Evolution of River Basin Management in the Okavango System, Southern Africa

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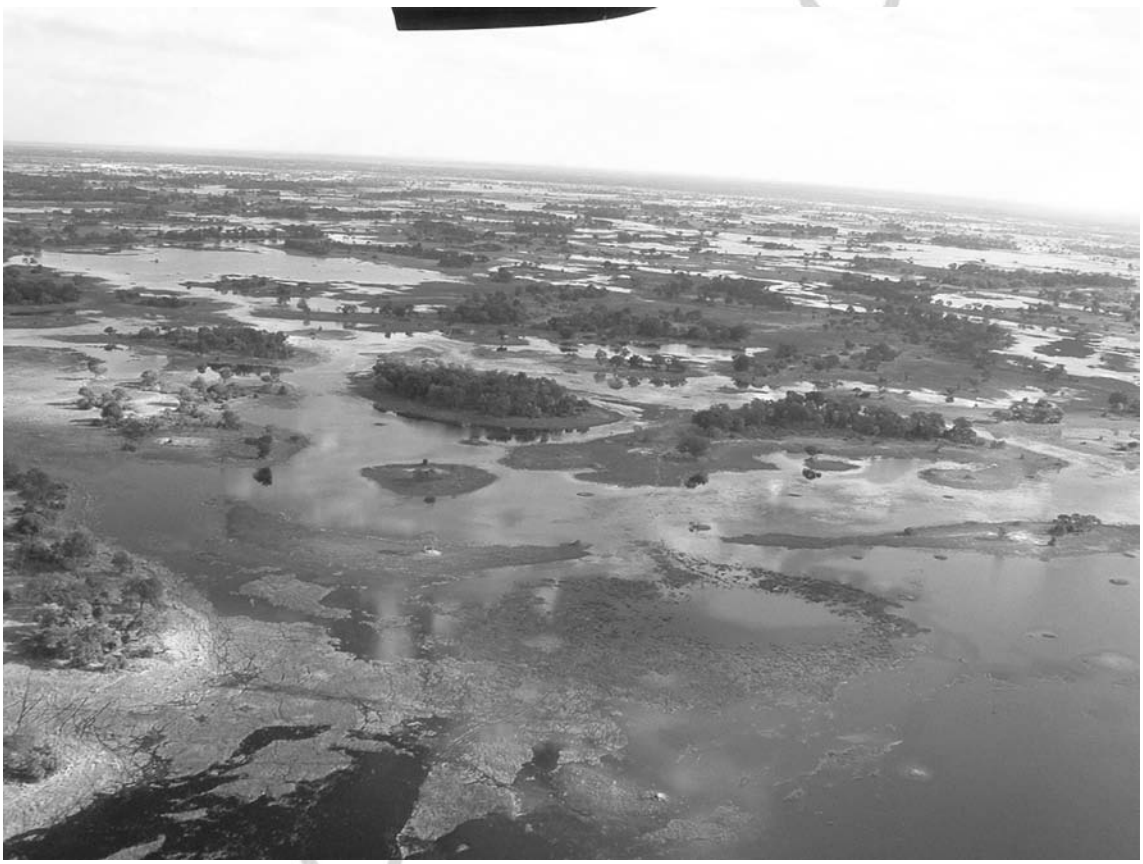

21 Evolution of River Basin Management in the Okavango System, Southern Africa

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21.1 Introduction

The Okavango River basin is a large, hydrologically unique basin containing one of the world's most magnificent wetlands – the Okavango Delta. The basin is shared between three countries: Angola, Namibia and Botswana, with multiple users, multiple interests and, hence, multiple stakeholders present within each of them. The water resources in the basin are currently little utilized, and the basin and the Delta are in near pristine conditions. This situation is not a result of conscious management efforts as these have been very weak or non-existent. Rather, it is a result of conditions in the basin, both natural and socio-economic, that have not favoured development. Almost the whole basin is on Kalahari sand that is very nutrient poor, has low agricultural potential and thus the basin has always had low population density. In Angola, from where the majority of the basin's water currently emanates, there was civil war from 1975 until 2002 and no development has taken place. In addition, the Okavango Delta in Botswana has been infested with tsetse flies, which effectively kept livestock out and thus provided an exclusive environment for African wildlife.

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With peace in Angola, population growth and an imperative to improve the livelihoods of the predominantly poor people inhabiting the basin, increased pressure on water resources in the basin is inevitable. From upstream to downstream, there is a clear gradient in development priorities. Angola is re-populating its part of the basin with agriculture as the economic cornerstone and has plans for irrigation and construction of a number of hydroelectric power plants. Namibia is putting emphasis predominantly on agriculture and irrigation. Botswana, in turn, has a thriving and economically very important tourism industry in the Okavango Delta which is based on wildlife and is dependent on the conservation of the sensitive ecosystem. There is also here, however, pressure on water resources for the growing population in the vicinity of the delta. As a result, management of the basin and its water resources requires balancing of often conflicting needs and international co-operation and co-ordination in water resource utilization (Turton *et al.* 2003).

The current management paradigm in the basin is that of sustainable development. Problems facing decision-makers in the basins are, therefore, centred on how to achieve a balanced development of local populations without compromising the integrity of the basin's natural environment and thus without jeopardizing the basis for such development. To achieve this, a

management framework has been established at the local and international levels. Here we describe how the current management institutions function, what challenges they face and what their achievements are against a background of social and natural features and processes.

21.2 Geography, Hydrology and Biology

21.2.1 Geology and geomorphology

The Okavango system is a part of the endoreic Makgadikgadi basin located in central southern Africa (Fig. 21.1). Based on hydrological differences related to geology, topography and climate the Okavango system can be divided into three parts: the Okavango River catchment, the Okavango Delta and the Boteti sub-basin.

The whole basin, apart from the headwaters of the Cubango where crystalline rocks outcrop, is covered by Kalahari sands. These are highly weathered, well sorted, fine to medium sands, of mixed aeolian-fluvial origin, the nature of which projects strongly on the character of the basin (Thomas and Shaw 1991). The headwaters of the main tributaries, the Cubango and the Cuito, occupy a topographically higher area (1500–1800 m a.s.l.) where mean annual rainfall is over 1200 mm yr^{-1} and the drainage network and topographic relief are well developed. The mid reaches of the Okavango River, as well as the Delta and Boteti basin, occupy a flat plateau (900–1100 m a.s.l) with topographic gradients smaller than 1:3000 (McCarthy *et al.* 1997). This, combined

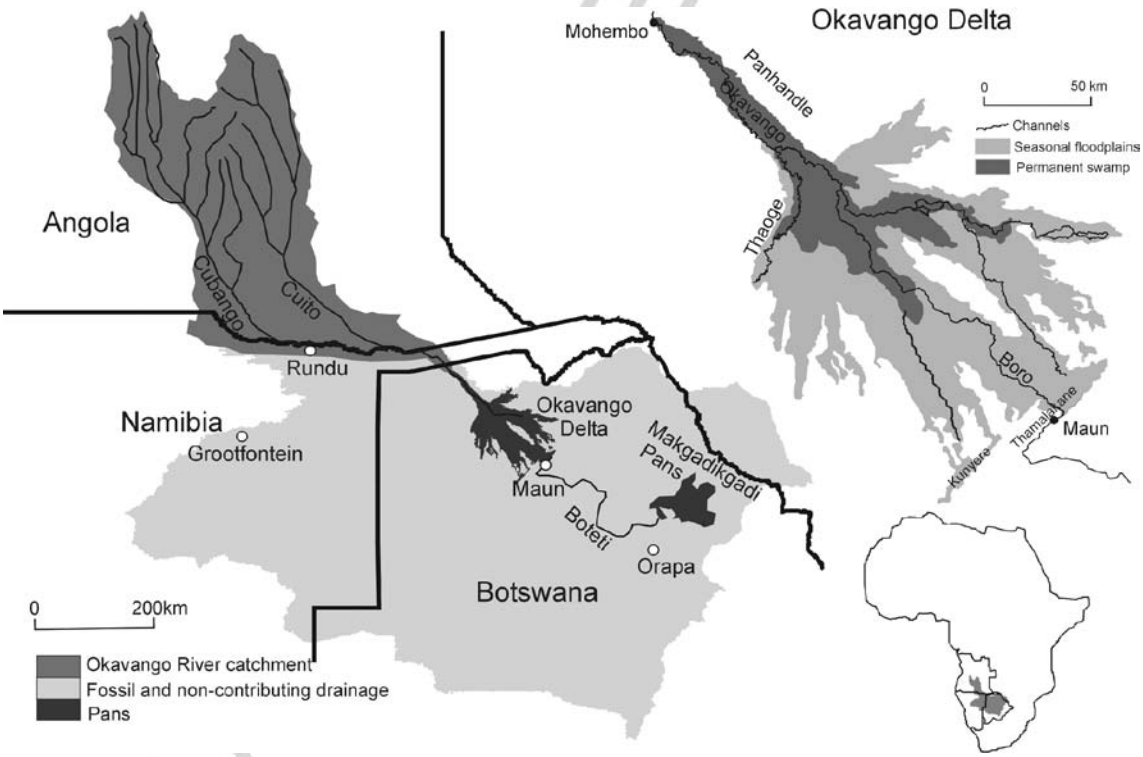

Fig. 21.1 The Okavango Basin.

with a very permeable nature of the Kalahari sands, and low rainfall (less than 450 mm yr^{-1}), makes the area essentially devoid of structured continuous drainage other than that of the Okavango River. Fossil valleys indicate, however, that in the (geological) past, rainfall in the region must have been much higher than present.

The upper part of the Okavango Delta, the Panhandle, is a broad flat-bottomed valley with anatomizing and meandering channels and a system of permanent and seasonal floodplains. The Panhandle broadens into the Okavango Delta proper, which geomorphologically is a large alluvial fan (McCarthy 1993). The upper part of the fan is occupied by a central swamp; a broad, featureless permanently inundated area. This separates into four main distributaries, each of which splits into a set of secondary distributaries. There is no consistent channel continuity within the Delta and a large part of the flow takes place in the form of overland flow through interconnected floodplains of breadth reaching 20 km. The distributaries terminate at a system of north-east to south-west trending faults, where flows are taken over by rivers collinear with the faults, the Thamalakane and the Kunyere. Two topographic depressions are present at the north-east and south-west extensions of the faults, which at times form lakes, but tend to dry out in drier periods.

The Boteti sub-basin comprises essentially a single river channel of ephemeral character, which terminates in a small alluvial fan in the Makgadikgadi pans. The Boteti River currently receives its water exclusively as a spillover from the Okavango Delta through the Thamalakane River.

21.2.2 Rainfall, runoff and flooding

The runoff from the Okavango River catchment amounts on average to 9306 Mm $annum^{-3}$, which is approximately 7% of total average catchment rainfall (Fig. 21.1, Table 21.1). This adds to approximately 4800 Mm $annum^{-3}$ falling over the Okavango Delta in the form of local rainfall. The flow into Boteti averages only 20 Mm $annum^{-3}$.

Table 21.1 Variability of inputs to the Okavango Delta: local rainfall and flow of the Okavango River

	Rainfall at Maun (mm yr^{-1})	Okavango River flow at Mohembo (Mm yr^{-3})
Annual		
Minimum	150 (1994/95)	5,266 (1996)
Maximum	1,190 (1973/74)	16,012 (1963)
Average	448 (1922–2008)	9,300 (1934–2008)
5-year period		
Minimum	314 (1925–1929)	5,909 (1993–1997)
Maximum	700 (1973–1977)	12,614 (1961–1965)

Outflow from the Delta is, therefore, only 2% of the inputs (Fig. 21.2). Evaporation in the catchment accounts for 98% of the water. Importantly, however, a significant part of the evapotranspiration takes place through terrestrial vegetation, supplied by flood water infiltration and lateral groundwater flows of local character (Ramberg *et al.* 2006b). The water balance indicates that this process uses up to 24% of the total inflow (Wolski *et al.* 2006).

Rainfall in the basin is highly seasonal, with distinct wet (November–April) and dry (May–October) seasons. The flow in the Okavango River is perennial, however, with an annual flood event. Inter-annual variability in rainfall and flows is moderate but there is evidence of dry and wet pluri-annual periods occurring at 9 and 40-year time frames (Tyson *et al.* 2002; Mazvimavi and Wolski 2006).

The flooding in the Delta is predominantly caused by the seasonal flood pulse from the Okavango River. This causes the inundation to expand along the Delta, a process that takes about 6 months, with annual minimum inundation occurring in February–March and maximum in August–September (McCarthy *et al.* 2004). Local rainfall contributes to inter-annual variation in flood extent, but causes expansion of the inundated area only during high rainfall years (McCarthy *et al.* 2004). The hydro-period conditions vary throughout the Delta. The central swamp is permanently inundated and is surrounded by a system of seasonally flooded plains,

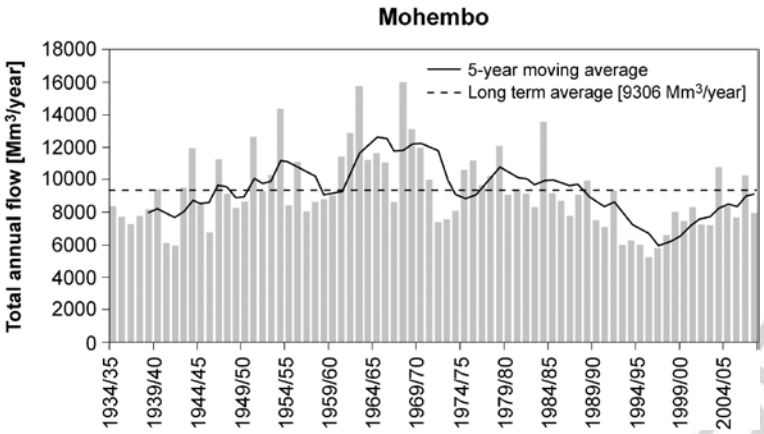

Fig. 21.2 Long-term discharge of the Okavango River at Mohembo.

but the frequency of flooding here has large variations from regular-annual to once or twice in a 40-year period. These seasonal floodplains are not fixed in space, but migrate, expand and shrink in response to inter-annual and pluri-annual variation in hydrological inputs.

21.2.3 Fate of solutes

The transport of waterborne solutes into the Delta, being in effect an endoreic system, would be expected to cause accumulation of precipitated salts at the surface. Yet the Okavango Delta is a lush, freshwater environment. This is due to the dominant role of infiltration in the system and chemical evolution of groundwater associated with Okavango Delta islands. In the model summarized by Ramberg and Wolski (2008), infiltrating water is drawn towards islands by the evapotranspirative uptake of riparian vegetation. This uptake causes a concentration of solutes that ultimately leads to precipitation of carbonates and silica to form the island's soil matrix. The groundwater, chemically enriched mainly with sodium and chloride, is trapped under the island centres due to groundwater depression caused by vegetation transpiration. This groundwater then sinks occasionally to the deeper strata through density-driven flow. The whole process leads to vertical and horizontal stratification of groundwater with freshwater localized to shallow aquifers in areas subject to inundation and saline groundwater occupying deeper parts of the aquifer and present within islands or larger land bodies. This system is kept in balance by the presence of riparian woody vegetation and continuous growth of islands. Degradation of the island vegetation belt can thus potentially lead to mobilization of saline groundwater lenses and destructive salinization of freshwater floodplains.

21.2.4 Sedimentation and abandonment of streams

The stream channels in the Okavango Delta are banked by stands of papyrus and reeds and water can easily seep across banks. The water flowing into the Delta carries little suspended sediment and the majority of sediment is carried in the form of bed load. This cannot be carried across vegetated banks and is trapped in channels, ultimately leading to channel aggradation, development of vegetation blockages and channel abandonment. This process causes major changes in the distribution of water within the Delta at timescales in the order of 100–150 years, but local changes in channel structure and flooding patterns occur at shorter timescales as well. This has clear negative consequences for human activity, as it renders waterways non-navigable,

jeopardizes infrastructure such as tourist camps and affects water supply schemes and sedentary communities whose livelihoods are based on utilization of wetland resources. It is, however, recognized as a very important process in the maintenance of the Okavango Delta ecosystem, leading to its dynamic vegetation successions and high biological productivity through release of nutrient pools during the drying phase, accumulated and stored before then within the permanently flooded areas. The most dramatic example of the process is that of the Thaoge distributary, which dried out between 1890 and 1920 and turned several thousands square kilometres of wetlands into dry Kalahari savannah. Changes at smaller spatial scales have been observed since in several parts of the system (Wilson 1973; Wolski and Murray-Hudson 2006).

As mentioned earlier, the Okavango Delta is located within a tectonically active zone. Tectonic movement is, therefore, another factor that can lead to abandonment and re-flooding of large parts of the Delta.

21.2.5 Vegetation in the basin

The Okavango basin is covered by savannah woodlands with deciduous species in the south and evergreen species in the north. *Acacia* spp. and *Colospermum mopane* dominate the south, while *Burkea* dominates the central part of the basin. In the north, *Brachystegia* dominates, but the topographically highest parts are covered by a *plan alto* grassland. Wildlife densities are generally low with the exception of the Okavango Delta but the situation in Angola is largely unknown (Mendelsohn and El Obeid 2004).

21.2.6 Biodiversity in the Okavango Delta

For the Okavango Delta area (*c.* 28.000 km^2) the number of identified plant species is 1300, fish 71, amphibians 33, reptiles 64, birds 444 and mammals 122 (Ramberg *et al.* 2006a) (Table 21.2). In the Delta there are large variations in habitat patterns over small distances, although the Delta is very flat and is made up of homogeneous sand. Small differences in altitude of 1–2 m lead to large differences in the frequency and duration of flooding, which creates habitat gradients; from permanent rivers and lagoons to permanent swamps with reeds and papyrus, to seasonally flooded grasslands; occasionally flooded grasslands; riverine woodlands and dry woodlands. Each of these ecotones has a distinct species composition not only of plants but also of reptiles, birds and mammals.

Table 21.2 Number of species in taxonomic groups of originally terrestrial origin observed in each major habitat in the Okavango Delta (modified from Ramberg *et al.* 2006)

Taxonomic group	Total number of species	Aquatic/ perennial swamp	Wetland/ seasonal swamp	Dry land/ terrestrial
Plants[a]	1061	205	519	704
Reptiles	64	7	5	52
Birds	444	112	57	275
Mammals	122	3	21	110

[a] From Snowy Mountains Engineering Corporation (1990) and therefore the total number of species differ from the figure in the text.

In a worldwide biodiversity comparison (Junk *et al.* 2006) of six globally important wetlands located in tropics and sub-tropics, the Okavango Delta had a low number of fish species, but the second highest number of plants and mammals, the third highest number of amphibians and the highest number of reptiles and birds. In particular, the number of large mammal species and their high abundance are outstanding in the Okavango Delta as compared with the other large wetlands. Wetlands, however, generally do not have high biodiversity in comparison with, for instance, sub-tropical and tropical forests, and the species richness in the Okavango Delta is about the same as that in savannah systems in Southern Africa.

A total of 46 plant habitat types have been identified in the Okavango Delta. Each specific habitat fragment, however, is fairly small (*c.* 0.05 km^2) and thus is repeated many times over the Delta landscape (Ramberg *et al.* 2006a). The

highest habitat diversity (areas with exceptionally high vegetation heterogeneity) occur along the perimeter of the wet Delta, along the Panhandle and along the major flow channels to the east and west. It is very likely that the total species diversity is also highest in these areas. The implications for the management of biodiversity in the Delta are immense since these areas are the ones that will be impacted first, probably becoming drier, if the inflow in the Okavango River is reduced by upstream developments or climate change.

21.2.7 The importance of the flood pulse

The uni-modal flood pulse sensu Junk *et al.* (1989) creates and maintains the seasonal floodplains. This ecotone forms perhaps the most important habitat in the Delta as it sustains the high abundance of grazing mammals and is very important for fish productivity.

The biomass of large mammals in African savannah systems is correlated to rainfall and nutrient status (Fritz *et al.* 2002). A model estimate, based on a large number of data, predicts a biomass in the Okavango Delta of around 1200 kg km^{-2}, while it is actually almost ten times higher and in the range of the more nutrient-rich savannah systems in Africa (Table 21.3). The prolonged period of favourable grazing caused by the flood pulse arriving several months after the rains is one reason for this. The other is the relatively high nutrient levels in the floodplains. Concentrations of phosphorus in water of seasonal floodplains are typically 7–50 times higher than in the permanent channels, while the concentrations in dry floodplain sediments are 6–10 times higher than in the dry woodland soils (Ramberg *et al.* in preparation). This enrichment is probably caused by nutrient accumulation and storage in the dry sediment/soil matrix from year to year and release when flooded.

In African flood plain systems there is a direct positive relation between flood size and fish production (Welcomme 2001) and this is the case also for the Okavango Delta (K. Mosepele, personal communication, 2008). In particular, the real high flooding years seems to provide very favourable conditions for fish reproduction (Lindholm *et al.* 2007). The flood pulsed seasonal floodplains are thus likely to be decisive for the total biological productivity in the Delta both of terrestrial grazing mammals and their large predators such as lions, leopards, cheetahs, hyenas and wild dogs, and of the aquatic fish fauna with dependent fish-eaters such as birds, otters and crocodiles.

Table 21.3 The number of species, density and biomass of large herbivores in a 6966 km^2 study area in the Okavango Delta (modified from Bonyongo 2004)

Habitat category	Number of species	Density (no. km^{-2})	Biomass (kg km^{-2})
Grassland dependent	8	29.09	6,678
Not grassland dependent	4	2.04	5,210[a]
Total	12	31.11	11,888

[a] The high biomass is caused by elephants with 4083 kg km^{-2}.

21.2.8 The importance of river channel abandonment

The large-scale switching of river channels caused by sedimentation and the resulting drying up of large areas and flooding of others described above, cause firstly a dramatic succession of vegetation where for instance woodlands are turned into grasslands, while permanent swamps are turned into woodlands. It also creates a regional nutrient pattern where the areas under flooding accumulate nutrients and the drying up areas release them with very high biological productivity as a result (Ellery and McCarthy 1994).

21.3 Historical Use and Management of the System

The population density in the whole Okavango River basin has always been low, caused mainly by the nutrient poor and low productive Kalahari sandy soils and the low, erratic rainfall with

fairly frequent periods of drought that can last 4–5 years.

Small-scale farming has been and still is the dominant source of livelihood in the basin but the value of farming varies from the north to south following the gradient in rainfall (Mendelsohn and El Obeid 2004). Normally each household cultivates a few hectares and keeps small herds of sheep and goats. In the fringes of the Okavango Delta flood recession agriculture is practised and fishing provides an important supplement. Expansion of farmers and livestock into the Delta has been restricted by the presence of tsetse flies.

Under the traditional way of utilizing the Okavango Delta some management and water control activities such as reed burning and bunding for reclaiming of agricultural land, building of dams and water diversions for farming, clearing of vegetation blockages in channels for accessibility, were carried out (Wilson 1973). These actions had only local effects and had no influence at the system as a whole (Potten 1976). Importantly, people were moving in response to variable flooding conditions. The capital of the Batawana, for instance, the largest group living in the Delta area, was moved three times during the 1800s (Wilson 1973).

The early (1850–1920) European travellers in the region regarded the Okavango Swamp as a waste of water and suggested often unrealistic schemes for its 'better' utilization such as irrigation of the Kalahari with redirected flows of the Zambezi and Okavango (Schwarz 1920). Such schemes did not, however, pass the economic scrutiny of hardnosed colonial governments. From about 1920, a number of smaller-scale water management projects were carried out in the Okavango Delta. Attempts were made to remove the extensive papyrus blockages and restore the water flow in the failing Thaoge channel in the western part of the Delta. In the eastern distributaries, channels were cleared from vegetation and bunds constructed in order to reduce evapotranspiration and increase outflow (Wilson 1973). These projects had only short or no desired effects.

With the arrival of independence in Botswana and with new enthusiastic Government officers, and likewise sympathetic foreign aid organizations, a number of water development schemes were implemented in the Delta such as a large-scale rice cultivation project (funded by China), a modernization of the traditional flood recession agriculture (funded by Germany) and a construction of a bypass canal to substitute for the failed Thaoge channel (assisted by the Netherlands). All of these projects, in spite of considerable financial input (several million US$ each), failed due to either a lack of knowledge about the nature of the Delta system or ignorance of the local political and socio-economic situation.

Before 1975, the colonial authorities in Angola developed plans for utilization of Okavango water to the stage of feasibility studies. Due to the relatively steep gradient of the headwater rivers, 17 potential locations for hydroelectric dams were identified. Also, irrigation schemes of 54,000 ha, mostly along lower reaches of the Cubango and Cuito, were considered feasible (SWECO GRONER 2005). The independence in 1975 and subsequent civil war in Angola, however, prevented realization of these plans.

In Namibia, the majority of colonial development (mainly large-scale cattle farming) took place in the central and southern parts of the country while the Okavango region was left to the indigenous population, so no large-scale plans were made there.

In the period 1970–1980 both Botswana and Namibia made prognoses of population growth and economic development that indicated increased water shortage by the 1990s and so turned their attention towards the Okavango. In Botswana, projects were initiated with financial support from international aid organizations to investigate feasibility and means of water abstraction from the Delta and its transfer towards the more populated eastern part of the country. In Namibia, a Water Development Plan was formulated in 1974, with plans to include Okavango into the water supply system of the country, and building of a hydroelectric station

at Popa Falls, just upstream from the border with Botswana.

In Botswana, the situation was additionally complicated by the discovery of diamonds in the Orapa area located in the distal Boteti basin. In search of water to supply the constructed mine and mining town, the engineers turned to the Boteti and the Okavango Delta. A dam was constructed at the end of the Boteti to store water for the mine. In 1973, the Boro channel was dredged and bunded at a length of 17 km in order to reduce the loss of water into floodplains and increase flows down the Boteti River. This reduced the seasonally flooded area in the lower Boro, which was exacerbated by the general decline in rainfall and inflow during that period. This negatively affected the local flood recession farming and lead ultimately to a 'popular uprising' and breaching of the bunds in 1981.

In the mid 1980s, Botswana was hit by a major drought. Associated reduction of water supply to the Orapa diamond mine triggered the initiation of the Southern Okavango Integrated Water Development Project (SOIWDP) (Snowy Mountains Engineering Corporation 1990). The aims of the project were to supply water to the Orapa mine, to Maun and to the rural population along the Boteti. The proposed engineering works aimed to reduce channel overflow and flooding along a 50-km stretch of lower Boro River and construction of several reservoirs along the Thamalakane and Boteti Rivers. In 1992 the project was approved. At this stage, however, the local community remembered the effects of the 1973 dredging and started to oppose the project. The tourism industry, already well established in the Delta, expressed its disagreement as well, and eventually international conservation groups started to lobby the Government. The Government decided to put the project on hold, and commissioned the International Union for Conservation of Nature (IUCN) to do an independent evaluation. The major conclusions of the assessment were that the benefits were overestimated and too uncertain while the socio-economic costs were underestimated (Scudder *et al.* 1993). When the Government received the report in 1993 it called off the project immediately.

As mentioned earlier, Namibia had considered plans to augment its interior water supply with Okavango water since the 1970s. The 1974 National Water Master Plan included a phased construction of a system of reservoirs and water carriers in the interior and finally linking it to the Okavango River. Four out of five phases were implemented by 1987. The last phase was to construct a pipeline to bring water from Rundu by the Okavango River to Grootfontein and into the already constructed system of canals. This part of the project was delayed, but after a several years' long drought a crisis situation had evolved, with very little water left in the reservoirs on the interior Namibia highlands, and a forced implementation of the project started in 1996. This was done unilaterally (without consulting OKACOM) with reference to the emergency situation and caused strong opposition in Botswana. Fortunately, the drought ended with better rains in beginning of 1997, and the construction of the pipeline was postponed (Ramberg 1997).

This coincided with, and probably contributed to, the Botswana Government unilaterally ratifying the Ramsar Convention in 1996 and declaring the Okavango Delta a Ramsar site: a wetland of international importance. This was the ultimate recognition that the Okavango Delta should be managed as a conservation area, to maintain the natural wetland system and its biodiversity, and to use its water and natural resources sustainably.

21.4 Current Situation in the Basin

Estimates of the population living in the Okavango River catchment and within 20 km of surface water in the Delta and Boteti are: 350,000 in Angola, 163,000 in Namibia and 88,000 in Botswana (Mendelsohn and El Obeid 2004). The population densities are low, and the water resources of the Okavango Basin are relatively

Table 21.4 Estimates of current water abstractions within the Okavango basin

	Water users	Water use (Mm yr^{-3})}
Botswana	Domestic water supply	3.84 (recorded in 2004, Department of Environmental Affairs 2008)
Namibia	Domestic and irrigation – state water scheme	3.0 (recorded in 2007, NamWater personal communication)
	Irrigation – public and private water schemes	13.2 (allocated, actual value unknown, NamWater personal communication)
Angola	Domestic	13.8 (estimated, Ashton and Neal 2003)

little utilized. The total water abstractions for human use do not exceed 33 Mm $annum^{-3}$, which is less than 1% of mean annual discharge of the Okavango River (Table 21.4). The water supply schemes are mostly for domestic use and only in Namibia are there a few irrigation schemes. This low utilization of the water resource takes place in spite of the Okavango River being the only permanent water body within the borders of Namibia and Botswana and in spite of their growing populations. The low water abstraction in Angola is not surprising, however, considering that this country first went through a 25-year liberation war against the colonial rulers that ended with independence in 1975, but then almost immediately turned into a civil war that did not end until 2002. The southern part of Angola, within the Okavango River basin, was at times a war zone during this period and became de-populated.

21.4.1 Sources of livelihood

The majority (77%) of the population in the basin is rural and their livelihood relies on small-scale agriculture and cattle, supplemented by fishing and utilization of river-related and dry land veld products (Mendelsohn and El Obeid 2004). The Delta is the major tourism attraction in Botswana and tourism is the second largest GDP generating activity after the mineral industry. Tourism is also of some importance in Namibia's part of the basin. In the Delta area, tourism generates more income than all other economic activities together such as agriculture, fishing, etc. (Murray 2005) and spin-offs from tourism such as construction, transport, supplies, training, etc. form an engine of development in the urban centre of Maun. The tourism in the Okavango Delta relies on exclusivity ('low numbers – high costs') and is dependent on the large numbers of charismatic wildlife and the pristine nature of the environment.

21.4.2 Economic development potential

The potential for economic development in the basin is limited mainly by its remoteness, lack of mineral resources, relatively poor soils and harsh climate. Some potential for irrigated agriculture exists, however, in parts of Angola and Namibia and is planned to be explored by both governments. There also exists potential for hydropower generation along the Okavango River in Angola and Namibia, and the feasibility of hydropower plants has been investigated there (Mendelsohn and El Obeid 2004). This might be an important direction of development in the basin considering rising energy prices and climate change concerns related to the use of fossil fuels. Ecotourism is a realistic development option, and plans are being considered for wildlife parks in Angola. Within the Botswana part of the basin, development is envisaged to go towards further expansion of wildlife-based tourism.

21.4.3 Emergence of water resource management initiatives in the basin

Some of the developments described above have the potential to cause reduction of water flows and change to the hydroperiod; changes in sediment transport; and to cause pollution of the river with nutrients and pesticides. This is further complicated by the upstream–downstream principal differences in the way the river water is perceived to be used. The two upstream countries

are predominately planning for water withdrawals for domestic use and irrigation, while Botswana, as an end user and with its unique economic dependence on wetland tourism, emphasizes its need for water conservation.

The necessity for collaboration and information exchange on water development between the Okavango basin states was realized in the early 1990s. The Permanent Okavango River Basin Water Commission (OKACOM) was established in 1994 with a protocol signed by the three countries which replaced earlier bilateral technical commissions. The OKACOM is essentially a communication platform with no decision-making power; however, it effectively acts as a management body, as it is mandated to advise and present recommendations to respective governments. The OKACOM recognized the need for a unified management plan for the basin, and started working towards development of such in the mid 1990s. By 1995 a proposal for a project tasked with development of such a plan was prepared and submitted to UNDP for funding (Okavango Basin Water Commission 1995). This was approved and a preparatory project was completed during 1997–1999 resulting in a full planning proposal. Due to difficulties between delegations and with UNDP-GEF, the project was not approved until 2001 but did then, for the same reasons, not start until 2005 as 'Environmental Protection and Sustainable Management of the Okavango River Basin (EPSMO)'. It was, unfortunately, hit by serious problems with red tape and poor governance. The project manager resigned and the project was on hold for more than a year and started again only in 2007.

In the meantime, in Botswana, the first discussions on the development of a management plan for the Okavango Delta took place in 1998. The need to formulate such a plan stems directly from the recognition of the Okavango Delta as a Ramsar site, and the fulfilment of Article 3.1 of the 1971 Ramsar Conversion which states that 'The Contracting Parties shall formulate and implement their planning so as to promote the conservation of the wetlands included in the List, and as far as possible the wise use of wetlands in their territory'. The first conceptual paper outlining the need and content of such a plan was produced in 1999 by the then National Conservation Strategy Agency (later the Department of Environmental Affairs) Government of Botswana, IUCN and HOORC (see section 21.5.2 for definition of HOORC). This proposal was funded by the Ramsar Bureau and in the course of subsequent years, the Okavango Delta Management Plan Project (ODMP) got funding in two more steps for more detailed planning. The third comprehensive phase started in 2003, ended in April 2007 and produced a management plan that remains to be implemented.

So although it would have been ideal to have the basin-wide plan in place and then align the Delta plan to that, it happened the other way around (Box 21.1).

Box 21.1 The progress of OKACOM and ODMP

Permanent Okavango River Basin Commission (OKACOM)

1994 – Three nations (Angola, Namibia, Botswana) agreement signed
1997 – Preparatory planning of management proposal started and first funding received
2001 – Funding for substantial planning project received
2005 – Planning project (EPSMO) started
2007 – Planning project re-started

Okavango Delta Management Plan (ODMP)

1996 – Ramsar Convention signed by Botswana
1997 – Okavango Delta designated as a Wetland of International Importance
1999 – Preparatory planning of management plan proposal started and first funding received
2003 – 2007 Planning project (ODMP)
2008 – Implementation started

21.5 The Okavango Delta Management Plan

21.5.1 Guiding principles for the ODMP

The main activities of the ODMP project (2003–2007) aimed 'to develop a comprehensive, integrated management plan for the conservation and sustainable use of the Okavango Delta and surrounding areas' (Department of Environmental Affairs 2008). It is not a water management plan, although it encompasses elements of such. The approach to development of the plan was borrowed from Ramsar Planning Guidelines (Ramsar Convention Secretariat 2007) and IUCN's Ecosystem Approach to wetland management (Shepherd 2004). It is integrative and adaptive in nature and based on participation of stakeholders in the plan development and implementation process.

It has to be realized that the integrated approach to management is not strongly supported within the regulatory framework of Botswana. The 1968 Water Act regulating water resources planning and management is based on a centralized approach with minimal participation of water users in decision-making. Only more recent regulations advocate integrative approaches to resource management, such as the National Wetlands Policy and Strategy (not approved yet), and the National Water Master Plan (1992, currently being revised).

Additionally, the requirement to achieve integrated management of water and environmental resources was a formidable challenge to the existing fragmented planning in the Delta, which had been sub-divided in about 20 Wildlife Management Areas (WMA) and one Game Reserve each with its own management plan. In addition there were sectoral plans by largely unco-ordinated government departments with a mandate to manage different resources within the Delta. Lack of communication often led to confusion, duplication and omission of roles. This led to avoidable mistakes such as construction of roads on seemingly dry land that later, during high flood years, came under water and thus became useless. It is also believed that this fragmentation of management made matters worse when it came to natural resources use conflicts in the Delta (Magole 2008) and these conflicts are still rampant. The main friction is between the traditional resource users and the modern and expanding tourism industry which, because it is based on nature and wildlife, also finds natural allies in conservation groups. Local people in general complain about large land allocations for tourism or other commercial purposes that cut them out from their subsistence sources such as firewood, reeds, grass and fishing. Farmers in particular complain about increased crop damage and predation by wild animals. Elephants are the worst problem as they have increased dramatically during the last decades and are protected.

Sectoral planning and management is well illustrated by the actions of Department of Animal Health. To separate livestock from wildlife that carries diseases such as foot-and-mouth and to stop its transmission to cattle, a fence was constructed in the 1980s to surround the Delta on the south, east and north. That this also cuts off the Kalahari wildlife populations from their natural fall-back areas in the Delta was not considered. Similarly in 2001–2002, spraying against tsetse flies was undertaken in the Okavango Delta, with little or no involvement of the Departments of Tourism, Environment and Wildlife or other stakeholders.

Similarly, the increasing human populations around the Delta, urbanization and demands for higher living standards have caused stress on the water supply systems and in particular Maun has had long periods of water shortage. A number of additional groundwater sources have been identified by Department of Water Affairs that, in typical fashion, narrowed down the alternatives to one based on technical and economic grounds before consultations with other departments and stakeholders were done.

21.5.2 Organization and work of ODMP

Initially, two possible organizations for the project were discussed. The first was to establish

a strong planning team with special mandates outside of the existing management structures to ensure integration and efficiency in the planning phase. The drawback, however, would come in the implementation phase as it would require major changes in legislations to transform the planning team into an implementing body. This was regarded as unrealistic and it was concluded that it would not be possible to separate the existing government departments from the tasks they had been given by law and they would be unlikely to have much sympathy for what had been planned without their involvement. An alternative approach was followed whereby new structures and functions were put in place that linked the existing government departments together by frequent meetings and improved communications, but basically the responsibility for development and implementation of the integrated ODMP was vested in them.

ODMP was initially divided into 12 components each representing a prominent resource use sector; such as water, fish, land, plants and range, wild animals, livestock, tourism, and the less conventional planning sectors of stakeholder participation, research strategy and data management. In most planning processes these are considered cross-cutting issues and hence inherent and to be dealt with within the other sectors/components. In the ODMP process, however, these together formed a substantive sector which was complete with a budget and allocated to an equally unconventional but appropriate planning partner, University of Botswana's Harry Oppenheimer Okavango Research Centre (HOORC).

The sectors were tasked with situation analysis within their sector. They had to answer questions such as: what is the state of the resource? Who is using the resource? Who is managing the resource? Who else has interest in the resource? Are there any conflicts in the use of the resource? To achieve integration, sectors were organized into task forces with members from all the professional areas involved in the use and management of the resources within the Delta. Thus, multidisciplinary teams were formed in accordance with the requirements of the integrated water resources management (IWRM) (Al Radif 1999). These allowed new opportunities for the sectors to communicate their views and plans, learn from other sectors and to negotiate their stake in other sectors, e.g. the tourism sector was able to negotiate its land and other resources requirements from the land board and wildlife sectors. Communities were also brought in through community leaders and resource use groups representatives as well as community focal persons who became members of task forces and acted as the intermediary between the ODMP planning team and the communities. A large number of traditional community meetings (*Kgotlas*) were organized for people to contribute their perspective on the situation of the resources, their suggested solutions and to appraise solutions suggested by the technical planning team.

The planning process was led and co-ordinated by the Department of Environmental Affairs (DEA) under the Ministry of Wildlife, Environment and Tourism. The co-ordinators (DEA) reported to a National Steering Committee of Permanent Secretaries and Directors of involved departments. At the district level in Maun the co-ordinators and the planning sectors were supposed to report to the Okavango Delta Wetland Management Committee made up of all district level stakeholders and task forces of experts, but this was not implemented. All this led nevertheless to a large number of meetings and across-sector interactions that gradually broke down barriers between all these officers from different sectors. Last but not least, the co-ordinators and the sectors had to report every milestone achievement to the communities in village *Kgotlas.* This gave the ODMP an unprecedented stakeholder involvement.

21.5.3 Problems faced by ODMP

The ODMP project became seriously delayed right from the outset (Table 21.5). It took a long time to mobilize project officers and to organize the project secretariat, partly related to the com-

Table 21.5 The planned and actual time frame for the ODMP project phases

Milestones	Proposed duration (months)	Actual duration (months)
1 Inception report	7	20
2 Framework management plan	6	12
3 Draft management plan	12	6
4 Final management plan	14	6
5 Studies and research[a]	12	Left for implementation phase
6 Pilot projects[a]	12–24	Left for implementation phase
Total	39	44

[a] Activities 5 and 6 were planned to be done in parallel with activities 3 and 4.

plexity and bureaucratic nature of the procurement process in the public sector. This led in the end to a forced finalization of the project and important elements were left out from the final product: an integrated management plan for the Okavango Delta.

Most government officers seconded to Maun were at a basic or intermediate level of competence. Many in charge of project components had a limited capacity to either deliver, or ensure delivery of project output of adequate quality. Although HOORC staff played a significant and sometimes decisive role for the maintenance of quality they could ensure consistent high quality. In particular, as most government officers only stayed in Maun for a limited period, by the end of the project in 2006 about 80% of the government officers who took part in the start of the project in 2003 had been transferred. Again, basic training and introduction had to be done to the new replacements into the principles of IWRM and the particular Delta environment. Institutional memory could never be developed.

For HOORC, the participation in the ODMP project became a mixed blessing. Because of the deep involvement by its staff in all task forces it became automatically disqualified in tendering for research projects when these were advertised. Instead, external consultants were used, often from outside Botswana, and some of them relied heavily on HOORC resources and know-how. The opportunity for local and national capacity building within the project was thus not effectively used.

The integrated nature of the ODMP was supported by the prevailing culture of cross-sectoral integration at District level. However the governance in Botswana is centralized and most important decisions are taken on higher levels in Gaborone, 1000 km from Maun and the Okavango Delta. Sometimes the Secretariat in Maun had problems with the collaborating partners that could be traced back to lack of buy-in for the project at a senior level. This is where the ODMP started to suffer the consequences of operating the integrated approach within a sectoral institutional setting. The ODMP Secretariat was not in control of the collaborating officers' time and budget and the participating departments had the liberty to make spending and priority decisions 'almost' independent of the Secretariat. A case in point was the water component; the Department of Water Affairs chose to do its work for ODMP in Gaborone and used most of its budget for development of a hydrological model at the expense of the integrative and stakeholder driven process promoted by the ODMP. Negotiations for a better approach proved futile because the ODMP Secretariat could not force the preferred management approach on a department which had the legal mandate to make decisions on water management.

The lack of buy-in for the project at top level in ministries and their departments also became clear in their participation in the National Steering Committee, which was the forum for heads of departments, usually directors, who however rarely participated but sent fairly

low-level representatives. However, the same was also the case with representatives for major donors: IUCN, Swedish International Development Agency (SIDA), Danish International Development Agency (DANCED) and German Development Service (DED). The overall governing committee for the project became, therefore, fairly insignificant.

21.6 Management Framework at the International Level – OKACOM

The Permanent Okavango River Basin Water Commission (OKACOM) was established in 1994 essentially as an advisory body with a mandate to deal with aspects of water management in the basin such as measures and arrangements to determine the long-term safe yield of water in the basin, the reasonable demand for water, the criteria to be adopted in the conservation of the natural environment, equitable allocation and sustainable utilization of water resources, the investigations related to the development of any water resources, prevention of pollution of water resources and control of aquatic weeds, and measures to alleviate short-term water shortages (Okavango Basin Water Commission 1994).

Co-operation of the three basin states over the shared basin is also regulated by the Southern Africa Development Community (SADC) Protocol on Shared Waters (South African Development Corporation 2001), to which all three countries, as members of SADC, subscribe. The protocol is based on the principles in the UN Convention on the Law of the Non-Navigational Uses of International Watercourses. According to the protocol, countries sharing a river basin are expected to harmonize their planning, development and use of water resources, and avoid situations leading to conflicts, maintain an appropriate balance between water resources development and use, and environmental conservation, utilize water in an equitable and reasonable manner and prevent causing significant harm to other riparian states, and mitigating any harm caused.

The Ramsar Convention, ratified by Namibia and Botswana, is another international agreement that is guiding interactions of the three countries over the Okavango basin issues. The Okavango Delta, a declared Ramsar site, is not within the borders of Namibia, however, that country as a signatory to the Convention agrees to participate in the conservation and wise use of the wetland. It does not directly affect management of water resources upstream, particularly in Angola which is not a signatory to the Convention.

The framework of international agreements guiding the process of basin management is thus almost as good as it gets. It is, however, important to realize that these agreements are lacking compulsory jurisdiction and enforcement, and rely instead on the opinion of the wider world community and the will to maintain good relationships with the neighbouring countries. This seems, however, not to be a strong deterrent as illustrated by the example of Namibia in 1996 when they decided unilaterally to build a pipeline from the Okavango River to supply water to Windhoek. With reference to the 'emergency situation', provided for in the Helsinki Rules (International Law Association 1966), they did not have to seek permission from the other riparian states. Luckily good rains fell just before the construction project was about to start and it was shelved without the need to further test the international water management framework (Ramberg 1997).

21.6.1 Organization of OKACOM

The OKACOM is made up of a Commission, a Steering Committee and a Secretariat. The Commission is composed of three representatives from each country; senior civil servants usually with expertise in water management, law and environmental issues. The Okavango River Basin Steering Committee (OBSC) comprises technical experts from usually the ministries responsible for water and environment, and other invited experts. The OBSC provides technical advice to the commission and has formed task

forces dealing with hydrology, biodiversity and institutional issues. A Secretariat (sponsored by USAID and SIDA) based in Maun, Botswana was established in 2008 to be the administrative arm of OKACOM and facilitate information exchange among the basin states. The Commission is consulting with a number of stakeholders in the basin such as the independent Basin Wide Forum. This Forum was originally organized by the SIDA sponsored project 'Every River has its People' and executed by the national conservation organizations in the three countries. It comprises ten representatives of local communities from each country and provides an opportunity for local communities to share experiences about uses of the basin and problems encountered.

21.6.2 The work of OKACOM

In contrast to the Okavango Delta, where there are a number of acute conflicts, the problems in the Okavango River basin are mainly potential and perceived. This is a lucky situation because OKACOM has moved very slowly. It has functioned in an erratic way and has had problems in starting even a fairly straightforward planning project similar to ODMP. The slow progress was caused by a cluster of factors that seem to be typical for international resource sharing projects. The three countries have all been colonies or protectorates under different foreign powers that have given them different administrative cultures, with Angola from Portugal, Namibia from Germany and South Africa, while Botswana got it from Britain. They also have different official languages and in particular the Angolan delegation needs to rely on translators. During the 1990s, the deliberations at the meetings were remarkably antagonistic and the delegations did not show much trust in each other. In addition, the communications between the three delegations functioned in a haphazard way, and venue and time for meetings were frequently changed often at the last minute.

There is now a remarkable improvement in the relations between the delegations, probably because there have been very few changes of delegates and eventually good personal relations have evolved, but the delegates have also been trained in conflict resolution through an initiative by USAID. This organization also funded the Okavango Integrated River Basin Management Project (IRBM), a 4-year (2004–2008) initiative that provided support to the Commission's institutional development. It improved the ability of OKACOM to function as a multinational planning and consensus building institution to effectively manage and co-ordinate the use of river basin resources; targeted development of a formalized information system; and supported local governance of natural resources. The OKACOM Secretariat that has been established in Maun is now evolving into the much needed communication hub. The OKACOM is becoming a clearinghouse for research- and management-oriented projects in the river basin and has established working relations with ODMP and has HOORC staff in two of its technical task forces. Importantly, OKACOM, initially concerned primarily with allocation of water, has embraced the integrated, participatory approach to water resource management, and started looking at the basin as a whole. OKACOM's own planning project, EPSMO, that restarted in 2007, is now, among other things, collaborating with HOORC to determine the environmental flow requirements for the Okavango basin.

21.7 Conclusions

The contradiction between development policy and conservation policy is not grasped when it comes to the Okavango Delta and is a major challenge. The strong trend towards a sedentary lifestyle with ambitions to develop permanent infrastructures such as roads, electrical power supplies and water channels for communication and irrigation, are in direct conflict with the commitment to the Ramsar convention where the requirement is to maintain the nature of the wetland, which in the case of the Okavango Delta means that its inherent unstability has to be maintained, with the consequence that people

Table 21.6 Overview of management structures for ODMP during the planning and implementation phases

	Planning phase 2003–2007	Implementation phase 2008–
National Steering Committee	Regular meetings	Abolished
Facilitator in Gaborone	Responsible for high level integration in Gaborone but transferred to Maun when CTA left	Abolished
District Wetland Committee	Not active	Activated but weak due to lack of legislation
Secretariat under DEA with special mandate	Mainly responsible for production of the plan. Played a key role for integration between departments, in communications and liaisons	Abolished
Chief Technical Advisor (CTA)	Played a key role but resigned midway.	Abolished
11 sectoral government departments	Active	Responsible for implementation. Department of Environmental Affairs now on par with the other departments
Technical task forces to 11 government departments	Played key roles for practical integration	Abolished
HOORC	Played key roles in task forces, for data base management, library services, community mobilization, research planning	Play key roles in database management, library services, research and environmental monitoring

should move with the water, not the other way around.

Integrated water resources management in the river basin can not only focus on the amount of water (to share) but, moreover, the aim must be to preserve the flood pulse (the hydroperiod) that is decisive for the ecological functions of the riparian floodplains all along the river and for the whole Okavango Delta.

Some of the problems that came to mar the ODMP project were not fully anticipated in the beginning (the difficulty to get buy-in from high levels of government departments, weak support from donors), while others were well known (slow recruitment procedures, transfer of staff, weak facilitator in Gaborone, exclusion of HOORC from research projects) and could have been dealt with in the negotiating phase before the project started. At that time, however, the eagerness to start took precedence over a more cautious approach. It was, nevertheless, a major achievement to produce the management plan that should now be implemented. Most of the management structures established during the planning phase, which were meant to achieve integration, have now been abolished and the situation is almost as it was before the whole exercise started in 2003 (Table 21.6). It is an improvement that DEA has an office in Maun and HOORC has been strengthened, but most implementation work has to be done by the government departments that are now slowly rolling back into their sectoral positions. For this type of big project that requires integration across many sectors of government and society at large, an overruling authority is probably necessary. In the case of Botswana that function could be based either in the Ministry of Finance or in the Office of the President.

The development of OKACOM has been a slow process but that seems to be the rule when it comes to international resource sharing organizations, such as for the River Rhine and the Baltic Sea. Apart from local specific difficulties the development of trust seems to be a common problem. For the Okavango basin the best way forward may be to develop as much shared activity as possible, for instance in cultural exchange, training and research. Here the lack of professional capacity is probably the bottleneck that most hampers progress in integrated water resources management.

Financial and logistic support from foreign aid organizations has been crucial for the development of both projects. It has been most effective when the supporting organization has had determination and staying power because integrated water management, although logical and desirable, is in practice riddled with problems. In spite of difficulties with communications, institutional and cultural dividers, as well as shortcomings in manpower and other resources, both projects are on positive trajectories and their achievements are considerable (Box 21.2). Both are also working with an adaptive management philosophy so corrections of, for instance, institutional arrangements can be made as they progress.

It is perhaps the learning process in both ODMP and OKACOM that is the most valuable outcome, and in this chapter we have tried to describe not only the successes but also the challenges and difficulties both projects have faced, because these are pioneer projects from which others can learn.

Box 21.2 Overview of ODMP and OKACOM achievements

ODMP

- Management plan in place
- Much larger awareness of IWRM
- Department of Environmental Affairs office in Maun
- Better communications between government departments
- HOORC role in data base management, training, research and monitoring recognized and strengthened

OKACOM

- Development of management plan ongoing
- Building of basin-wide awareness under way
- Secretariat in place in Maun
- Trust and communications between national delegations much improved
- Links established with ODMP and HOORC

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