Chapter 13: The Okavango River Basin – Resolving the Dichotomy Between Development and Environment

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1 Introduction

In any watercourse system in a river basin that covers the territory of more than one sovereign State, the water resources should be shared equitably among the countries concerned. Maximising the development potential of the basin for the benefit of the population requires an understanding of the potential of the natural resources available to support the population and to implement the identified development options without compromising the environmental integrity of all ecosystems. In the Okavango River Basin, this complex task is compounded by the relative location of the four basin States (Angola, Botswana, Namibia, and Zimbabwe), pressing development needs in those countries, the pristine nature of the ecosystems, and the international pressure to protect the unique Okavango Delta. Unresolved, these issues may lead to conflict between the need for socio-economic development and the protection of the environment. People are just as much part of the environment and have the capacity to preserve the environment or destroy their livelihood to their own detriment. Several measures to prevent or manage the dichotomy between development and the environment in the Okavango Basin have been implemented since 1994 when the Okavango River Basin Water Commission was established.

2 Background

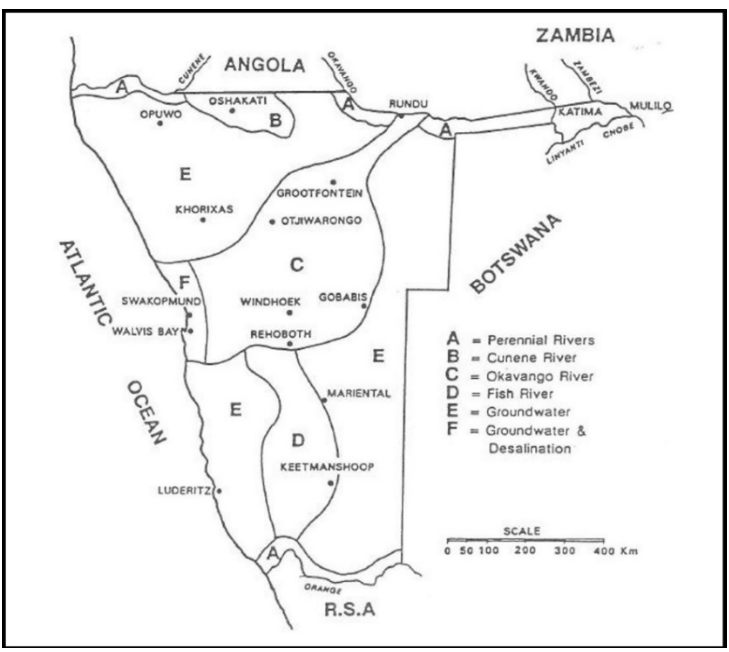
The territory of South West Africa, a German colony prior to the First World War, was entrusted to South Africa in 1920 as a Mandate under the League of Nations Covenant. In 1963 the South African Government published the Report of the Commission of Enquiry into South West African Affairs, commonly known as the Odendaal Report.[1] Seen against the background of increasing domestic and international opposition to the South African administration, the purpose of the report served, *inter alia,* to recommend the best ways to promote development in the mandated territory. The plan did have some positive outcomes because huge capital investments were made available by South Africa for infrastructure development projects in Namibia, including bulk water supply schemes comprising dams, pipelines, and canals. For the first time, water

1 Botha (1998).

from the Kunene River secured the availability of reliable water supplies to communities in the Cuvelai Basin in northern Namibia, as well as the Ruacana hydropower facility and other large, bulk water distribution and supply projects, especially in the communal areas in the Kavango, Zambezi, Otjozondjupa and Omaheke Regions.

Further water resource investigation studies were funded and conducted to deal with the supply of water to the rest of Namibia, and a Master Water Plan was tabled in 1974. The plan was revised in 1993 after considering additional information about the availability of water resources and the areas with the best potential for future growth. After considering many options, the revised Water Plan recommended that the demand on the water resources of the central area, both in the interior and at the coast, must respectively in future be augmented from the perennial Okavango River and from desalinated seawater at the coast (see the letters “C” and “F” in the figure below. The legend of the figure shows which water sources should be utilised to supply the areas indicated).

Figure 1: The Revised 1974 Master Water Plan of Namibia



Source: Figure compiled by the author.

Access to the water from the Okavango River is unavoidably linked to the principles of international water law, territorial sovereignty, and transboundary water resources management. However, Namibia only became an independent, sovereign State in 1990, and the Department of Water Affairs (DWA) subsequently advised the new

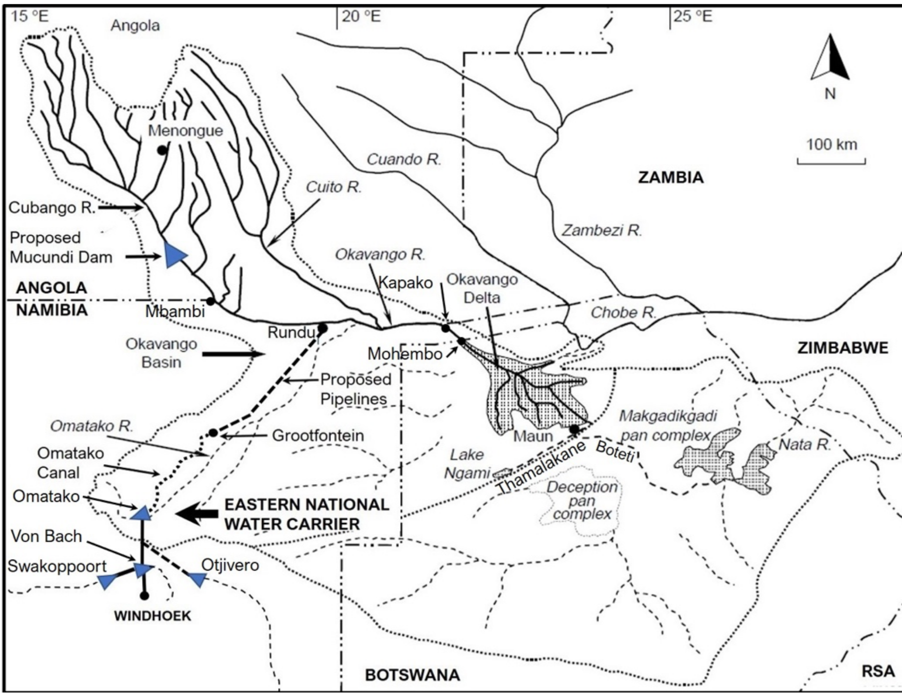
Government to establish water commissions on all the perennial border rivers of Namibia to negotiate with the other basin States about future access to the water of those rivers. In 1991, two bilateral water commissions were established. The first was the reinstatement of the Permanent Water Commission (PJTC) between Angola and Namibia to deal with the management of the Kunene River basin, and the second was the Joint Permanent Water Commission (JPWC) between Botswana and Namibia to deal with the utilisation and management of water resources of common interest, such as the Okavango River, the Cuando–Linyanti–Chobe River system, and groundwater resources. In 1992 both commissions had meetings in Windhoek, Namibia, and provided an opportunity for the three basin States to discuss prior proposed institutional arrangements concerning the management and utilisation of the water of the Okavango Basin. The Namibian Government took the initiative by bringing the delegations of the said commissions together at a joint meeting to discuss the possibility to establish a Tripartite Water Commission between Angola, Botswana and Namibia in view of the absence of an instrument of joint cooperation between all three basin States to manage the Okavango Basin.[2] This endeavour came to fruition in September 1994, when the Permanent Okavango River Basin Water Commission (OKACOM) was established by an agreement between Angola, Botswana, and Namibia. The main purpose of the delegations to the OKACOM was to jointly address the objectives, expectations and concerns of the sovereign basin States and to advise the respective governments about the development possibilities while strengthening all levels of good, cooperative governance in each individual State.

3 The Okavango River Basin

The name of an international river is normally the name of the river at its terminus because the tributaries of the river may have other names in the upstream basin States. The perennial Okavango River is part of a complex system of perennial rivers and endorheic ephemeral watercourses converging in the Makgadikgadi depression located in northern Botswana, as can be seen in the figure below.

2 Pinheiro *et al*. (2003).

Figure 2: Geographical extent of the Okavango River Basin, its rivers, the location of important towns and existing or proposed major water projects



Source: Map redrawn from Map 1 in Ashton / Neal (2003).

The total area of the drainage system into the depression is 725,200 km^2 (rounded figure) and covers portions of the territory of four sovereign States comprising 200,200 km^2 in Angola, 340,000 km^2 in Botswana, 165,000 km^2 in Namibia and 20,000 km^2 in Zimbabwe. Only 57% of the total area of the larger Makgadikgadi Basin or 413,600 km^2 (rounded figure), comprising 200,200 km^2 in Angola, 59,600 km^2 in Botswana and 153,800 km^2 in Namibia, yield perennial runoff. The total length of the Okavango River is about 1,610 km (rounded) between Menongue in Angola and Maun in Botswana and ranks fourth in length in Southern Africa.

Table 1: Perennial Okavango River Sections

River Section	Distance (km)			Clarifications
Cubango – Mbambi	970		970	Cubango in Angola
Cuito – Cubango	920			Cuito to confluence with Cubango
Mambi – Rundu		165	160	Namibia calls river section "Kavango"
Rundu – Cuito		125	120	Namibia calls river section "Kavango"
Cubango – Cuito	**1,260**		1,260	**Cubango to confluence with Cuito**
Cuito – Kapako		60	60	Namibia calls river section "Kavango"
Kapako – Mohembo		50	50	Okavango crosses Namibian territory
Mbambi – Mohembo		**400**		**Namibian access to Kavango**
Mohembo – Delta Fan	100		100	Delta Panhandle section in Botswana
Delta Fan – Maun	150		150	Okavango terminates in the Delta
Mohembo – Maun	250			**Botswana access to Okavango**
Total·length·of·Okavango			**1,610**	**Headwaters** in **Angola to Maun**

Source: Table compiled by the author.

The Okavango has two perennial tributaries, the Cubango and the Cuito. The headwaters of the Cubango starts at an elevation of about 1,850 m above mean sea level and flows 970 km in a south-westerly direction until it reaches Mbambi on the west-east boundary between Angola and Namibia. The boundary extends to the middle of the Cubango, and from that point, the middle of the river is the border between the two countries for about 350 km until the Okavango turns southwards at Kapako, crosses Namibia for about 50 km to Mohembo and enters the panhandle of the Okavango Delta in Botswana. The length of the panhandle is about 100 km, and the terminus of the Delta 150 km further to Maun.

The Cuito starts near Menongue on the eastern side of the headwaters of the Bié plateaux at an elevation of 1,430 m above mean sea level and flows 920 km south-eastwards to join the Cubango. The Okavango terminates at an altitude of 850 m above mean sea level near Maun on the southern edge of the endorheic Okavango Delta in Botswana. The Okavango is called the Kavango in Namibia. In years with high perennial flow into the Okavango Delta, water flows out of the delta area via the Boteti River in the direction of the Makgadikgadi Pans and westwards via the Thamalakane River into Lake Ngami.

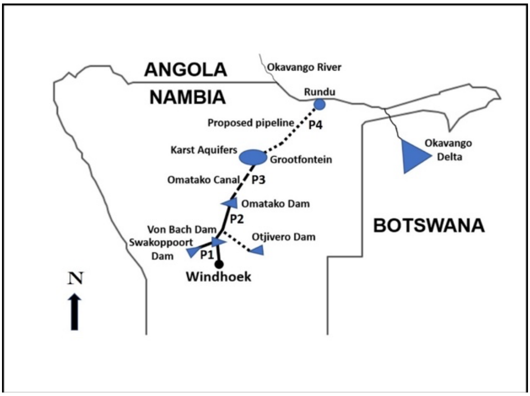
The origin of the ephemeral Omatako River Namibia is at the Omatako Hills in central Namibia. The watercourse goes northwards to join the Okavango River, 45 km upstream from the Cubango – Cuito confluence. However, the runoff has never reached the Okavango River in living memory. The Omatako only flows for some distance in its upper reaches during the rainy season, depending on the intensity and duration of the summer rainfall. The Omatako dam is situated in the upper reaches of the Omatako and is only 50 km from the southern boundary of the Okavango basin. Zimbabwe contributes some ephemeral flow via the Nata River into the Makgadikgadi pan complex on the eastern side of the basin in Botswana. The Nata is known as the Amanzamnyama River in Zimbabwe. The mean annual rainfall in the headwaters of the Okavango in Angola is 1,300 mm but decreases to 500 mm in the middle Okavango. Further southwards, the precipitation is between 350 mm and 450 mm in Namibia and Botswana, respectively. The average annual runoff in the Okavango is about 9,863 million m^3 which is rounded off to 10,000 Mm^3 or 10 km^3. The contribution of Angola to the flow is 94.5%. Botswana contributes 2.6% and Namibia 2.9%.

4 Development of the Eastern National Water Carrier in Namibia

In the period after the Odendaal Plan was tabled, the socio-economic growth in Namibia accelerated to 7% per annum, and it soon became apparent that the water resources in the central area and the central coastal area of Namibia would not be able to meet the estimated future water demand. This led to the construction of the Von Bach Dam – Windhoek Water Supply Scheme and a Master Water Plan that was adopted in 1974. The result was that major water supply infrastructure projects were launched according to the master plan under the auspices of the Department of Water Affairs. The construction of the proposed Eastern National Water Carrier in Namibia (ENWC) to link the central area of Namibia with the Okavango River started in 1970 when the Von Bach Dam on the Swakop River was completed.[3] By 1977, the Von Bach – Windhoek pipeline had to be upgraded due to the growth in Windhoek, and a new dam had to be built as Phase 1 of the ENWC project. See “P1” in the Figure below. Work on the Swakoppoort Dam, 80 km downstream from Von Bach on the Swakop River, started in 1977 and was completed in 1979. In each phase of the four phased development plan, an additional water source would be added over time as the water demand increased and Swakoppoort Dam was the next water source in operation, linked with a pipeline to transfer water to the central water treatment works at the Von Bach Dam. Phase 2 started in 1980 with the construction of the Omatako Dam that was linked via a pipeline to the Von Bach Dam (see “P2” in the Figure below).

3 Ravenscroft, W. (1985). The Eastern National Water Carrier – Assuaging the Nation’s Thirst. South West Africa Annual 1985.

Figure 3: Eastern National Water Carrier



Source: Figure compiled by the author.

This is a typical transboundary interbasin water transfer scheme from the internationally shared Okavango basin into the Swakop River basin, which a national river system in Namibia. There is no objection to such interbasin transboundary transfers in the principles of international water law.

It is also planned to divert water in future from the Omatako – Von Bach pipeline to the Otjivero Dam located in the Nossob River, which is an endoreic watercourse in the Orange River basin and the project theoretically implies a water transfer from the international Okavango River into the upper reaches of the international Orange River basin which is shared between Botswana, Lesotho, Namibia, and South Africa. Phase 3 of the ENWC was the construction of a 260 km parabolic shaped concrete-lined canal and 40 km of inverted syphons (total 300 km) to link the Omatako Dam with the water sources of the Karstveld Aquifer system located in the vicinity of Grootfontein, which is about 250 km from Rundu on the Okavango. The inverted syphons transport the water in the canal under the rivers and other obstacles that cross the open canal. The fourth and final Phase of the ENWC should have been completed by 1992, but the project could be delayed due to more efficient water use innovations such as water demand management, the reclamation of domestic sewage effluent to potable water standards, water banking in the Windhoek Aquifer, increasing the efficiency of the three dams system in the central area by means of interbasin water transfers to reduce evaporation losses, the managed recharge of the Windhoek Aquifer with treated surface water from the water treatment plant at the Von Bach Dam and the conjunctive use of surface water and groundwater from the Karst and Windhoek Aquifers. All these conservation actions and access to alternative water sources give credibility to the future need to obtain access Okavango water, which is a right in terms of the UNWC.

5 Environmental Issues

5.1 The Omatako Canal

Environmental issues are harmful effects on the biophysical environment due to human activity. Environmental protection is a practice of protecting the natural environment for the benefit of both the environment and humans. From a water engineering perspective, the value of environmental assessments is that it may uncover and prevent fatal flaws in the conception, design, construction, and operation of infrastructure development projects. It is therefore a useful tool. However, the perception of many people in Africa was that the need for environmental assessments for infrastructure projects was primarily aimed at preventing development to preserve the pristine African environment and wildlife for the benefit of tourists arriving from densely populated first world countries. Another important aspect is that water and people are part of the environment and that an increasing population is placing an additional burden on the environment, especially in arid areas like Namibia.

The first major conference on international environmental issues, the United Nations Conference on the Human Environment[4] (also known as the Stockholm Conference), was held from 5 to 16 June 1972 in Stockholm, Sweden. This marked a turning point in the development of international environmental politics. In 1989, the Department of Agriculture and Nature Conservation, the Gobabeb Research Center and the Engineering Professions Association of Namibia, held a workshop on practice and procedures for environmental assessments.

At that time, the DWA was confronted with an environmental disaster along Grootfontein – Omatako canal and stood accused of failing to conduct a proper environmental assessment before the canal was built. The water engineers were condemned as “the wreckers of the environment” by building dams in the ephemeral rivers, long pipelines and canals across the arid countryside and perpetrating the unsustainable abstraction of groundwater while failing to do environmental assessments. But man needs water to survive!

However, before the construction of the Omatako canal there were no environmental policy or law in place that required and made environmental assessments compulsory, but the engineers in the DWA considered three possible alternatives and conducted an economic analysis to determine the most economically viable option for the water supply link between the Omatako dam and Grootfontein. The difference in elevation between the Karst Aquifers in the Otavi mountainland and the Omatako Dam made it possible to gravitate water from Grootfontein to the Omatako Dam via:

4 United Nations Conference on the Environment. Documents available at https://bit.ly/3qd70tx, accessed 8 June 2021.

- A canal, which would be longer because it must follow the contours of the landscape; or
- a large diameter pipeline over a shorter distance; or
- a smaller diameter pipeline over a shorter distance but would generate additional operating costs to pump the required water.

The economic and technical analysis indicated that the canal would be the most attractive cost alternative and would have the additional advantage of using labour-intensive construction methods. This provided an opportunity to employ about a thousand men that could learn construction skills for future, more skilled employment opportunities in the construction industry while earning an income.

The DWA was aware of possible environmental consequences, such as water losses from the canal due to evaporation, and the solution to reduce this, was to design a parabolic shaped canal section instead of using a box or trapezium shape. This alternative was therefore the least expensive option, even if the cost of the evaporation losses was included. The DWA had prior experience in the construction and operation of other canals in Namibia, notably in the Cuvelai basin (±110 km), at the Hardap irrigation scheme (±10 km) and the Noordoewer – Vioolsdrift irrigation scheme (±40 km). In all these cases there were no major environmental consequences except for the occasional goat, sheep, cow, or wild animals (and rarely children) that drowned in the canals. Even the senior staff of the Department of Agriculture and Nature Conservation were informally consulted, but no fatal flaws were anticipated. The Omatako canal was fenced with a cattle fence on both sides while small bridges across the canal and access roads were provided in the canal servitude to enable a farmer to farm on both sides of the canal where it crossed a farm and for the DWA to inspect and maintain the canal.

However, soon after the canal was completed, it was found that large numbers of wildlife are trapped in the dry canal or drown in the canal when water was flowing. This was caused by several factors that were never considered to be an issue. It was known that canal would not carry water when the dams had enough water because there was no point in pumping groundwater (that cannot evaporate) via the canal into an open water body like a dam. The parabolic shape of the empty canal had steep sides and the trapped animals had to be assisted by hand to escape if they were found alive or removed if they were dead. Most of the animals trapped were small, such as snakes, aardvark, and tortoises, while others like warthogs, jackal and small antelopes were trapped less frequently. Even bigger game like eland and kudu sometimes misjudged their jumping capacity and ended up in the canal. Maintaining the canal became an expensive, continuous effort to inspect and remove trapped wild and domestic animals. Horrific numbers of trapped and drowned wildlife were quoted and reported in the media.[5] The canal became known as the 'Killer Canal'.

5 *Weekly World News* (1990).

Another unidentified fact was that the canal formed an ecotone.[6] An ecotone may appear on the ground as a gradual blending of two biological communities across a broad area, for example, the same type of grassland may have been rejuvenated after rainfall in one area and is green, while the grass in other areas that have not received rain have not yet regrown to restore the grazing capacity. An ecotone may manifest itself as a sharp boundary line, such as the Omatako canal, that obstructs the east-west-east migration of wild animals across the canal in search of grassland for grazing, depending on the areas where sufficient summer rainfall has occurred on the eastern or western side.

Seen in retrospect, it was not only a disaster, but useful lessons were learned about the value of proper environmental assessments and how to mitigate the consequences. Mitigation was tried by experimenting with various kinds of escape structures on the canal to assist the animals to get out while the canal was empty or full and to provide improved fencing along the canal to prevent animals from entering the canal servitude. An experimental study was also done to cover a section of the canal with reinforced concrete slabs to test its efficiency and cost. This option worked well, and although the cost to cover the canal, plus the cost of the canal without the cover was still less than the other alternatives considered before the canal was built, the Government never made money available to cover the canal.

5.2 The Proposed Rundu–Grootfontein Pipeline Feasibility Study

This pipeline would be the final Phase 4 link of the ENWC to the Okavango River. See “P4” in the figure above. This leg of the project was supposed to be completed by 1995 at the latest, but since less costly alternatives were developed and implemented to increase water use efficiency and conservation, it was possible to delay the completion of the project.

After the failure of the 1995/96 rainy season in Namibia, it became ominously clear that the country would face an unmanageable water supply crisis in the central area at the end of 1997 if insufficient rains were to fall during the 1996/97 rainy season. The only solution to the challenge was to complete the proposed Rundu–Grootfontein pipeline component of the ENWC within the available twenty months between May 1996 and December 1997.[7] The planning for the project was completed, and an environmental assessment was done with all basin States participating according to their interests in the project.[8]

6 Kark (2013).
7 Heyns (2007:162).
8 DWA (1997).

During June and September in 1996, the Minister responsible for water in Namibia and the Namibian Delegation to OKACOM met with their counterparts in Gaborone, Botswana, and Luanda, Angola, respectively, to discuss the impending critical water shortage in Namibia.[9] The Ministers expressed their satisfaction over existing cooperation in the water sector and the exchange of information, endorsing the principle of mutual consultation about studies on planned measures and the need to draw water from the Okavango River to address the short-term and long-term water supply deficits in Namibia.

Although Botswana knew since the middle eighties about the pipeline, the Angolan authorities were also informed when the OKACOM was established, but the sensational press release made after the meeting between the Ministers in Gaborone brought the whole issue of the abstraction of water from the Okavango River into the international arena. A few internationally supported NGO's and environmental interest groups expressed their concern about the proposed project. Most of the interested parties were unaware of the long-standing Namibian intention to utilise the waters of the Okavango River to augment the central area water resources, and very few understood that Namibia was complying fully with the conditions stipulated in the OKACOM Agreement and international water law principles. This gave rise to somewhat alarmist reactions[10] that did not fully represent the details of the issue, stating that the Namibian Government had never informed Angola and Botswana about its planned measures to use Okavango water.

A commissioner in the Namibian delegation to the OKACOM made a presentation about the planned measures of Namibia at an information meeting in Gaborone, Botswana, in November 1996 and pointed out that the Namibian water requirement from the Okavango is only about 100 Mm^3/a, which is a negligible 0,1% of the mean annual runoff in the river, while the unknown 'sleeping giant' is Angola because there is a civil war going on in the upper Okavango basin and no planned development projects can be implemented, but it will happen when hostilities have abated.

Both the technical and the environmental feasibility studies were eventually completed in consultation with OKACOM and included a broad base of stakeholder participation in Botswana and Namibia. Fortunately, however, the good rains that fell in Namibia during the 1996/97 rainy season improved the water situation to such an extent that the emergency project could be shelved to the relief of all concerned parties, but it was clearly confirmed that this pipeline is still a critical must for Namibia's development.

Some of the reasons why the completion of the ENWC could be delayed for more than 25 years since 1995 is because of the cost of the project (estimated ± N$ 10 billion

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9 Ibid.
10 Ramberg (1997).

in present values) and other innovative water management alternatives that were implemented. These are

- the inter-basin transfer of water between the dams in the central area of Namibia;
- the conjunctive use of groundwater from the Karst aquifers;
- managed recharge of the Windhoek aquifer with water from the centra area dams;
- increasing the capacity of the Windhoek water reclamation facilities; and
- the implementation of water demand management measures such as public participation in water conservation, reduction of water losses in water distribution pipelines and a water tariff system to encourage water-saving practice.

However, the writing is on the wall, and studies are at present being conducted to consider alternatives as the completion of the water carrier to the Okavango, desalination of seawater to transfer water into the interior of Namibia and other, clearly less viable alternatives such as linking the central area with the newly completed Neckartal Dam, located about 500 km south of Windhoek.

5.3 The Proposed Divundu Hydropower Project

The Okavango River flows through Namibia for approximately 50 km and the Popa Falls is about 30 km from the border between Botswana and Namibia. The "falls" is not much more than a rapid because the fall down the rapid is only between 2.5 and 4 metres, depending on the flood level during and after the rainy season. It is nevertheless a scenic tourist attraction which is a source of income for the people living at Divundu. Although the head through the turbines will be low, the high volume of the water flowing in the Okavango makes it possible to generate hydropower.

In August 1969, the Director of Water Affairs commissioned a preliminary feasibility investigation of the proposed Popa Falls Hydropower Scheme near Divundu town. This was followed up with a new study in 2003[11] and it is possible to construct a weir, 9.75 m high and 930 m across the river, about 7.5 km upstream of Popa Falls to maintain the flow of water at the falls and the potential for tourism in the area. A hydropower plant at the weir will generate 20 MW or 165 GWh of electricity per year. An environmental assessment of the proposed project[12] was made in 2009 as part of the Okavango River basin transboundary diagnostic analysis conducted by OKACOM.

The presence of the weir will have environmental impacts due to flow regulation, impeding sediment transport and the loss of seasonal, pulsed flows into the Okavango

11 NamPower (2003).
12 OKACOM (2009).

Delta. Evaporation losses will be insignificant, but about 5 km^2 of agricultural land within Namibia will be inundated. The priority of the power station is extremely low in comparison to other alternative power sources available to Namibia and the development of the proposed hydropower scheme, has been laid to rest at present. This shows the value of proper investigations to determine the viability of proposed projects.

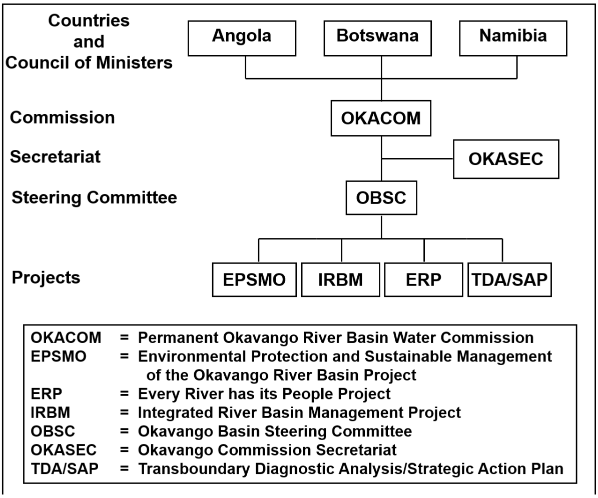
5.4 The Activities of the OKACOM

The establishment of OKACOM demonstrates the political will of the Okavango basin States to create a management institution that must determine the needs of civil society and facilitate the social, scientific and environmental investigations required for planning and development purposes. The Commission must jointly advise the governments of the respective countries about the development of the basin in each State to maximise the socio-economic benefits for the advancement of the standard of living of the population. The Commission is therefore responsible for ensuring good collective governance that meets the objectives and expectations of the sovereign basin States, while strengthening the levels of governance in each individual State. To achieve this, the Commission must

- determine the long-term sustainable safe yield of the water resources in river basin;
- estimate the reasonable demand of possible agricultural, mining, industrial and human developments;
- prepare criteria for the conservation, equitable allocation, and sustainable utilisation of water;
- conduct investigations related to water infrastructure development and investment;
- recommend measures to prevent water pollution;
- develop measures for the management and alleviation of the effects of droughts and floods; and
- address other matters as determined by the Commission.

The structure of the Commission is shown in the Figure below. The countries (Angola, Botswana, and Namibia) are represented by the respective water ministers in the Council of the Commission. The Council convenes as required, to be informed by the Commission (OKACOM) about the work that is being done and to enable the Ministers to agree jointly about the decisions that must be taken forward to the respective governments for advice, endorsement and approval.

Figure 4: Structure of the OKACOM



Source: Figure compiled by the author.

The Commission comprises three delegations, each with three commissioners, one of which is the leader of each delegation. Each leader of delegation is also a co-chairperson of the Commission and is the chairperson when a meeting takes place in his country. Each delegation is supported by advisors as required. The supporting staff are from the different water and other ministries in each country, and they form the Okavango Basin Steering Committee (OBSC). The OBSC guides the activities of the OKACOM Secretariat (OKASEC) that is responsible for coordinating all activities related to administration and meetings, the different studies and investigations that are in progress, as well as stakeholder participation and workshops.

Some of the studies that were conducted by OKACOM under the supervision of the OBSC and OKASEC are shown in the above Figure. The first study that was done by OKACOM after its creation in 1994 was a preliminary transboundary diagnostic analysis (TDA) funded by the Global Environmental Facility (GEF). This work led to the Environmental Protection and Sustainable Management of the Okavango (EPSMO) Project, which produced a revised report about a Transboundary Diagnostic Assessment (TDA)[13] of the Okavango Basin and a proposed a Strategic Action Programme (SAP) to develop the basin. This report was published in 2011 and provided an overview of the environmental issues, existing and proposed developments, as well as recommendations for future work. This led to a project to do a Multi-Sector Investment Opportunities Analysis (MSIOA)[14] to assist the basin States in achieving socially just,

13 OKACOM (2011).
14 OKACOM (2019).

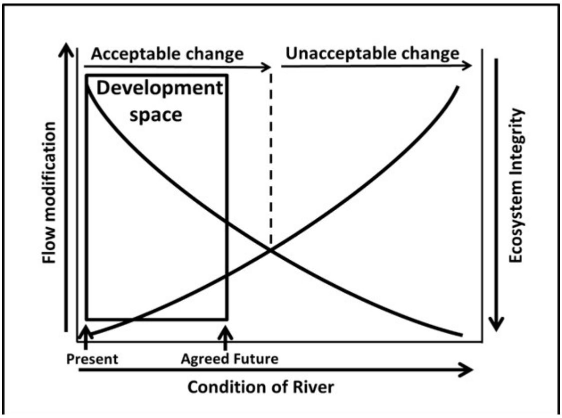
economically viable, and environmentally sound development because investments are required for appropriate infrastructure development to support socio-economic prosperity.

6 The Development Space

The TDA is a basin-wide policy framework document for the Okavango River basin that lays down the principles for the development of the basin and improvement of the livelihoods of its people through the cooperative management of the basin and its shared natural resources. The TDA defined a theoretical conceptual framework, referred to as the "development space," to illustrate the boundary conditions and trade-off between economic development and environmental degradation, based on two conceptual parameters: ecosystem integrity and the level of basin development. The development space is the total context in which development may happen, within the ecologically acceptable limits of change, such that the greatest sustainable net benefit is achieved, as shown in the Figure below.

The graph starting at the bottom in the left corner of the figure shows the increase in development over time. This development affects the condition of the river, as shown by the arrow at the bottom, and causes the modification of flow in the river, as shown by the arrow on the left in the figure. As the development grows, the ecosystem integrity is reduced because of the changes in the flow condition and the modification of the flow as shown by the arrow on the right. This degradation over time is shown by the graph starting in top left corner of the figure. The dotted line starting where the two graphs cross, is the point between acceptable and unacceptable growth. The square in the figure shows the development space between the present development and the agreed future development of the Okavango basin, which should be contained to the left of the optimal dotted line.

Figure 5: Representation of the development space based on the conceptual limits of acceptable hydrological change



Source: Figure compiled by the author.

6.1 Development plans

One of the most important drivers for economic development, among many other resources, is water. However, the availability of water in the Okavango basin is limited if the environmental integrity of the Okavango Delta must be left unaffected. This is unavoidably not an option, because water will be required for human development as well. The other side of the coin is that the overuse of water will be unacceptable. Some way had to be found to determine the boundaries between water use, development, and the requirements of the ecosystem. In this regard, water supply infrastructure development is not the only type of development required because the term "development" includes improving the quality of life of the population, poverty reduction, food production, better nutrition, education, health, job opportunities through industry and mining or maintaining ecosystem services in the rural areas to achieve prosperity in general, to name some.

The TDA identified that the total population in the basin is 1.69 million in Angola, 0.19 million in Botswana and 0.22 million in Namibia (rounded figures). The total estimated water requirements of the three basin States for planned measures by 2040 would be 3,700 million cubic metres, including water for human consumption, agriculture and interbasin water transfer. This amounts to 37% of the mean annual runoff in the Okavango River.

6.2 Negotiating the Development Space

The MSIOA examined a complex, multicriteria scenario analysis which produced information about a range of alternative development opportunities and a better understanding of complex possibilities. This can be used to inform the decision-making process to determine the optimal preferred future state of the Okavango basin, based on a considered evaluation of trade-offs between return on investments, environmental impacts, social justice, equity considerations and climate resilience. It is important to acknowledge that the final decision will also be informed by political-economy considerations.

The proposed development agenda for each State was assessed, based on a review of their national development plans, including a review of regional initiatives such as the SADC Indicative Strategic Action Plan. The proposed developments were confirmed through a series of national consultations and engagements with officials and experts in related disciplines in each country.

Ten different basin development scenarios were considered for growth sectors that have high water demands or will have a significant impact on the river in terms of abstraction or alteration of the flow regime. These include urban water supply for towns and cities, irrigation for food production, hydropower production and water transfer out of the basin.

The MSIOA allocated water for domestic consumption as primary right of use, followed by water for commercial and industrial activities, collectively referred to as urban water supply, while reserving water for the environment in perpetuity. The abstraction of water from the Okavango for urban use in the basin will increase to 40 Mm^3/a by 2040. In addition to the urban water demand within the Okavango basin, there are plans to export water from the basin to meet the urban water needs in the Cuvelai River basin in Angola (78 Mm^3/a) and the Central Area of Namibia (62 Mm^3/a).

It is expected that the present area under irrigation in the basin will increase from 170 ha to 280,000 ha in Angola and from 2,550 ha to 23,000 ha in Namibia. Although there are no immediate plans for further irrigation development in the basin in Botswana, the present 30 ha under irrigation will increase according to an allowance of 2,000 ha under irrigation and has been included in the model study. The total abstraction from the river at the estimated levels of development would be 3,800 Mm^3/a by 2040.

As far energy production is concerned, 28 potential hydropower projects have been identified for development within the basin. These are all situated in Angola, except for one in Namibia at the Popa Falls. The 12 largest projects have a total potential capacity of 400 MW and an estimated energy production of 1,900 GWh/a per annum. None has been developed, but the overall potential of these projects is large in relation to the energy demand in the basin, which is only 10% of the potential or 40 MW. It follows that the large hydropower projects can only be economically viable if the generated power can be exported out of the basin. The generation of hydropower is a non-consumptive use of water, except for limited evaporation losses from the reservoirs, and the identified schemes will not significantly reduce the average flow in the Okavango. However, the operational regime of the hydropower plants and dams are expected to change the timing and rate of flow of the Okavango, reducing high flows and increasing low flows or the pulsed flow into the delta.

The purpose of the proposed Mucundi Dam and hydropower station in Angola is twofold. It can be configured to regulate the river flow and will have an installed capacity to generate 105 MW, and the possibility exists to export surplus power into the Southern African Power Pool (SAPP) that is a cooperation between nine national electricity companies in Southern Africa under the auspices of SADC. The members of the SAPP have created a common power grid between their countries and a common market for electricity in the SADC region.

The extent to which all the considered developments in the Okavango basin will materialise would depend on the investments required to improve existing and build new water supply infrastructure in the urban and rural environment as well as capital for urban, rural, industrial, mining, hydropower, and irrigation development. There is therefore a need to develop further tools that can help to identify and clarify where trade-offs are needed between competing interests.

7 Conclusion

Development is a complex phenomenon. It is about improving the wellbeing of people and raising welfare, but there exists a dichotomy between development and environment because it is perceived that development will lead to environmental degradation. It is argued that due to rapid growth, there has been an incessant overuse of natural resources and indiscriminate damage to the environment because of infrastructure development, poor agricultural practice, harvesting of ecosystem services and pollution. However, sustainable development is the key, and the Okavango River basin States recognised the need to jointly confront the issues at stake and to ensure that planned measures will maintain the integrity of the environment for all that live in the Okavango Basin. OKACOM found a way to resolve the potential threat of conflict between development and environment as well as to foster the existing cordial relations between sovereign Okavango Basin States to build trust, understanding, cooperation and collaboration.