water law, as well as any international or regional watercourse management treaties and protocols ratified by the basin states, help to guide the activities of individual countries sharing a river basin (Wouters 1999). In the final analysis, however, it is the decisions and actions of national governments and individual stakeholders that play a decisive role.

In southern Africa, the water-rich Okavango Delta and its tributary rivers provide a classical example of a transboundary system where human and ecosystem needs compete for scarce water supplies in an otherwise arid region (McCarthy & Ellery 1998). Because of its perennial flows, the Okavango River and the world-renowned Okavango Delta system function as a form of "linear oasis" (Bethune 1991). The comparative abundance of water supplies has prompted numerous plans and attempts to divert or abstract water from the system for domestic, agricultural and industrial uses (UNDP/FAO 1976; JVC 1993; Heyns 1995a). Most of these attempts have not proceeded because of the adverse social, economic or environmental consequences that could arise (IUCN 1993) and, to date, very small quantities of water are withdrawn from the system (MGDP 1997; Ashton 2003). As a result, the Okavango River and Okavango Delta system remain largely intact from an ecological viewpoint while the need for water remains acute, or is worsening in many surrounding areas.

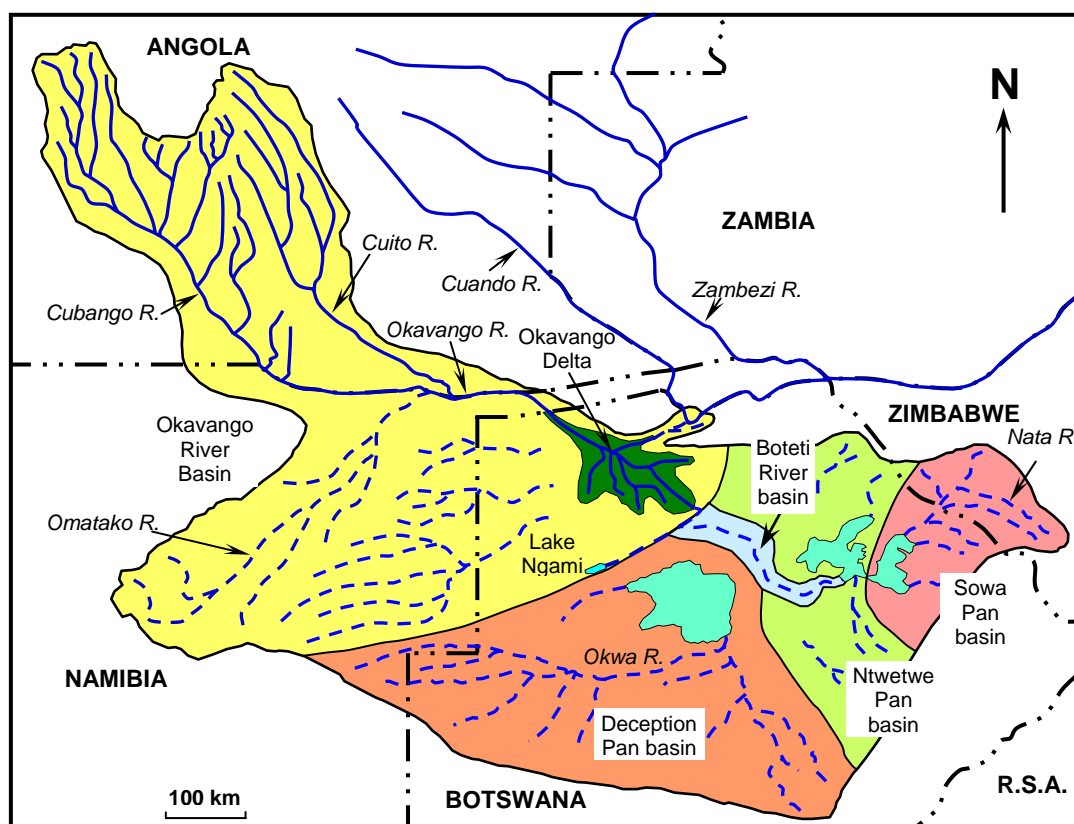
The extraordinarily rich biodiversity and scenic beauty of the Okavango Delta and its component ecosystems have attracted widespread national and international concern about the future of this unique system (Ellery & McCarthy 1994; Ramberg 1997). In particular, attention has been focused on attempts to avoid forms of manipulation or management that could lead to adverse ecosystem changes. While many individuals, organisations and governments welcome this attention, some see it

as a subtle form of external interference in matters of territorial sovereignty (Heyns 1995b; Pallett 1997). Recurring droughts and escalating regional water shortages in Botswana and Namibia (Ashton 2000a; 2000b; 2003), coupled with mounting local and international concerns for the biological integrity of the Okavango Delta and its inflowing rivers, have accentuated the need to reach consensus on appropriate ways of managing the system (Ellery & McCarthy 1994). Since the Okavango catchment drains three countries (Angola, Botswana and Namibia), all stakeholders and authorities must agree on any water resource management actions that are deployed.

In an attempt to assist these efforts, this chapter examines the different strategic issues that already, or may in future influence water resource management decisions and actions in the Okavango basin. Particular attention is paid to the role and influence of international treaties and protocols to determine the type and degree of control that they could (or should) exert on stakeholders and authorities. Importantly, an assessment of this nature relies on a clear understanding of the basic features of the Okavango system, as well as the demands for water that could be made of it. Accordingly, this chapter provides a brief background description of the geographical and hydrological context of the Okavango system, as well as its role, linkages with, and importance within the larger Makgadikgadi drainage basin.

Geographical and hydrological context

The Okavango system forms part of the Makgadikgadi basin, which drains portions of four countries (Angola, Namibia, Botswana and Zimbabwe; see **Map 1**) and is one of the driest and most sparsely populated catchments in southern Africa. The basin is endorheic (internally draining), and receives inflows from one perennial river system in the north-west (the Okavango River), as well as several smaller, ephemeral or episodic rivers in the drier southern portion of the basin, which only contain surface water flows for short periods after heavy rainfall (Pallett 1997). Spatial and temporal variations in rainfall over the catchment cause wide differences in the quantities of runoff that each sub-basin contributes to the overall Makgadikgadi basin system (McCarthy et al 1998; 2000; Ashton 2003).



Map 1. The Makgadikgadi basin, showing the extent of the four sub-basins, the Okavango Delta, the Boteti River drainage basin and the different tributary rivers. Ephemeral and episodic rivers are shown as dashed lines, while perennial rivers are shown as solid lines. Source: Map redrawn from UNDP/GEF (2001).

Based on its topographic and hydraulic characteristics, the Makgadikgadi basin can be divided into four distinct sub-basins or catchments that seldom have direct hydraulic contact with one another, and a small river basin (the Boteti River) that directs occasional outflows from the Okavango Delta to the Makgadikgadi pans. Ntwetwe and Sowa pans comprise the Makgadikgadi Pan system in the east, while the Deception Pan complex forms the southern portion of the basin. Sowa Pan, the easternmost sub-basin of the Makgadikgadi basin, receives seasonal inflows from the Nata River system that rises in western Zimbabwe (Pallett 1997; Ashton 2000a; **Map 1**). Apart from the more obvious surface water resources in the Makgadikgadi basin, there is some evidence that the southern portions of the basin may be more closely linked together through a series of shared groundwater aquifers (MGDP 1997). However, the full extent of these possible groundwater linkages is unknown and will need to be clarified in future.

The areas of the different sub-basins of the Makgadikgadi basin are shown in **Table 1**. The Makgadikgadi basin covers an area of approximately 725,293 km², with Botswana providing the largest proportion (46.9%), followed by Angola (27.6%), Namibia (22.7%) and Zimbabwe (2.8%). The Okavango catchment or sub-basin covers an area of some 413,550 km² (in Angola, Botswana and Namibia), with an additional 15,844 km² contributed by the wetland area of the Okavango Delta plus its islands (in Botswana). The combined area of the Okavango sub-basin and the Okavango Delta comprises approximately 59% of the Makgadikgadi basin (**Table 1**).

Table 1. Comparison of the area of each Makgadikgadi sub-basin within the different countries comprising the basin, and their proportional contribution to the area of the Makgadikgadi basin. (See **Map 1** for the position of each sub-basin).

Sub-basin	Country contribution (km ²)				Total area (km ²)	Proportion (%)
	Angola	Botswana	Namibia	Zimbabwe		
Okavango River	200,192	59,575	153,783	0	413,550	57.02
Okavango Delta	0	15,844	0	0	15,844	2.18
Boteti River	0	10,920	0	0	10,920	1.51
Deception Pan	0	11,241	11,241	0	164,543	22.69
Ntwetwe Pan	0	74,028	0	0	74,028	10.21
Sowa Pan	0	26,389	0	20,019	46,408	6.39
Totals	200,192	340,058	165,024	20,019	725,293	100.00
Proportion (%)	27.60	46.89	22.75	2.76	100.00	

Direct rainfall in the Okavango Delta contributes approximately a quarter (3,205 Mm³ = 24.5%) of the total annual water budget, while the Okavango River inflows provide 75.5% (McCarthy et al 1998; 2000; Ashton & Manley 1999). For the period 1932 to 2001, the annual Okavango River inflow at Mohembo has averaged 9,863 Mm³. Overall, the Angolan portion of the Okavango catchment provides some 94.5% of the total runoff in the Okavango River, while 2.9% originates in Namibia and the remaining 2.6% is contributed by Botswana (Ashton & Manley 1999; **Table 2**). In effect, virtually all of the surface runoff is contributed by slightly less than half (46.6%) of the Okavango catchment (413,550 km²), while the remainder (53.4%) contributes almost nothing to the catchment's surface water resources (**Table 2**).

Table 2. Comparison of country contribution and relative proportion of the Okavango basin contributing to average annual river inflows at Mohembo.

Country	Country contribution to average annual river inflows (Mm ³)	Country contribution to annual average river inflows (%)	Area of Okavango basin contributing to annual river inflows (%)	Area of Okavango basin NOT contributing to annual river inflows (%)
Angola	9,320.5	94.5	38.7	0.9
Botswana	256.4	2.6	3.8	36.7
Namibia	286.1	2.9	4.1	15.8
Total	9,863.0	100.0	46.6	53.4

Prolonged periods of severe drought during the 1980s and 1990s reduced annual flows in the Okavango River at Mohembo by between 15% and 45% (**Figure 1**; McCarthy et al 2000; Ashworth

2002; Ashton 2003), with a corresponding decline in the long-term average annual inflow. Flows in many other southern African river systems show similar patterns of decline during the last 20 years and this pattern seems to be part of an 80-year cycle of high and low flows (McCarthy et al 2000). Declining inflows to the Okavango Delta have been matched by equally dramatic declines in the volume of water flowing out of the Okavango Delta to the Thamalakane and Boteti rivers (Ashton & Manley 1999; Ashworth 2002). These declining river flows have coincided with periods of growing demand for water to meet the needs of domestic and other water users in Botswana and Namibia (MGDP 1997; Ashton 2003).

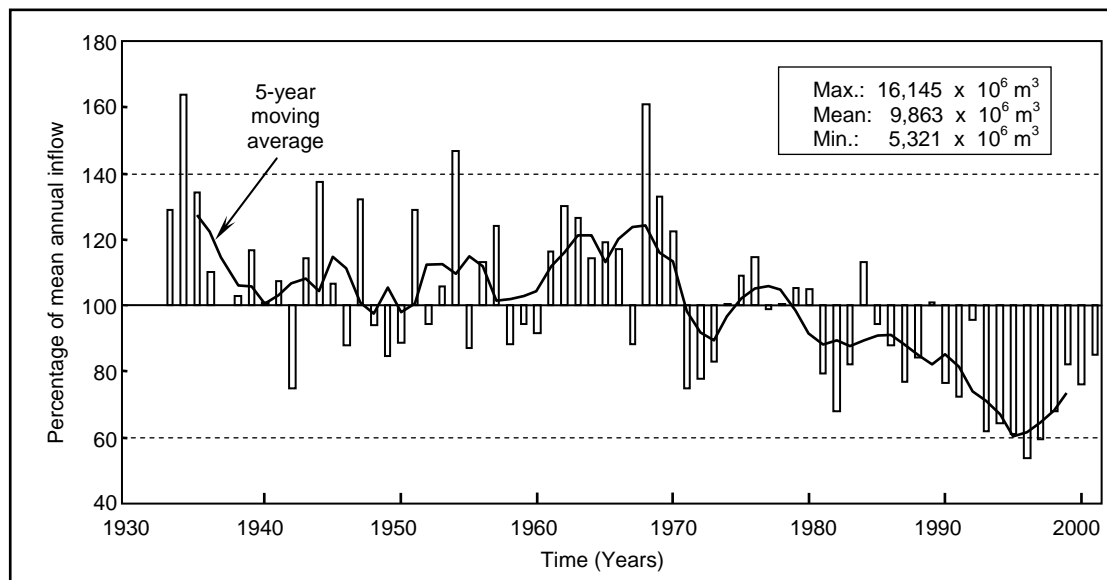


Figure 1. Annual variations from mean annual flow (100%) in the Okavango River at Mohembo for 1933-2001, compared with the five-year moving average for the same period. (Data for 1932-1974 were calculated from flows gauged at Mukwe, a short distance upstream in Namibia (Ashton & Manley 1999); data for 1975-2001 reflect flows measured at Mohembo, taken from McCarthy and others (2000) and Ashworth (2002). Each hydrological year runs from 1 October to 30 September.)

Because the use of water by one country in a shared river basin can influence users in other states, it is essential that water use should be carefully regulated to prevent unintentional hardship or conflict (Wouters 1999). International water law, as well as treaties, protocols and specific national policies and legislation provide critically important cornerstones for the effective and efficient management of shared water resources. However, while legal regulation of the interests and sovereignties of individual basin states may be necessary, this presents challenges that are both technical and judicial in nature (Pallett 1997). It is therefore appropriate to review the context in which international water law and the provisions of other international treaties and protocols may apply to the Okavango basin.

International water law

Importantly, international water law lacks the compulsory jurisdiction and enforcement that characterise domestic legal systems. Rather, it relies on its acceptance by the affected states and the opinion of the wider world community. The basis of modern international water law has been derived over many decades and the most notable achievement has been the development of the Helsinki Rules on the uses of international rivers (ILA 1966). The principles embodied in these rules have been expanded into a set of 33 draft articles that are designed to assist each basin state in negotiating a reasonable and equitable share in the beneficial uses of available water resources (ILC 1994). These articles form core components of the United Nations Convention on the Law of Non-Navigational Uses of International Watercourses (UNCSW 1997) (key practical issues linked to the Helsinki Rules are listed in **Text Box 1**).

The draft articles drawn up by the International Law Commission strongly promote the concepts of prior and ongoing consultation between basin states, and the mutual sharing of data and information in reaching consensus (ILC 1994). A key aspect of these articles is that, in the event of two states coming into conflict, the obligation not to cause harm to another state prevails over the concept of equitable use

that is stated in the Helsinki Rules (Wouters 1999). This is based on the argument that the use of water by one state cannot be equitable if it causes harm to another (ILC 1994). The principle of equitable sharing does not mean that each state has an equal share (of the water), but rather that the social and economic needs of each state must be accorded equal consideration when arriving at a judgement.

Text Box 1. Practical aspects of the Helsinki Rules

In the determination of a country's reasonable and equitable share of the water of an international (shared) river, the Helsinki Rules (ILA 1966) suggest a number of factors that must be considered and taken into account. Some of these factors are:

- The geography of the basin, particularly the extent of the drainage basin in the territory of each state;
- The hydrology of the basin, and the contribution of water by each state;
- The climate affecting the basin;
- The nature of the use of water from the basin in the past, present and future;
- The population dependent upon the water of the basin in each state;
- The economic and social needs of each state and the comparative costs of alternative means of satisfying these needs;
- The availability of alternative water resources and the comparative costs of utilising these resources;
- The avoidance of unnecessary waste in the use of the water of the basin;
- The possibility and practicality of compensation to one or more basin states as a means of resolving or adjusting conflicts between basin states; and
- The degree to which the needs of one state may be satisfied without causing substantial injury to another basin state.

Importantly, the Helsinki Rules claim that a basin state may not deny another state the reasonable use of water in an international drainage basin for the purpose of reserving the water for itself. Furthermore, an existing reasonable use may also continue unless it can be shown that it needs to be changed or stopped to accommodate a more beneficial and urgent use. This creates the possibility of making future adjustments, reflecting the flexible nature of the Helsinki Rules.

In addition, the draft articles indicate that all states sharing an international river basin should jointly form a river basin management authority or organisation that can equally represent the interests of each state (ILC 1994). This approach has been adopted successfully elsewhere in southern Africa (Pallett 1997) and is the basis for the Permanent Okavango River Basin Water Commission (OKACOM) agreement between Angola, Botswana and Namibia (OKACOM 1994).

National policies and legislation

In the context of national policies and legislation, Angola, Botswana and Namibia have clear policies and laws that govern the ownership and use of water and land. In each country, the respective national constitutions consider all water to be a national (public) good that is owned by the state, where the relevant state department administers all water uses on behalf of the state (Republic of Botswana 1990; Republic of Namibia 2000a; ANGOP 2002). A brief summary is provided for each country below.

Angola

In Angola, the management and use of water are currently regulated as part of the Environmental Framework Law (Republic of Angola 1998). This law is based on articles 12 and 24 of the Angolan Constitution (Republic of Angola 1992) and defines the framework for protection and management of the environment and all natural resources, while promoting the principles of sustainable development and the guidelines of Agenda 21. A specific Angolan Water Law that incorporates these features has been developed (Ministry of Fisheries and Environment 2000; Russo et al 2002) and has recently been promulgated (ANGOP 2002).

In terms of Angolan law, all water is owned by the state, and the relevant organ of the state (government department) is the formal custodian of the country's water resources. Water resource management is decentralised to provincial authorities wherever possible (ANGOP 2002). With the recent cessation of the Angolan civil war, the Angolan government's overriding concern has been to overcome the social, economic and environmental damage caused by this protracted conflict. Accordingly, policy frameworks and strategic plans are based on the fundamental principle that the sustainable use of the natural environment is essential. This is encapsulated in two key documents, the National Environmental Management Programme (PGNA) and the National Environmental Strategy (ENA). Responsibility for the formulation and implementation of all aspects of environmental management currently lies with the Ministry of Fisheries and Environment (Russo et al 2002). At present, water use in Angola is administered by the Department of Agriculture since agriculture is the largest water use sector in the country. The Angolan Department of Water Affairs will administer Angola's new water law now that it has come into effect.

Botswana

The Botswana Department of Water Affairs, part of the Ministry of Mineral Resources and Water Affairs, is the designated custodian of Botswana's water resources (Khupe 1994). Importantly, the line function activities of any other ministries that can impact on the use of water resources, or otherwise lead to their degradation, has to be coordinated through the Department of Water Affairs. This is in line with Botswana's Constitution and its national policies of environmental conservation and resource protection (Republic of Botswana 1990; 1991; Khupe 1994).

In Botswana, ownership of all land and water rests in the state. Traditional land and water use patterns are respected in the constitution of Botswana and take precedence over new developments. All proposals for new water development projects must comply with the requirements of the National Water Master Plan (Khupe 1994). Several of Botswana's natural resource and land management policies, as well as policies that relate to land ownership and tenure, have important implications for the use of surface and groundwater resources (Khupe 1994). All developments related to water, or likely to impact upon water resources are required to meet the provisions of the National Water Master Plan (SMEC/KPB/SGAB 1992).

Currently, there is a high level of collaboration between government ministries within a national planning framework around the conservation of natural resources. Since independence in 1966, Botswana has produced several phased National Development Plans and, in addition, has a comprehensive National Water Master Plan that is regularly updated (SMEC/KPB/SGAB 1992). All water resource developments in Botswana are now coordinated closely with the aims and objectives of Botswana's National Development Plans (Khupe 1994).

Namibia

In Namibia, the Department of Water Affairs is part of the Ministry of Agriculture, Water and Rural development (MAWRD), and is responsible for water resource management (Heyns 1995b). The supply of water for domestic and industrial purposes is controlled by the state-run utility, NamWater (Heyns et al 1998).

In Namibia, the control, conservation and use of water used to be regulated by the Water Act No. 54 of 1956 (including amendments up to 1979) and the Water Amendment Act No. 22 of 1985 (Heyns et al 1998). These two acts were originally promulgated in South Africa and were applied during the period prior to, and shortly after Namibia's transition to independence. A new Water Act for Namibia is in the process of being finalised (Republic of Namibia 2000a). Under the original (South African) Water Act (which still holds in Namibia until the new act is passed by parliament), riparian landowners have a right to use (but not to own) surface water that flows across their land or which lies adjacent to their land (Heyns et al 1998).

The Namibian Department of Water Affairs is charged with the responsibility of acting as custodian for the country's water resources (Heyns 1995a; Republic of Namibia 2000b). The line function activities of several other ministries (e.g. the ministries of Lands, Resettlement and Rehabilitation, of Environment and Tourism, of Works) can have a major impact upon the country's water resources. These activities are coordinated through the Department of Water Affairs (JVC 1993; Heyns et al 1998). This is in line with the concern for environmental issues, and the prevention of natural resource

degradation, as expressed in the Constitution of the Republic of Namibia (Republic of Namibia 1989). Namibia's Second National Development Plan (NDP2), which covers the period until 2006 (Republic of Namibia 2001) makes explicit reference to the key role that water plays in Namibia's development plans and the need to align the activities of all government departments that have an influence on the country's water resources (Heyns et al 1998).

International conventions and treaties

In addition to the framework for international cooperation provided by the principles embodied in international water law, certain international conventions (**Table 3**) are also relevant to water management decisions in the Okavango basin, since these have either been signed, ratified or are being considered for future accession by the basin states concerned. The key provisions of the five international conventions and the respective responsibilities that they place on those states that have agreed to comply (or who may in future agree to comply) are briefly reviewed below.

Table 3. Ratification dates of key international conventions by Angola, Botswana and Namibia.

Country	Ratification date				
	Ramsar#	UNCBD#	UNCCD#	UNCSW#	UNFCC#
Angola	N/P**	1 Apr 1998	30 Jun 1997	N/P**	17 May 2000
Botswana	9 Dec 1996	12 Oct 1995	11 Sep 1996	N/P**	27 Jan 1994
Namibia	23 Aug 1995	16 May 1997	16 May 1997	N/P***	19 May 1995

Ramsar = Ramsar Convention on Wetlands of International Importance

UNCBD = United Nations Convention on Biological Diversity

UNCCD = United Nations Convention to Combat Desertification

UNCSW = United Nations Convention on the Non-Navigational Uses of International Watercourses

UNFCCC = United Nations Framework Convention on Climate Change

** N/P: not yet party to convention (based on available information)

*** Namibia has signed the UNCSW, but has not yet ratified it.

Ramsar Convention on Wetlands of International Importance

The Ramsar Convention on Wetlands of International Importance seeks to promote international awareness and cooperation in the conservation of threatened wetland ecosystems, particularly where these ecosystems support unusually large numbers of specific species or an unusually wide diversity of species. Wetlands that are considered to have special significance in an international or global context are judged to be of particular importance (Ramsar 1971).

Both Botswana and Namibia have ratified the Ramsar Convention, while Angola (together with four other southern African countries) is still considering its position. Among the key provisions embodied in its charter (Ramsar 1971), the convention requires each contracting party to:

- Designate at least one wetland to be included in the List of Wetlands of International Importance;
- Formulate plans that promote the conservation and wise use of wetlands in their territory; and
- Consult with other contracting parties regarding the implementation of the convention's obligations, especially where a designated wetland and its associated water system extends over the territories of more than one contracting party.

In accordance with these requirements, Botswana and Namibia have each registered and declared appropriate wetland systems as of 'international importance'. Botswana's listing of the Okavango Delta as a Ramsar site in 1996 has accorded this system the status of a wetland of international importance, and the designated area of the site (65,000 km²) makes it the largest designated Ramsar site in the world. The site encompasses the 15,844 km² Okavango Delta and its islands (table 1), plus a wide area of peripheral drainage and associated terrestrial ecosystems that are some three times larger than the Okavango Delta itself. The designation of the Okavango Delta as a Ramsar site has been widely welcomed by local and international bodies that have long recognised the unique and valuable nature of the system.

As noted above, one of the specific provisions of the Ramsar Convention requires other contracting parties that share part of a designated site or its inflowing rivers to participate in the conservation and wise use of the designated site (Ramsar 1971). Thus, while the Okavango Delta is physically located

in Botswana, as a contracting party to the convention, Namibia is also obliged in terms of the Ramsar Convention to contribute to conservation efforts since some 3% of the water that enters the Okavango Delta originates within Namibia's borders (Wilson & Dincer 1976; McCarthy et al 1998; Ashton & Manley 1999). The fact that Angola is not yet party to the Ramsar Convention is worrying, since it contributes over 94% of the river inflows to the Okavango Delta. Angola is considering its position in this regard, which is a promising prospect.

United Nations Convention on Biological Diversity (UNCBD)

Together with every other country in southern Africa, Angola, Botswana and Namibia have ratified the United Nations Convention on Biological Diversity (UNCBD) and aligned themselves with the convention's articles and provisions. The articles of the convention clearly affirm that contracting parties retain the sovereign right to exploit their own resources in accordance with their own environmental policies. However, in doing so, they bear the responsibility to ensure that activities within their jurisdiction do not cause damage to the environment of other states or of areas beyond the limits of their national jurisdiction (UNCBD 1992). Other key articles of this convention that refer explicitly to transboundary resource use, oblige contracting parties to:

- Cooperate with other contracting parties, either directly or through competent international organisations, in respect of areas beyond national jurisdiction and on other matters of mutual interest, for the conservation and sustainable use of biodiversity; and
- Introduce appropriate procedures that require environmental impact assessments of its proposed projects that are likely to have significant adverse effects on biodiversity aiming to avoid or minimise such effects and, where appropriate, allow for public participation in the procedures (UNCBD 1992).

Since all three basin states have ratified this convention, they are required to bear in mind any activities taking place within their borders that may have a detrimental effect on the biodiversity and ecological functioning of systems located outside their jurisdiction. In terms of these provisions, any decision by a basin state to utilise any of the water resources that sustain the biodiversity of the Okavango River or the Okavango Delta should be agreed to by all basin states.

United Nations Convention to Combat Desertification (UNCCD)

The United Nations Convention to Combat Desertification addresses the problems associated with the widespread degradation of land in arid, semi-arid and dry sub-humid areas that is caused primarily by human activities and climatic variations (UNCCD 2001). All southern African countries, including Angola, Botswana and Namibia, have ratified the convention, and key provisions require contracting parties to:

- Promote cooperation among affected country parties in the fields of environmental protection and the conservation of land and water resources, as they relate to desertification and drought;
- Undertake to strengthen sub regional, regional and international cooperation; and
- Cooperate in the preparation of sub regional and/or regional action programmes to harmonise, complement and increase the efficiency of national programmes (to combat the effects of desertification).

Typically, such cooperation between neighbouring states may include agreed joint programmes for the sustainable management of transboundary natural resources, scientific and technical cooperation, and the strengthening of relevant institutions (UNCCD 2001).

Because the Makgadikgadi basin is one of the driest catchments in southern Africa, land-use patterns within the catchment can have a negative influence on the ecological structure and functioning of associated ecosystems. The location of the Okavango River and the Okavango Delta within the Makgadikgadi basin suggests that these systems may be vulnerable to activities that occur in the Makgadikgadi basin. In particular, the wider regional water shortages might emphasise demands for additional water from the Okavango system to supply the growing needs of domestic, agricultural or industrial water users (Ashton 2003).

United Nations Convention on the Law of Non-Navigational Uses of International Watercourses (UNCWSW)

The United Nations Convention on the Law of Non-Navigational Uses of International Watercourses (UNCWSW 1997) is designed to apply to the uses of international watercourses and their waters for purposes other than navigation, and to ensure that suitable measures are taken for the protection, preservation and management of these watercourses and their waters. South Africa is the only southern African country that has ratified this convention to date, although Namibia is also a signatory (Republic of Namibia 2000c). Other southern African countries are considering their positions with regard to this convention. Given the large number of shared river systems in southern Africa, this is a welcome development. To date (July 2002), an insufficient number of countries have ratified this convention for it to be in force.

However, despite the fact that the convention is not yet in force, several important provisions (UNCWSW 1997) include requirements that:

- Watercourse states must use an international watercourse in an equitable and reasonable manner. In particular, any plan to use or develop an international watercourse must seek to attain optimal and sustainable utilisation of the system and its benefits for all the watercourse states concerned.
- Watercourse states that use an international watercourse within their territorial boundaries must avoid causing significant harm to other watercourse states.
- Before a watercourse state initiates or allows the implementation of any action that could have a significant adverse effect upon other watercourse states, it must inform such states of its intentions. In addition, each state must be given all the available technical data and information, including the results of any environmental impact assessment, to enable them to evaluate the possible effects of the planned actions.
- Watercourse states – individually and, where appropriate, jointly – shall protect and preserve the ecosystems of international watercourses.
- All international watercourses and their related installations, facilities and other works shall be protected by the principles and rules of international law that are applicable in international and non-international armed conflict, and must not be used to violate those principles and rules.

In terms of the provisions of this convention, if it comes into force, Angola, Botswana and Namibia would need to ensure that any planned development (e.g. irrigation agriculture) or water abstraction from the Okavango system does not cause deterioration in the goods and services derived from the system by the other basin states. Similarly, the provisions of the convention also require contracting parties to share information on possible plans to modify river flows or withdraw water from the system, and to work together to prevent any ecosystem damage that might occur as a result of such plans being implemented.

United Nations Framework Convention on Climate Change (UNFCCC)

The primary objective of the United Nations Framework Convention on Climate Change is to achieve the stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a timeframe sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner (UNFCCC 1992). Angola, Botswana and Namibia have all ratified this convention. Although the convention is not directly related to the issues of water consumption and resource management, it plays a significant role in countries, such as these basin states, where water scarcity is an ongoing concern. In the key articles of this convention (UNFCCC 1992), contracting parties are required to:

- Cooperate to promote a supportive and open international economic system that would lead to sustainable economic growth and development in all parties, particularly developing country parties;
- Promote sustainable management, and promote and cooperate in the conservation and enhancement, as appropriate, of sinks and reservoirs of all greenhouse gases including biomass, forests and oceans, as well as other terrestrial, coastal and marine ecosystems; and
- Cooperate in preparing for adaptation to the impacts of climate change, develop and elaborate appropriate and integrated plans for coastal zone management, water resources and agriculture, and for the protection and rehabilitation of areas, particularly in Africa, affected by drought and desertification, as well as floods.

Regional treaties and protocols

Over the years, Angola, Botswana and Namibia have entered into several regional protocols and agreements with each other and with other neighbouring states. While these agreements and protocols may not be accorded the same status as global treaties, they still represent important strategic accords or contracts that formalise, assist and promote international cooperation between the respective signatory parties. The different agreements are reviewed briefly below.

Bilateral and Multilateral commissions

Angola, Botswana and Namibia have entered into several bilateral agreements with each other and with their neighbours to coordinate the management of transboundary water issues in river basins shared between them (Pallett 1997; Tarr 1998; Taylor & Bethune 1999; MAWRD 2002). These agreements have included the formation of joint permanent technical commissions (JPTC) or permanent joint water commissions (PJWC) between the countries concerned. The specific commissions are:

- Joint Permanent Technical Committee (JPTC) on the Limpopo River between Botswana and South Africa (1983);
- Permanent Joint Technical Commission (PJTC) on the Cunene River between Angola and Namibia (1990);
- Joint Permanent Water Commission (JPWC) between Namibia and Botswana, to deal with the utilisation of water resources from the Cuando/Linyanti/Chobe river system, as well as the Zambezi and Okavango rivers (1990);
- Permanent Water Commission (PWC) on the Orange (Gariep) River between Namibia and South Africa, with a separate specific agreement on the Vioolsdrift and Noordoewer Joint Irrigation Scheme (1992);
- Permanent Okavango River Basin Water Commission (OKACOM) between Angola, Botswana and Namibia (1994) (see below for further details); and
- Orange-Senqu River Commission (ORASECOM) between Botswana, Lesotho, Namibia and South Africa (2000).

In addition, the Zambezi River Basin Commission (ZAMCOM) on the Zambezi River is currently under discussion between Angola, Botswana, Malawi, Mozambique, Namibia, Tanzania, Zambia and Zimbabwe.

Revised Protocol on Shared Watercourse Systems in the SADC Region

Every member state of the Southern African Development Community (SADC) has signed the Revised Protocol on Shared Watercourse Systems (SADC 2001) that replaced an earlier version. However, only Botswana and Namibia have ratified the protocol to date (SADC 2001). The original protocol and its revision (SADC 2001) represent a significant development, and indicate shared and heightened awareness of the critical importance of water resources for the entire southern African region. Key provisions of the revised protocol include:

- The utilisation of shared watercourse systems within the SADC region is open to each riparian or basin state, in respect of the watercourse systems within its territory and without prejudice to its sovereign rights.
- Member states within the basin of a shared watercourse system shall maintain a proper balance between resource development for a higher standard of living for their people, and conservation and enhancement of the environment to promote sustainable development.
- Member states within a shared watercourse system undertake to establish close cooperation with their neighbours in the study and execution of all projects likely to have an effect on the regime of the watercourse system.
- Member states shall utilise a shared watercourse system in an equitable manner. In particular, a shared watercourse system shall be used and developed by member states to attain its optimum utilisation and for benefits consistent with the adequate protection of the watercourse system.

Clearly, the provisions of the revised protocol (SADC 2001) are very similar to those contained in the United Nations Convention on the Laws of Non-Navigational Uses of an International Watercourses (UNCSW 1997).

The provisions of the revised protocol entitle Angola, Botswana and Namibia to develop water systems that flow within the boundaries of their sovereign territories. However, the provisions also require each state to inform its neighbours of any plans to develop or modify a shared river system, to work together to ensure that each state shares in the benefits of such plans, and to ensure that environmental degradation is avoided or minimised. As the lowest state in the Okavango catchment, Botswana is the most vulnerable to any upstream developments in Angola or Namibia. Given the virtually pristine condition of the Okavango Delta at present, any sustained change to flow regimes in the Okavango River system could have significant adverse impacts on the Okavango Delta.

Permanent Okavango River Basin Water Commission (OKACOM)

In 1994, Angola, Botswana and Namibia established the Permanent Okavango River Basin Water Commission (OKACOM) to investigate ways to accommodate the legitimate water needs of the three countries in a sustainable manner, and to collaborate in the management of the basin's water resources in general (OKACOM 1994). The objective of OKACOM is to act as a technical advisor to the three contracting parties on matters relating to the conservation, development and utilisation of water resources. Each of the three parties has appointed a commissioner to represent their country's interests.

The functions of the commission, as stipulated in Article 4 of the OKACOM Agreement (OKACOM 1994), are to advise the three contracting parties on:

- Measures and arrangements to determine the long-term safe yield of the water available from all potential water resources in the Okavango River basin;
- Reasonable demands for water from consumers in the Okavango River basin;
- Criteria to be adopted in the conservation, equitable allocation and sustainable utilisation of water resources in the Okavango River basin;
- Investigations, separately or jointly by the contracting parties, related to the development of any water resources in the Okavango River basin, including the construction, operation and maintenance of any water works;
- Prevention of pollution of water resources and control over aquatic weeds in the Okavango River basin; and
- Measures that can be implemented by one or all of the contracting parties to alleviate short-term difficulties resulting from water shortages in the Okavango River basin during periods of drought, taking into consideration the availability of stored water and the water requirement within the territories of the respective parties at that time.

The OKACOM agreement specifically advocates the use of Agenda 21 principles that were developed at the United Nations Conference on the Environment and Development as an action plan for sustainable development worldwide (UNCED 1992). It also acknowledges the Helsinki Rules on the use of international waters (ILC 1966). Sustainable development is defined as "development that meets the needs of the present without compromising the ability of future generations to meet their needs and aspirations" (WCED 1987). The key principles of Agenda 21 that are relevant to the functions of OKACOM include:

- States retain the sovereign right to exploit their own resources according to their own environmental and development policies, and must ensure that all activities within their area of jurisdiction do not damage the environment of other states or areas outside the limits of their national jurisdiction.
- In order to achieve sustainable development, environmental protection shall constitute an integral part of the development process and cannot be considered in isolation from it.
- Environmental issues are best handled with the participation of all concerned citizens, at the relevant level.
- Environmental impact assessments, as a national instrument, shall be undertaken for proposed activities that are likely to have a significant adverse impact on the environment and are subject to a decision of a competent national authority.
- States shall provide prior and timely notification and relevant information to potentially affected states on activities that may have a significant adverse transboundary environmental effect and shall consult with those states at an early stage and in good faith.

Practical implications for management of the Okavango basin

The preceding discussion on national and international dimensions of water resource management has highlighted several key points in international water law, as well as in regional and international conventions and treaties that can exert a complex influence on decision-making in the Okavango basin (**Figure 2**). Importantly, international water law sets down the philosophy and tone for interstate collaboration. These principles are further defined and explained in the specific conventions that deal with particular issues.

It is important to emphasise once again that no external party is able to enforce the principles of international water law or the provisions of specific treaties and conventions (IUCN-ROSA 2001). Similarly, a third party can only be called upon to resolve a dispute if all the states concerned have agreed to such an intervention. Instead, conflict prevention depends on the goodwill of the authorities concerned, their acceptance of and adherence to the spirit underlying the principles, and their individual and collective commitment to work together in a spirit of cooperation and collaboration.

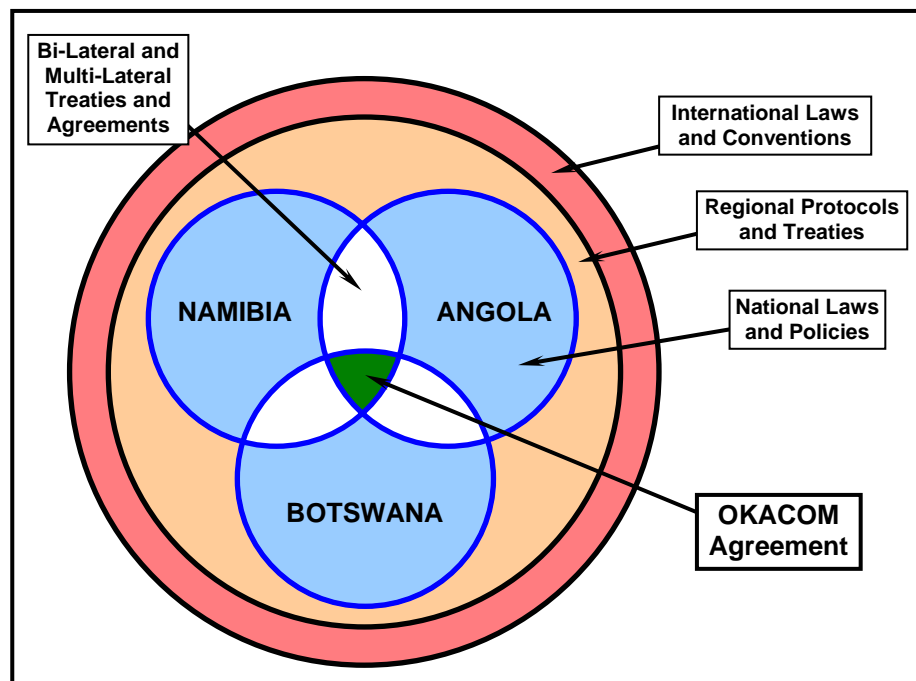


Figure 2. Diagrammatic representation of the relationships between the three Okavango basin states (Angola, Botswana and Namibia), the OKACOM agreement, other bilateral and multilateral commissions, treaties and accords, and the framework provided by national laws and policies, regional protocols and treaties, and international laws and conventions.

In every case, the three underlying principles of state sovereignty, state responsibility and good neighbourliness between states are directly linked to the relationships between states and form the foundation for transfrontier cooperation on all issues and matters of concern (Wouters 1999). In essence, the complementary nature of these principles entitle each state to act without outside interference, provided that its actions are not harmful to other states and are carried out in a manner that respects the rights of its neighbours. Two central tenets of any water-sharing agreement between states that share a particular water resource are, firstly, that each state is entitled to a fair and equitable share of the resource in question and, secondly, all water use in terms of any such agreement must be reasonable, beneficial and equitable. However, international water law and the provisions of specific treaties and protocols provide very little guidance on these contentious issues and it is left to the individual states to reach an agreement that is acceptable to all.

The SADC Treaty (SADC 1992) and the Revised Protocol on Shared Watercourse Systems (SADC 2001) provide additional definition and guidance on regional integration and cooperation between southern African states, while incorporating the three principles outlined above. Importantly, though it is not strictly prescriptive, the SADC Treaty provides an enabling environment that helps states to

address the objectives of promoting economic growth, reducing poverty, and enhancing the quality of life of all people in the region. Significantly, the SADC Treaty perceives that collaboration between states should be based on sovereign equality, respect for human rights, equity and mutual benefit to all participants, while also recognising that citizens and non-governmental organisations are important stakeholders.

International conventions and the SADC Treaty and protocols share many similarities in their objectives and intent because they were derived from similar sets of guiding principles. However, differences in managerial systems within specific countries and the diverse array of rights, obligations and practices of stakeholders have made it difficult to implement these instruments in practice (Ashton & Chonguiça 2002). In particular, the presence of a dual legal system in most southern African countries has often led to the trivialisation of customary or traditional laws and practices. As a result, many individuals and communities become alienated from management and planning processes because they perceive that their beliefs and value systems have been discounted (IUCN-ROSA 2001). In addition, management decisions taken at central government level have often ignored, marginalized or abrogated prior patterns of resource use by communities that have developed coping strategies to contend with naturally variable supplies of resources. This is primarily due to the fact that international laws and treaties are concerned with the rights of states and not those of people as individuals.

Southern African countries have recognised the need to manage water resources in an integrated way at the catchment or river basin level and are starting to set up catchment management agencies at national level and river basin organisations at regional level (Pallett 1997; IUCN-ROSA 2001). However, these structures are not yet well developed and still need to bridge the gaps between individual and community water users, central government ministries and institutions, and multilateral institutions. This is particularly difficult in the case of water resource management, because it is a multisectoral issue that affects all aspects of social and economic development (Ashton & Chonguiça 2002). An important consideration is the need for truly effective public participation in the planning processes as a means to strengthen community support for and involvement in all water resource management decisions that affect their livelihoods (GWP 2000). Community support is a critically important feature, because the collective actions of individuals and communities on the ground, rather than those of state ministries or institutions, determine whether or not water resource management principles, policies and programmes are effective.

The need to involve communities in decision-making processes is widely recognised in all international treaties and protocols, but little guidance is given on how to achieve this. The emphasis on sovereignty issues in treaties and protocols leaves it up to individual states to decide how and to what extent communities will be involved, with the result that each state tends to adopt its own preferred approaches. There is no agreed system or set of standards whereby states can ensure public participation, nor are there any guarantees that the systems used will achieve the desired outcomes (GWP 2000; IUCN-ROSA 2001). Since there are no mechanisms whereby citizens can hold states accountable for these commitments, it is also not surprising that these differences have contributed to public perceptions that there is a need for greater transparency in decision-making processes.

In terms of international law and in accordance with international treaties and protocols, states are empowered to utilise and manage the resources within their areas of territorial sovereignty (ILA 1966; ILC 1994). However, where these activities may have an influence or effect on a neighbouring state, the states concerned are required to collaborate closely with their neighbours to develop a mutually acceptable solution that does not cause harm to one or more neighbouring states (Wouters 1999). This emphasis locates responsibility for transboundary resource management firmly within the ambit of national governments and removes any form of control from communities (IUCN-ROSA 2001). Importantly, the terms and provisions of existing laws, treaties and accords seldom make any meaningful provision for possible future changes to match or take account of possible future variations in resource availability (IUCN-ROSA 2001). This issue is particularly pertinent in the case of international or bilateral agreements between countries to share a specific water resource such as the Okavango basin. As each country's demand for water grows, the declining per capita availability of water or the implications of climate change may require modifications to the original legal agreement.

The high degree of mutual trust and commitment to collaboration and cooperation that are needed to achieve the effective and integrated management of a shared water resource are seldom easy to incorporate into existing institutional structures. In reality, many of the policies, priorities and strategies that are needed extend well beyond the boundaries of conventional line-function government

departments (Ashton & Chonguica 2002). Experience gained in Africa and elsewhere has shown that an independent organisation (such as a river basin organisation) is most likely to be able to represent the interests of all countries sharing the basin in question (Lundqvist 2000; Van der Zaag & Savenije 2000; Van der Zaag et al 2000). However, experience has also shown that most river basin organisations tend to regard water development purely as a hydrological problem. Indeed, the staff complement of most of these organisations comprises technical experts from the water sector, with little or no representation from the agriculture, mining, forestry, finance and planning sectors. This hampers appropriate consideration of the multifaceted, cross-sectoral approaches that are needed to transcend traditional administrative boundaries. Unless the institutional arrangement makes provision for the integration of all these disciplines, it will not be able to demonstrate an appropriate system of corporate and public governance that meets the needs of all participants (Ashton & Chonguica 2002).

The creation of such a transboundary institution requires each state within the river basin or management unit to accept and support the roles and responsibilities of its partner countries, while committing itself to the maintenance of a spirit of harmony and goodwill among its partners (Halter 1991; OKACOM 1994; Pallett 1997; GWP 2000; Lundqvist 2000; Van der Zaag et al 2000). An important element of such international partnerships is the realisation that each party's rights and obligations are mutual and reciprocal, rather than unilateral (Wolf 1999; Van der Zaag & Savenije 2000). In the specific case of a river basin organisation, the basis for any agreement on the quantities of water required by a country relies on the ability of each country to manage its water resources in a fair and equitable manner (Ashton 2000a; 2000b; 2002).

In relative terms, Angola has abundant water resources, while both Botswana and Namibia are water-scarce countries (Conley 1995). In addition, the three countries are at different levels of social, political and economic development and each country is likely to have different priorities and objectives in terms of its future needs for water (Ashton 2003). Accordingly, each will place different degrees of emphasis on water resource management issues in its segments of the Okavango basin. Notwithstanding these possible differences, the three countries have bound themselves to the provisions of the OKACOM agreement and, in doing so, have signalled their intention to collaborate on all aspects of the future management of the Okavango basin (OKACOM 1994). This proactive agreement between the three states provides a useful framework for the possible future evolution of OKACOM into an independent, multidisciplinary river basin organisation that would be responsible for the equitable management of the basin. The recent end of the civil war now enables Angola to address the development needs of its citizens who live in the Okavango catchment and, in particular, their needs for water (ANGOP 2002).

Recent population estimates (Ashton 2000b; FAO 2000; UNAIDS 2002) suggest that the combined population of the Okavango basin was in the order of 1.113 million in 2000. Approximately 76% of the Okavango basin population live in Angola, while the Namibia and Botswana segments of the basin contain 13% and 11% of the basin population, respectively (Ashton 2000b; 2003). Despite the dramatic effects of the HIV/Aids pandemic sweeping across southern Africa (Ashton & Ramasar 2002), the Okavango basin population is likely to increase to approximately 1.686 million by 2020 (Ashton 2003). By combining the population estimates for 2000 with data on current land-use patterns (FAO 2000), the total volume of water needed within the catchment during 2000 was estimated at 23.2 Mm³/year (Ashton 2000b; 2003). Angola would require approximately 13.8 Mm³ (60%) of this total, while 4.1 Mm³ (18%) and 5.2 Mm³ (22%) would be needed by Botswana and Namibia, respectively. It is important to note that these estimates are for consumptive water needs only and exclude allowances for the water needed to maintain essential ecosystem services within the Okavango River or the Okavango Delta (Ashton 2003).

Estimates of the future water needs for the Okavango basin countries will depend on population growth rates and the development trajectories of each country. Given the available projections for Namibia (Heyns 1995a; Republic of Namibia 2000b), plus generous estimates of the possible future water needs to meet social and economic development priorities in Angola and Botswana (Ashton 2003), the combined water requirements of the three countries in 2020 would be equivalent to some 3% (300 Mm³/year) of the mean annual runoff of the Okavango River at Mohebo. Of this volume, Angola's consumptive needs would be approximately 40%, while those in Botswana and Namibia would amount to 18% and 42%, respectively (Ashton 2003).

Given that natural flows in the Okavango River have varied between -45% and +65% of the mean annual flow (McCarthy et al 2000; Ashton 2003; **Figure 1**), a 3% decrease in mean annual flow is well

within the normal range of variation (Ashton & Manley 1999) and may not appear to be significant. The wide interannual variations in natural inflows to the Okavango Delta (Ashton & Manley 1999; McCarthy et al 2000) are significantly larger than those that could occur if the anticipated needs of water users are met. The fact that these natural variations have not led to catastrophic ecological consequences in the Okavango Delta as predicted by some people (e.g. Greenpeace 1991; Ramberg 1997), supports the contention that the Okavango Delta ecosystems are resilient and have become adapted to natural variations in inflow (McCarthy et al 2000).

The absence of sufficient information regarding the scale, significance and resilience of ecosystem responses within the Okavango Delta to decreased inflows of the magnitude suggested here makes it extremely difficult to predict with any accuracy or certainty the likely scale of responses to a *sustained* decrease in inflow. While it is clear that a sustained decrease in inflows to the Okavango Delta will reduce the flooded area of this wetland (Ramberg 1997; Ashton 2000a), the precise extent and location of such a reduction and its implications are unknown. Therefore, it is essential that the likely extent and consequences of such a decrease must be fully evaluated as a matter of urgency.

Another critically important physical feature is the dependence of the Okavango Delta on inflowing loads of sediment in the form of sand transported as bed-load along the inflowing river channels. It is this sand that elevates the river channels above the surrounding terrain and allows their waters to flow outwards from the channel to inundate this land (Ellery & McCarthy 1994; McCarthy & Ellery 1998). If the inflowing sand load is reduced, for example by being trapped within an upstream impoundment, the river channels would incise into the surrounding terrain and the flooded area would be greatly reduced (Ashton 2000b; McCarthy et al 1998; 2000). This would have enormous long-term consequences for the ecological structure and functioning of the Okavango Delta. Clearly, therefore, any attempts to impound water or alter river flows in the catchment upstream of the Okavango Delta should be very carefully evaluated to ensure that such schemes do not alter the patterns of sediment (sand) transport.

In addition, it is vitally important that Angola, Botswana and Namibia collaborate to derive accurate estimates of the volumes of water that each state may justifiably require. In this process, the three countries will also need to agree on suitable criteria that can be used as the basis of decisions regarding fair and equitable shares of the water resources that each country may safely withdraw from the system for its own uses. Clearly, the three countries must also ensure that all water abstractions are carefully controlled and managed (Ashton 2000a), while any resulting impacts on the Okavango Delta are monitored and evaluated as vigilantly as possible.

The highly complex nature of the problems facing the Okavango basin states should not be underestimated. The three states will need to harness their respective resources to ensure that the solutions derived are both amicable and sustainable in the long term. While it is inevitable that the three states will need to call on external agencies for additional technical and financial assistance, great care should be taken when accepting advice or assistance from outside parties. In particular, it will be important for Angola, Botswana and Namibia jointly to avoid any externally applied pressure or coercion to achieve particular environmental or social objectives that may jeopardise the achievement of their respective national and regional goals for social and economic development. Ultimately, Angola, Botswana and Namibia share responsibility for the effective management of the water resources within Okavango basin and for maintaining cordial relations with each other.

Whatever decision is taken on the future use of water from the Okavango basin, Botswana and Namibia will continue to face escalating water shortages and must ensure that their citizens' reasonable needs for water are promptly met. Angola also faces an enormous challenge to stimulate sustainable social and economic development in the aftermath of its civil war. If the basin states fail to achieve an equitable solution to water resource management in the Okavango basin, this could hamper social and economic development in these countries and in the SADC region as a whole.

It has been suggested that Botswana and Namibia could make use of alternative water sources within or adjacent to their territories as one way of reducing their potential demands for water from the Okavango system (Conley 1995; Heyns 1995a). Given the generally arid nature and shortage of available surface water resources in both countries, groundwater resources and the respective border rivers shared with other states are likely to be the only options that can be exploited cost-effectively (Pallett 1997). Both countries already depend heavily on ground water resources and it is clear that these sources also have finite limits to their exploitation (MGDP 1997; Ashworth 2002; MAWRD 2002).

Ultimately, water abstraction from the various border rivers that Botswana and Namibia share with their neighbours offers the most likely long-term, sustainable solution for meeting the water needs of these countries (Heyns 1995b; Shela 1996).

Charting the way forward

The preceding discussion has highlighted the wide variety of strategic issues that individually and collectively influence water resource management in the Okavango basin. It is clear that these issues encompass a wide range of spatial and temporal scales, while their influence extends from local to national and international levels and spans ecological, social, economic, institutional and political frameworks. For convenience, the various strategic issues have been grouped into logical units based on their relationships to one another and the ways in which their influence is exerted (this grouping or framework is shown as a conceptual diagram in **Figure 3**). This arrangement of the key strategic issues highlights their diversity and also serves as a useful foundation on which to evaluate possible ways of moving forward. Their inter-relationships are explained briefly below.

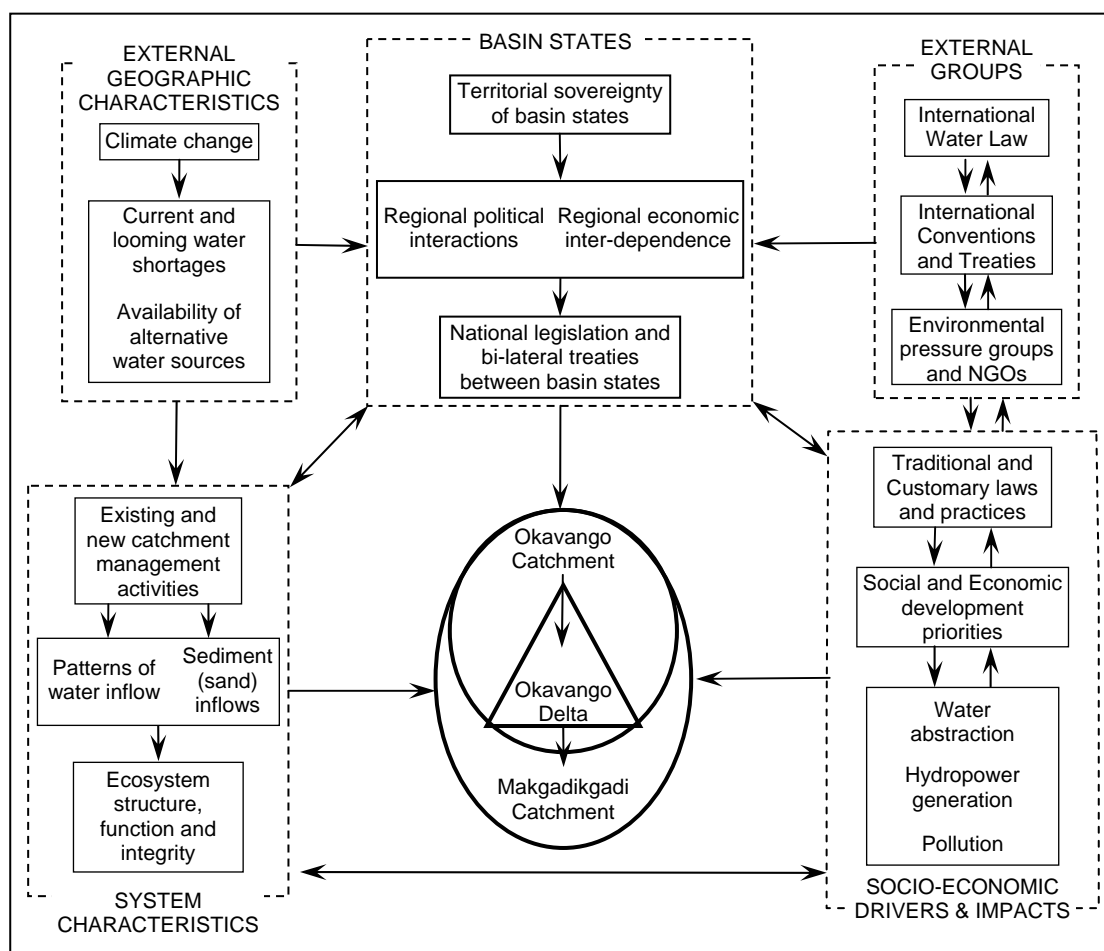


Figure 3. Components and interrelationships between groups of key strategic issues that influence decision-making in the Okavango basin and Okavango Delta.

In **Figure 3**, the central position occupied by the three basin states reflects the importance of their territorial sovereignty and their vital role in jointly reaching a harmonious solution to questions of water-sharing and water resource management in the Okavango basin and, with Zimbabwe's involvement, in the larger Makgadikgadi basin. In the case of the Okavango basin, the three basin states are supported and guided by the provisions of international laws and treaties, as well as regional and bilateral treaties, protocols and accords that have been ratified. External agencies, NGOs and even individuals also provide financial and technical support for decision-making at this level. Working together, the three states have to achieve a delicate balance between exploiting their resources to promote sustainable social and economic development within their countries, and

ensuring that the structure, functioning and integrity of the Okavango system retains its ability to deliver the required ecosystem goods and services. External characteristics, such as climate change and the looming water shortages that are also linked to the availability of alternative water resources, will typically be outside the control of the basin states, although they will influence decision-making.

This conceptual diagram and its accompanying explanation can be used by the three basin states to complement their existing deliberations and decision-making processes under the auspices of the OKACOM Agreement (OKACOM 1994). This proactive agreement between these three states is a highly significant achievement and should be supported by all parties that may be concerned with water resource management issues in the Okavango basin. In essence, OKACOM represents the most legitimate institutional vehicle for the basin states and external agencies to work together towards mutually agreeable solutions. A critically important issue that OKACOM will need to resolve is the question of what constitutes a 'fair and equitable share' of the Okavango basin's water resources that each state may use for its own purposes. There is a very strong likelihood that disputes will be avoided if this issue can be resolved to the satisfaction of all parties. Earlier, it was noted that water resource management in a shared river basin should transcend the normal line-function responsibilities of single government departments if it is to be effective. If OKACOM evolves in the future into a river basin organisation, it will be appropriate to review its existing structure and, if necessary, adapt it to ensure that it is able to reflect the diversity of needs and issues that must be dealt with. In addition, effective public participation is needed to ensure that the decisions taken can be implemented on the ground.

While the territorial sovereignty of each state is normally recognised as being paramount and unassailable in international law, states also bear several associated responsibilities that guide and direct any interactions with their neighbours. These obligations are particularly pertinent in the case of a shared water resource such as the Okavango River, because they specify that states may not act unilaterally in any way that may have an adverse impact on their neighbour(s). These principles are designed to form the backdrop for harmonious relationships between states, enabling them to reach agreement on all matters related to the exploitation of shared resources.

A number of external agencies and NGOs have expressed concern that any attempt to withdraw water from the Okavango River or its tributaries could have catastrophic consequences for the ecological structure, functioning and integrity of the unique Okavango Delta. While there is some information to substantiate these claims, the precise extent of any change and its implications for the Okavango Delta are largely unknown. From an ecological perspective, the mosaic of ecosystem components in the Okavango Delta clearly reflects the wide variety of flooding regimes that occur on annual and longer time scales. The information available indicates that the natural range of variation in river inflows far exceeds the change in flows that would occur as a result of water abstraction to meet the likely collective needs of Angola, Botswana and Namibia. Nevertheless, the high level of uncertainty about the possible consequences of sustained water abstraction from the system should be seen as a strong warning signal that the system could face serious risks of irreversible damage. As the relevant authorities, the three basin states must evaluate the likely significance of these risks and the resulting consequences if these risks are deemed to be acceptable. Recently, Gumbrecht and his co-workers (2002) at the University of the Witwatersrand used remote-sensing techniques and historical flow analyses to develop a model to predict the maximum extent of inundation in the Okavango Delta. This model appears to have a very high level of accuracy (90%) and should prove to be an extremely useful tool when water resource managers need to evaluate the likely consequences of water abstraction from the Okavango River.

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