CUVELAI BASIN MANAGEMENT

TOWARDS ESTABLISHMENT OF CUVELAI BASIN MANAGEMENT COMMITTEE

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1. INTRODUCTION

The Cuvelai basin is located on the northern central part of Namibia. It forms a delta that drains the southern Angola and brings water to Namibia, and gradually converges into the Etosha Pan. On average, high floods of four in every ten years occur. Local rains also contribute to surface flow in the basin.

The climate in the basin is that of semi-arid, which is characterised by variable rainfall. Summer rains occurs the most. The eastern part receives more and reliable rains compared to the western part. People had settled in area where there is plenty of water and still continue to do so. In past years they relied mostly on water drawn from shallow wells during the dry periods. Recently, an extensive network of pipelines supplying water from the Kunene River provides large proportion of the population with water, while other people get it from boreholes.

Almost half of the Namibian people reside in the rural part of this basin. Rapid population growth, currently at 2% p.a., is the biggest threat to achieving sustainable development in the area. Most of the people in the basin are communal farmers and rely on land and vegetation for their livelihood. The most important crops are pearl millet and sorghum, while cattle, goats, donkeys and poultry dominate livestock numbers. Droughts are frequent in the basin, causing lack of food, water and grazing, at times. Although floods occur, water in the bigger part of the basin is saline and fresh water is deeper and expensive to draw. Proper management of the resources is important to remove resource stress and sustainable develop the basin.

Growing population and bad land use practices therefore, place severe stress on already strained natural resources base of the region. Climate change has added a lot of its own stress, few floods occurs and their magnitude decreased. Increasing competition for water among users and lack of equitable and efficient allocation system leads to shortages and degradation of the resources. These problems and nature of stresses prompted the piloting of Basin Management Committees for this basin. As provided in the draft Water Resources Management Bill, the minister on his own initiative has indicated the need to establish such committees, to better manage the water resources on an integrated manner. Managing on hydrological boundaries is an approach the government of Namibia decided to take, to be implemented as soon as possible for stressed basins. Stakeholder participation and decision-making at lowest appropriate level will make water resources management effective. The consultation with stakeholders has started at the regions that are part of the Cuvelai basin to introduce the concept and the wish to begin the pilot of the Cuvelai Basin Management Committees.

As such, development in water resources management embodies the evidence that suggests that improved natural resources management occurs if polices and strategies are developed on a basin-wide basis. By this approach, policies that reflect the sensitivities and stresses within the basin's natural resource base can then be followed by the various administrations to ensure some uniformity of approach or impact. A basin wide policy and strategy approach is necessary such that each regional administration would not adopt a different emphasis on use of the water and related resources with possible adverse and unintended affects on the basin's ecology.

Integrated water resources management of this basin is very crucial, given its state of degradation. The physical conditions may not change in a long run but with some resources management, can be improved. This will be only achieved if all stakeholders, direct, indirect, potential and government officials, work and plan together. This study will follow the establishment of the Cuvelai Basin Management Committee from initial consultation of the concept of managing on basin level, identification of opportunities, problems and threats associated with the use of natural resources to support rural community production and protection of the environment, to the implementation of a working committee. Its role would be to develop management plans to address the identified objectives and targets.

The report is structured in the following manner:
Description of the basin gives a current situation (literature review) and background to understanding problems in the basin. It starts off with geographical location and climate, population and economy, education and employment. It also describes the current water supply infrastructure, services and uses such as agriculture. Then it looks at the available surface and ground water sources and quality. Enabling institutions and legislation especially when it comes to water allocation is mentioned. The chapter ends with concluding remarks and some situation analysis.

Chapter 4 deals with identification of main problems and issues done through regional stakeholders' consultation, with a list of issues by region. It then attempts to analyse the issues and come up with possible measures towards sustainable water use and development. Throughout the process stakeholders' input is solicited, through meetings, workshops and other consultation methods. The aim of the study is to involve stakeholders throughout the process of problem identification and generating solution or measures to address these problems.

In chapter 5, strategies for integrated water resources management in the basin and country are explored. It explained a rationale for managing on basin level, establishing of basin management committees and their proposed structure and functions. The subsequent chapters of the report discuss establishment of Basin management committees in the Cuvelai and the institutional strengthening support from GTZ to this process.

In the end of the report conclusions and recommendations are given with the overall objective of achieving sustainable use, better management and development of water resources in the Cuvelai basin, by concentrating on integrated water resources management and participatory approach.

2. METHODOLOGY

2.1. Study approach

It is generally agreed that integrated water resources management will be more effective if carried out on river basin level and with the involvement of stakeholders. At the same time, identification and integration of all issues relating to the resource base is essential for efficiency and to address socio-economic and environmental challenges. In Namibia as in many countries, this approach is gaining momentum. The National water policy calls for decentralisation of the operational management of water resources and services to lowest practical level. The draft Water resources management bill empowers the minister to establish a Basin management committee, on his own initiative or on request by stakeholders, to manage water better.

To date, the former minister has indicated the need to pilot a basin management committee for Cuvelai basin. The reason being that the basin is under stress from land, water and environmental degradation and most people in the country reside in that area. Setting up a basin management committee will help to combat future resource degradation through integrated water resources management.

2.2. Objective of the study

The objective of this study is to introduce the concept of integrated water resources management at basin level and its application in Namibia through establishment of basin management committees.

2.3. Discussion and information gathering

This study follows the introduction of integrated basin-wide management approach and its strategies in Namibia through the establishment of Cuvelai basin management committee, the implementation and monitoring of projects. The process started with regional consultation of stakeholders to introduce the concept of water management of basin level, setting up of committees and identification of issues (opportunities and threats) and problems currently facing the basin. These problems/issues will be analysed and prioritised and projects developed to address and solve them.

The involvement of stakeholders is very important, as they determine the direction of the research and work to be carried out at later stages. Different experts or consultants give technical support throughout the process. The current situation of the basin is carried out through literature review and stakeholders' interviews and other consultations. This then lead to background and understanding of problems in the basin. As consultation has already started, further consultations targeted selected group of representatives from different sub-basin groups. These should make up the committees and their first task will be basin plans development, implementation (facilitating) and monitoring.

3. DESCRIPTION OF THE CUVELAI BASIN

3.1. Geographical location, topography and climate

The Cuvelai basin is located in central northern part of Namibia (**Figure 1 & 4**). It consists of a collection of ephemeral rivers. The main Cuvelai River, whose main tributaries rise in the highlands of central Angola where it have water in their upper course throughout the year. It then reaches the very flat areas of the Etosha basin, also known as Oshanas, and ramifies into a delta, which is about 70 km wide and then gradually converges into the Etosha Pan. In the west, more ephemeral watercourses join the Cuvelai system, the most westerly being the Etaka Channel, a depression, which is probably a paleo-channel from Cunene River to the Oponono Lake then to Etosha Pan. To the east some channels or linear east-west depression systems with ephemeral flow, converge into the Etosha Pan, while the north-east of the area has no visible surface drainage. The basin is also delineated in such a way as to include all the eastern rivers such as Omuthiya, Omuramba Owambo and the groundwater artesian aquifers around Tsumeb and Oshivelo, which flow towards the Etosha Pan as well.

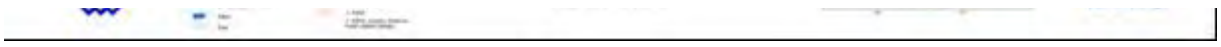

Figure 1: Cuvelai Basin

The basin extends almost 400 km in East-West and some 370 km North-South. Most of the area is extremely flat and gradually slopes down in a conical way towards the Etosha Pan. The altitude of this plain ranges from 1 090 to 1 150 m AMSL, having a north to south slope of less than 1:2 000. To the west are some foothills of the Kaokoveld Mountains, which provide distinct terrain features.
The areal distribution of rainfall ranges on average from 300 mm/a in the west to 550mm/a in the east. This means, rainfall is highly variable from year to year and place to place. Most of it occurs in the form of convective thunderstorms during the rainy season, from October to April, and could have disastrous effects on crops. Within a season, rainfall may vary from half to double of its average value. Potential evaporation ranges between 1 900 to 2 000 mm/a and is greatest during summer before the main rainy season (Oct-Dec). Mean annual potential evaporation from free water bodies exceeds the mean annual rainfall by a factor of about five. As a result, most rainwater is rapidly lost from the system. The resulting rainfall deficit is approximately 1 400 mm/a for most of the basin (DWA, 1991).

Droughts in the basin are expected to happen every so often. They may occur when there is too little rain or when rain falls at the wrong time to support crops or the growth of natural vegetation. This can lead to misusing of land by poor agricultural practices or by over-exploitation of natural resources, leading to desertification in the basin.

With temperatures ranging typically from 5°C in winter to 35°C in summer, the climate can be classified as that of the hot steppe type. Winter crop farming does not happen, due to the fact that frost never occurs. Winds in the Cuvelai are not very strong during most of the year.

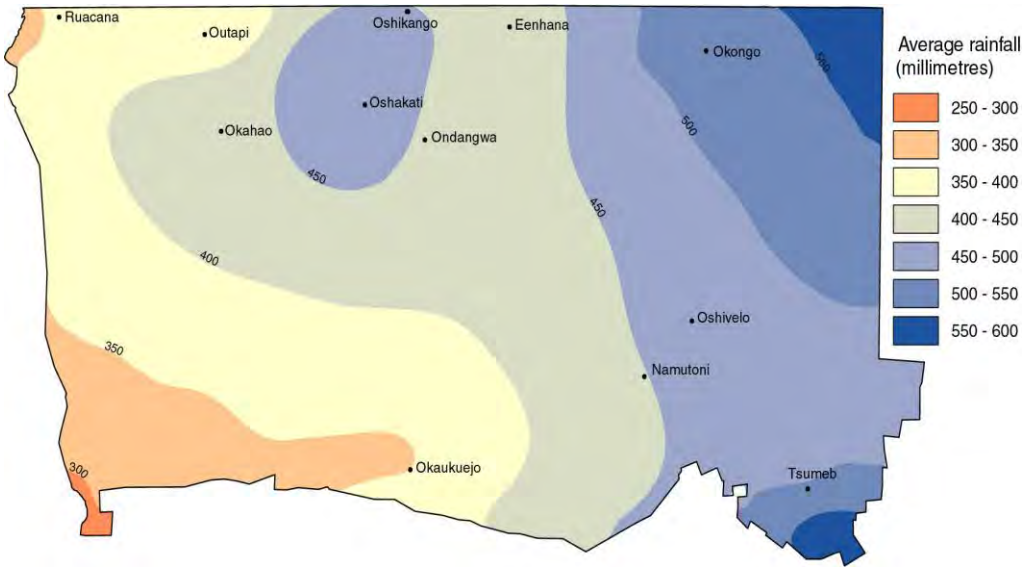

Figure 2: Rainfall map of the basin (Mendelsohn et. Al, 2000)

3.2. Population and economy

Historically, the first occupants of the basin are the hunter-gatherers. These people were low in number and their impacts on the environment were very little. Later on the agro-pastoralists arrived and they farmed and herded cattle.

The current total population is about 785 000 in the four regions that covers the basin. The 2001 census reveals that the present growth rate for the population in the four regions of the basin is just about 2% per year. Rapid population growth is the most important threat to achieving sustainable development in the area. Growing number of people will place severe stress on the already strained natural resource base of the region.

TABLE 1. TOTAL POPULATION BY REGION 1991 AND 2001 CENSUS

Region	1991	2001	Growth rate/year
Ohangwena	179 634	227 728	2.1
Omusati	189 919	228 364	1.7
Oshana	134 884	161 977	1.7
Oshikoto	128 745	160 788	2.0

TOTAL	**633 182**	**778 857**	**1.9**

(Source: National Planning Commission)

People settle in areas where infrastructure developments offer various resources and services such as water, health care, transportation and education. Most of the population is concentrated in the central part, which forms a triangular shape stretching to Oponono Lake, 100 km north of Oshikango at the Angolan border and then east and west over the same distance. Real urbanisation is limited to the Oshakati-Ongwediva and Ondangwa-Oluno town systems. Many smaller population concentrations can be found at the traditional tribal centres or other places with infrastructural development such as schools or hospitals. The Cuvelai Delta shows a very dense rural population pattern, with up to 50 inhabitants per km^2, and people and cattle tend to cluster around the points where water is available (NPC, 1994).

Development is slowly reaching some of the areas in the basin. The economic growth potential is limited by the agricultural sector, and population still lives off communal subsistence farming, mainly stock and dry land crops.

Health problems are related to poverty and underdevelopment. Because of scattered nature of the rural population, many diseases go unreported. The most common debilitating and frequently fatal diseases are malaria, measles, acute respiratory infections, sexually transmitted diseases (including Aids), plague, malnutrition and tuberculosis. (MAWRD, 1995).Education and employment

The history of education in this basin goes back to the colonial times when different types of education systems were provided to different racial groups. The education system here was that of design for Bantus. This is an inferior type of education where not everyone is given proper opportunities to excel to their outmost capability. However demand for better education system increased and in the past parents or missionaries privately ran most schools. These schools have however been registered with government and provided with books, furniture and teachers. However, some people especially the poor don't believe in education. As a result most children mainly girls were left out of school to work in the field and tend to cattle. Financial constraints and lack of schools nearby also contributed to this fact. As a result, the literacy level was very low. Lately the government is making sure that education is a right not a privilege. The Namibian constitution makes a declaration that all children should be at primary school until end of grade 7 or the age of 16. Larger numbers of girls are found in secondary grades than boys who drop out in search for jobs. Schools have been built and parents encouraged to send their children to school. However, most of them are primary to secondary education, and a few colleges and vocational training (NPC, 1994).

According to the NPC, the level of formal employment is high. This is because of proximity to the towns of Oshakati-Ondangwa with some employment opportunities. These include teachers and education workers, employment, trading, health services and casual workers. Most people are self-employed and have small businesses like beer brewing, sale of livestock or craftwork, hawking or trading. Despite that, development is slow which means not enough job opportunities for the whole population. As a result there is a lot of migration to cities where people hope for better job opportunities. Those left behind try to get employment in nearby towns of Oshakati, Ongwediva and Ondangwa, which are growing economically (NPC, 1994).

3.3. Water supply infrastructure

Surface water is only available for certain periods in the Cuvelai basin, and people had to rely on other sources of water during dry periods. People had to settle in areas where they have access to groundwater in the basin many hundreds of years ago. Groundwater was tapped by hand dug wells, and was key factor for enabling people to settle. The western, southern and eastern areas of the region are supplied with groundwater from wells and boreholes. In 1991, 60 % of the water supply was dependent on dug wells, 10 % on drilled wells, and 30 % on a pipeline system. A number of drilling programmes, especially for drought relief, was conducted during the 1990s.

The central Cuvelai is supplied by a complex system of canals and pipelines from Angola, being the area bearing predominantly saline groundwater. Water stored in the Calueque Dam on the Kunene River just north of the border is pumped via a canal to the Olushandja Dam in Namibia, but most of the water is led into a concrete-lined canal where it flows by gravity to Oshakati. From the Olushandja Dam another branch of water is conveyed by gravity via the unlined Etaka canal to Tsandi and Okahao. This is used primarily for livestock watering. Drinking water is supplied to the same area by a pipeline running parallel to the canal (MAWRD, 1995).

The complex network of dams, canals, pipelines and purification plants serving thousands of water points throughout the most densely populated areas is about 2600 km long. Another 2000 km of pipeline is planned in the Oshivelo-Omuthiya, Engela-Endola, Ondobe-Eenhana-Okankolo-Oshigambo and Outapi areas. Treatment works at Olushandja, Outapi, Ogongo and Oshakati purify the surface water, before it is pumped through the pipeline system to the consumers. Current pumping rates vary between 47 and 63 Mm^3/a being far from the rate of 180 Mm^3/a agreed by Angola, so there is still potential for the new infrastructure. An increasing portion of the piped water will be used for livestock watering (MAWRD, 1995).

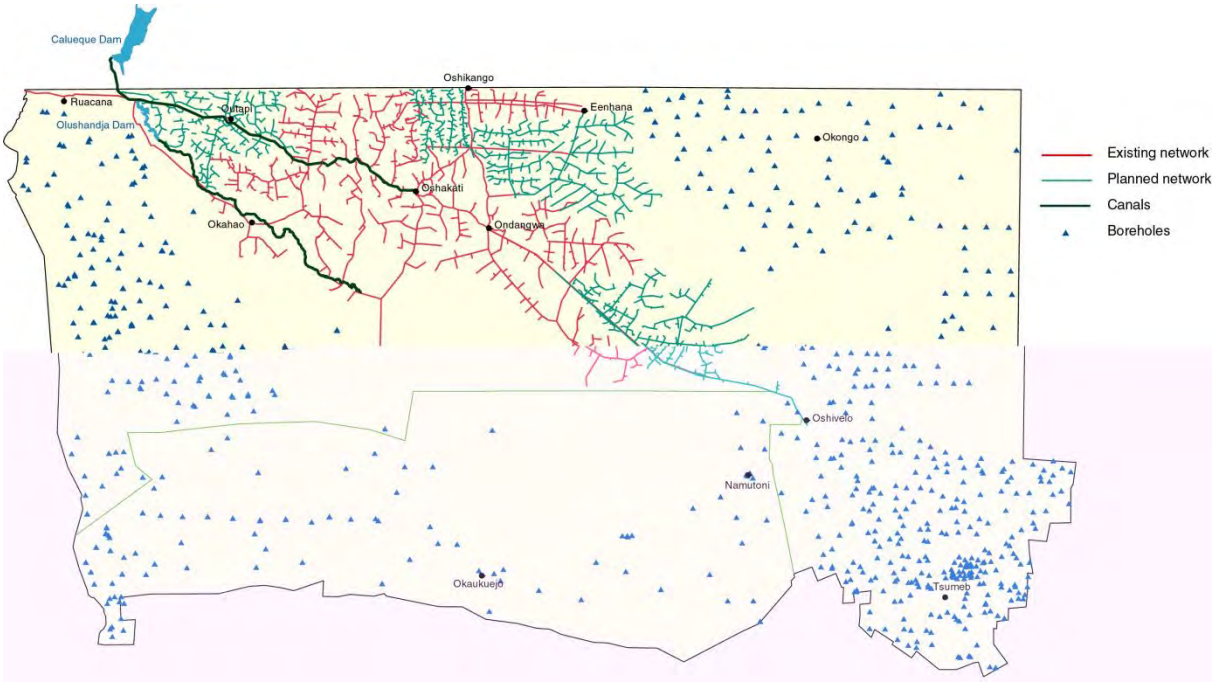

Figure 3: Water Supply system (Mendelsohn et. Al, 2000)

Water tankers supply some small-scattered villages, which have no access to safe water within a range of 2.5 km to a pipeline or a well tapping clean groundwater. Still more than 100,000 people (about 15 % of the total population) have been living beyond the desirable 2.5-km range from safe water access by year 2000. Community Based Management project of the Directorate of Rural Water Supply in the Ministry of Agriculture, Water and Rural Development is trying hard to bring this number down, extending the pipeline system fed by surface water or by drilling new boreholes.
The main target area is the Oshivelo Artesian Aquifer that is presently tapped by production wells supplying some 2.5 Mm^3/a of fresh groundwater via a pipeline to the Oshivelo-Omutsegwonime-Okankolo area. At the moment the Oshivelo scheme supplies 0.3 Mm^3/a to the local population while the total abstraction in 1999 amounted to 0.75 Mm^3/a. There is a risk of saltwater intrusion into the fresh-water horizons, especially from the west and from underlying strata. Therefore, the aquifers must be investigated in detail, before its full potential can be used (Christelis et al, 2001).

Namibia Water Corporation (NamWater) operates eight water supply schemes based on groundwater abstract almost 0.9 Mm^3/a of drinking water, of which 0.5 Mm^3/a are supplied to the three tourist rest camps of the Etosha National Park (Christelis et al, 2001).

Dams have been excavated in the Oshanas to utilise the run-off. Excavated dams are open on the side so that local water from the oshana can fill the excavation. The depth of the dam is limited by the local saline water table. In some area the water table is as shallow as 2 m, but favourable sites of 5 m have been sought and attained. Because of this precaution, little salt-water intrusion into the dams has occurred. Dams, which supplied water for human consumption, have been fenced off and unfenced dams with low slope to allow stock direct access are used for stock watering. These dams were designed to provide 2-year water supply including evaporation losses. With increased water demand there is a possibility for bigger dams to store more water. Because of the saline water table, an increase in water volume could only be achieved by increasing the surface area of an excavation dam. High potential evaporation losses did not make such a solution viable, and the concept of pumped storage dams was introduced. A pumped storage dam was excavated from ground level to the saline water table and had an embankment raised several metres above ground level. Water depths of up to 10 m have thus been obtained. Water was pumped from the sump dam, excavated adjacent to the storage dam. There were at least 17 pump storage dams constructed in the Basin to supply water to hospitals, schools and community centres. Water was sand filtered but because of problems with fine sand, simple purification system works were introduce to treat water for human consumption (DWA, 1991).

3.4. Agriculture

Agriculture is the basis for the economy in the area. The local land use system is the one where crops, trees and livestock are used. The crop component consists mainly of mahangu, sorghum, beans, pumpkin and melons. Livestock component consists of cattle, goats, sheep and donkeys; while the tree component consist of diverse mix of multipurpose species, including mopane, marula, palms, figs and boababs. Most farm areas include an area for the homestead, fields, livestock kraal, and an area with trees or shrubs. Farms with a fenced in grazing area are on the increase.

The demand for livestock watering, for the communal farm area north of the Omuramba Owambo, is in the range of 13 Mm^3/a based on estimated year 1998. Livestock populations are 550,000 cattle (LSU – large Stock Unit) and 1,325,000 goats, donkeys, etc. (SSU – Small Stock Unit) and demand figures of 45 l/d· LSU and 8 l/d·SSU. About 0.6 Mm^3/a of groundwater are being abstracted for livestock watering (31,000 LSU; 34,000 SSU) in the Tsumeb commercial farm area south of the Omuramba Owambo (Christelis et al, 2001).

Groundwater based irrigation is being undertaken on two farms: Mangetti Dunes and Namatanga (Kaokoland). The two farms grow vegetables applying drip irrigation at a water consumption rate of 10,000 m^3/a per hectare. Surface-water based irrigation is being undertaken on three Government farms near Ruacana and Oshikuku: Mahenene, Etunda and Ogongo. Two farms grow mainly vegetables on 10-12 ha land, each, while in Etunda 600 out of 1200 ha irrigable land are being irrigated growing vegetables, maize and wheat. The surface-water irrigation schemes apply sprinklers at a water consumption of 15,000-24,000 $m^3/a·ha$, thus twice as much as the drip irrigation technique (Christelis et al, 2001).

3.5. Water quantity and quality

3.5.1. Surface water

The Cuvelai System (also known as the Oshana System) consists of a collection of ephemeral rivers, shallow pans and wetlands, many of which join together and flow into the Etosha Pan following good rainy seasons. These streams originate in Angola, form a delta and gradually converge into Etosha Pan. Local downpours also make contributions to surface flow in the basin. The basin is composed of three major stream systems (**Figure 1**). The main Cuvelai in the centre, where it forms an inland delta before it converges into Etosha Pan and other smaller pans. Further west is a much more defined Etaka Channel, which can sometimes be seen as the present remains of the Kunene River when it drained into the region millions of years ago. Olushandja dam has been constructed on this channel to carry water from the Calueque dam in Angola and water is sometimes released in the channel for use by livestock in the area further downstream. This channel joins the main Cuvelai system at the smaller lake of Oponono, before is enters the Pan. The eastern part of the basin is two major streams, Gwashigambo and Omuramba Owambo. These don't join the main Cuvelai but ends straight into Etosha pan. Water reaching the Pan depends mostly on the volumes and forces of water flow, and occurs 8 out of 20 years of good flows make their way to the Etosha Pan.

The water flow patterns and frequency in the Cuvelai basin are highly variable and depends on how much rain fell and whether it fell in Angola or locally. When good rains fall, the entire basin gets flooded. The **TABLE 2** below shows an old record about flow at Okatana or Oshakati from 1940/41 to 1966/67, where the main flow channel of the Cuvelai Delta was assumed to be. Although partly based on the diaries of the missionary there and partly an attempted measurement, it should be valid in the order-of-magnitude and frequency of flood events.

TABLE 2. FLOWS AT OSHAKATI FROM 1941/40 TO 1966/67

FLOW MAGNITUDE	FLOW QUANTIFICATION (m^3/a)	NUMBER OF OCCURRENCES (27 YEARS)
No flow	0	10
Very weak flow	100 000	2
Weak flow	500 000	3
Normal flow	5 000 000	4
Good flow	15 000 000	3
Very good flow	50 000 000	3
Exceptional flow	100 000 000	2

TABLE 3, shows the records that were again attempted between, 1975/6 to 1979/80. These records are not very representative, as they are short term, and give a wrong impression of the floods in the region where droughts are frequent.

TABLE 3. RECORDED RUNOFF (10^3 m^3)

Station	Season	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	TOTAL
1	1975/76	0	0	0	117	256	13 519	1 896	0	15 788
2		0	0	0	0	1 119	18 803	24 739	58	44 720
3		0	0	0	793	8 114	622	4 060	82	20 671
4		-	-	-	-	-	-	-	-	-
5		-	-	-	-	-	-	-	-	-
1	1976/77	0	0	0	0	0	0	0	0	0
2		0	0	0	0	0	281	0	0	281
3		85	290	1 339	1 477	1 128	528	0	0	4 46
4		0	0	0	0	0	0	0	0	0
5		0	0	0	0	58	956	0	0	1 012
1	1977/78	0	0	0	0	11 515	4 105	8 083	0	23 703
2		0	0	0	0	19 466	10 170	6	0	29 642
3		0	0	4 209	8 080	6 507	805	0	0	19 601
4		0	0	0	0	6 164	0	20 898	3185	30 247
5		0	0	0	0	7 601	0	0	0	7 601
1	1978/79	0	136	0	0	18 669	3 101	0	0	21 905
2		0	0	0	0	18 424	16 211	134	0	34 769
3		0	0	0	0	0	0	0	0	0
4		0	0	0	0	113	64	0	0	177
5		0	0	0	0	16 067	21 040	0	0	37 107
1	1979/80	-	-	-	-	-	-	-	-	-
2		-	-	-	-	-	-	-	-	-
3		-	-	-	-	-	-	-	-	-
4		0	0	0	0	0	0	0	0	0
5		0	0	0	0	0	0	0	0	0

(-) denotes no record

Since then recording have never resumed, except for a few gauge plates at some bridges and culverts to measure water level. Some flow gaugings **(TABLE 4)** were done during the 1994/95 floods at selected sites.

TABLE 4: ESTIMATED FLOWS IN THE CUVELAI BASIN DURING 1995

Dates/period	Angolan Border	Oshakati - Okahao	Ondangwa – Oshakati
	Flow rate (m^3/s)		
15/02/1995	80	66.9	67.2
16-17/02/95	60	45.8	44.9
04-05/03/95	95	42.5	87.2
07-10/03/95	70	36.6	61.0
14-17/03/95	40	8.9	34.4
04-05/04/95	5	8.5	4.5
	Flow volume (Mm^3/a)		
TOTAL for 1994/95	245.8	136.5	211.0

As one can see the earlier records estimates the mean annual runoff (MAR) to be between 15 and 55Mm^3/a and are much lower, therefore underestimating the flow potential for the basin. In conclusion, the revised MAR estimate is between 100 and 200 Mm^3/a (DWA, 1995).

3.5.2. Groundwater

In describing groundwater in the Cuvelai Basin it is necessary to deal with the east, centre and west separately as the situation differs markedly in each zone.

Western Cuvelai

In this area a Kalahari aquifer is present but towards the western basin margin carbonate rocks are exposed forming karst aquifers. A transitional zone exists between these two aquifer types where the Kalahari is devoid of groundwater and buried fracture aquifers are found. Close to the margin of the central zone water quality deteriorates and elevated salinity becomes an obstacle to development. Water table depth is generally less than 40m in the western zone.

Central Cuvelai (oshanas)

For millennia people have lived in this area due to a ubiquitous, thin, shallow, freshwater aquifer. This has been exploited by manual excavation and has seen annual recharge from rainfall and runoff, and occasionally from floods originating in Angola, known as the Efundja. Deeper exploration has failed to locate potable water, constraining large-scale development.

A threefold subdivision of Kalahari aquifers in the central part of the Cuvelai Basin was proposed (GCS, 1991). This subdivision, which is only applicable in the area covered by the Cuvelai drainage system, comprises the following aquifers:

Discontinuous Perched Aquifer, containing fresh water perched above shallow impermeable layers largely confined to the Cuvelai drainage system from whence recharge is derived. This aquifer is commonly less than 8m below surface and exploited via unlined hand-dug wells and 'gat-dams' (broad, shallow excavations penetrating the water table).

Main Shallow Aquifer: where water levels are generally deeper than 8m but still accessible by hand-dug wells. Water quality varies from fresh to brackish, the latter condition interpreted as the result of mixing with saline water from the aquifer below.
Deep Aquifers: tend to be very saline containing relatively ancient water dating from the period in which the sediments were deposited (i.e. connate water). In places potable (drinkable) water has been intersected by boreholes in this deep aquifer but the relationship of this to the generally hypersaline water dominating the aquifer is not fully understood.

Eastern Cuvelai
In the eastern Cuvelai groundwater occurrence is similar to that in the adjacent Okavango Basin. Although shallow, perched aquifers are present in places; deeper Kalahari aquifers provide the bulk of domestic and livestock water requirements. The boundary between the Okavango Basin and the Cuvelai is poorly defined as the piezometric surface slopes very gently eastwards and westwards and the divide lacks clear definition.

Water rest level is generally in excess of 50m and direct recharge from rainfall and runoff is unlikely. It is thought that groundwater in this area originates as both connate water (retained in the sediments from the time of deposition) and through flow from the Otavi Mountainland to the south. (DWA-2, 1991)

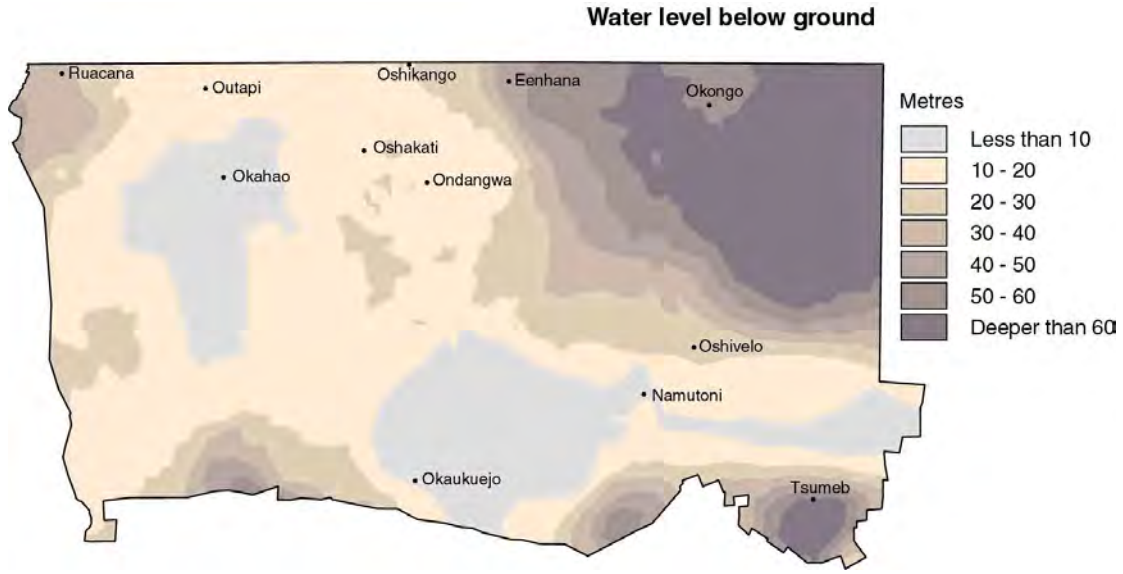

Figure 4: Water Level below ground surface (Mendelsohn et.al., 2000)

3.5.3. Groundwater quality

The abundance of rainfall, the topography and the chemical composition of the geological formations through which the groundwater percolates before it accumulates in an aquifer determine the chemical quality of groundwater. The groundwater in the arid regions tends to contain higher concentrations of dissolved salts, which may be unhealthy for human and animals. The corrosivity of such waters may

also cause damage to water supply equipment. The quality of groundwater over much of the basin is extremely poor and severely limits its use. The water quality is especially poor in the central areas extending south from the Namibia-Angola border between Oshikango and Ruacana in a south-easterly direction towards Etosha and Oshivelo. In Namibia, there is a quality grouping of groundwater in place that is based on the concentration of total dissolved solids (TDS), comparatively easy to determine (**TABLE 4**). As salt makes up most of the dissolved solids, this value also gives a good idea of the salinity of water. Any groundwater with a TDS value above 2600 mg/l is not fit for human use (Group D), while TDS values above 5000 mg/l are even harmful to livestock (MAWRD, 1995). The zone of saline water corresponds largely with the distribution of the Main Shallow Aquifer within the Andoni Formation, and except for brief periods when fresh water flows into that aquifer, this source is of very limited use. In the northwest of Oshivelo hints of poor quality groundwater at depth corresponding to increasing deterioration of the quality of the Oshivelo Artesian Aquifer in southerly direction. Refer to **Figure 5.**

TABLE 5. LIMITS OF CLASSES OF NAMIBIA NATIONAL WATER QUALITY CLASSIFICATION

Determinant	Units	Group A Excellent	Group B Good	Group C Low Health Risk	Group D High Health Risk
Ca	Mg/l	375	500	1000	>1000
Cl	Mg/l	250	600	1200	>1200
Conductivity	MS/m	150	300	400	>400
F	Mg/l	1.5	2	3	>3
K	Mg/l	200	400	800	>800
Mg	Mg/l	290	420	840	>840
Na	Mg/l	100	400	800	>800
NO_3	Mg/l	10	20	40	>40
PH		6-9	5.5 - 6 or 9 - 9.5	4 - 5.5 or 9.5 - 11	<4 or >11
SO_4	Mg/l	200	600	1200	>1200
TDS	Mg/l	1500	2000	3000	>3000
TH	Mg/l	300	650	1300	>1300

(source: State of Environment Report – Water in Namibia)

The water quality improves as one moves eastwards, westwards and southwards from the central zone. The best quality groundwater is available along the basin rim in much of the Tsumeb area, in the entire northeastern area of Ohangwena and Oshikoto, in southwestern Omusati and Etosha, and in the area northwards up to Ruacana.

In reality, relatively fresh groundwater can sometimes be found within the brackish central area, and small areas of saline water may be encountered in areas usually providing fresh groundwater. The fact is that separate horizons in the same area can have very different qualities of water. Thus, a borehole may reach a fresh-water aquifer 50 m bgl, but then being extended deeper to another aquifer at 100 m depth that provides brackish groundwater (DWA 2, 1991).

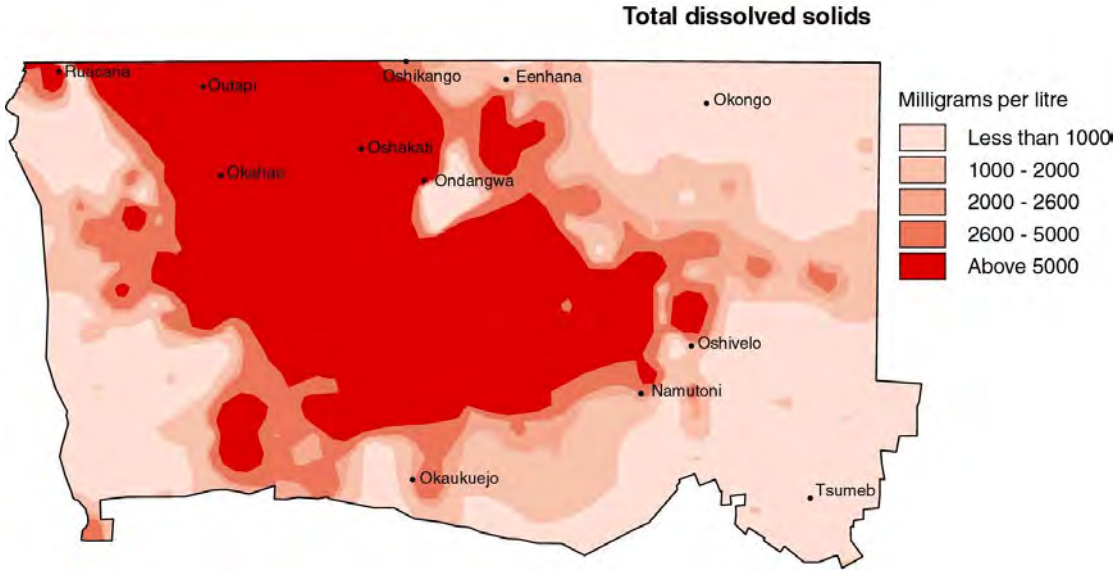

Figure 5: Total dissolved solids (Mendelsohn et.al., 2000)

3.6. Institutional, financial and legislative set up (Historical)

Historically, people in the basin have been organising themselves to supply and manage water resources. Under the leadership of the headmen, several communities have gathered and dig wells. Water was used efficiently and wastage was not tolerated. Both animals and humans were catered for with first priority given to human consumption. Water has always been a common pool good especially in the Oshanas after rainy season. The headmen informed communities when to use the resources like, cut grass, dig a well start open grazing etc. With the influence of the western culture and new government, the headmen have little say in what goes on with regards to the use of resources. The Local and regional government has taken up some of the headmen tasks. Traditionally people have moved from one place to another in search for water and grazing for their cattle. This was a good management strategy especially with regard to the overall environment. There was not as many overgrazing as currently and the people were free to move their cattle from one point to another with no problem.

The Ministry of Agriculture, Water and Rural Development promotes and facilitates sustainable development of agriculture, including rural development, and water in Namibia. The Department of Water Affairs (DWA) is responsible for equitable and reasonable allocation of water, controls water pollution, undertakes research and monitoring of water resources and implements water resources management. The Directorate of Rural Water Supply (DRWS), which was established in 1993 in response to the WASP (Water Supply and Sanitation Sector Policy) is responsible for rural water supply infrastructure and planning. The main goal is to support Community Based Management (CBM) of water supply while directly assuring that the resource itself is used in a sustainable manner. The community will own water supply infrastructure, and will operate and maintain the infrastructure on a cost recovery basis.

NamWater, a national bulk water supplier, supply water directly to DRWS for further distributions to rural communities. The wish of DWA is that the communities are involved in the supply of their water services. This was first introduced in the WASP. The main objective is to recover cost and involve stakeholder participation. CBM is administered by setting up water point committees who will be in

charge of their water points. Financial arrangements are so that in future the water point associations will be fully liable for the operation and maintenance and payments of all the cost related to water use.

The management of water resources in the country is according to the Water Act no. 54 of 1956, an old South African Act that applies to Namibia by virtue of section 180(1). This act is outdated and never really applicable to the arid climatic conditions of Namibia and its hydrological regimes. The Act gives the exclusive right for the use of private water to owner of the land on which such water is found, which most people in the basin don't have as a communal and state land, therefore discriminatory against non-land owners. On the other hand any person at any place where she has access to a public stream may take and use the water from such stream for purposes of washing, cooking, stock drinking waterborne sanitation and crop watering on land not exceeding 1 ha (MWARD, 2000). However the draft Water law is currently at cabinet and awaiting promulgation. This law addresses issues such as, equitable access to water resources, ownership of water, human and environmental needs, management of water resources as to promote sustainable development, economic value of water, stakeholder participation etc.

3.7. Conclusion

The description and current situation of the Cuvelai Basin give an idea of complexity and problem facing the basin with. These problems can be described as physiographic, social and economic ones. The characteristics of this basin have not been truly investigated and understood, which means more studies are required. These studies will help in understand the potential both for the ground water and surface water flow in the basin. Being the most populous basin in the country it is important to know how to supply the people and their environment with safe water. Currently most of the water supplied in the basin comes from the Kunene River through pipeline in the central part and ground water on the eastern and southern parts of the basin. During rainy or flooding season (1 in every 3 years), one can say that the Cuvelai has lots of water. The central part get inundated, water runoff towards Etosha, depending on the magnitude and intensity of the flood. Some of it is stored in the surface water impoundment, but only last for few months because of high evaporation rates. Groundwater in most cases also flow towards the Etosha pan. The aquifers can be divided in three zones of which each has different characteristics and occurrence patterns. In the central part of the basin, people have access to shallow fresh water but the deeper aquifers have saline to brackish water. Hand dug wells are used to argument the dam stored water but the technology used is not very sustainable. Projects have been started to line some of these wells. Towards the east, fresh water is found, sometimes very deep, but more wells need to be dug to provide access of water to all.

Currently this basin is easily affected by drought, lack of grazing and food. People still live in the traditional way were most of them are communal subsistence farmers and make their livelihood off land and vegetation of the basin. Wood is used both as building material and fuel. Unsustainable use of such resources led to overuse and bad land-use, making it difficult for the natural vegetation to recover to their normal state.
It is very important for people of the region to know how their basin is structured and how to use the resources in a sustainable manner. In the old days, resource management was done in such a way that people settled in areas where freshwater was available in shallow wells and moved their cattle to surrounding areas for seasonal grazing, which helped the land to recover. Nowadays, people live in one place and rely on that same land for many years. Without proper management of such system

degradation is sure to follow. Headmen are not in charge of managing their natural resources anymore, leaving it more of a common resource tragedy, with no one to give order as to how and when to use it. In the end basin Management Committees will be in charge of these resources and should come up with ways to manage these resources in a sustainable and optimal manner. Technical support is needed to investigate the potential for these resources and appropriate technology applied.

4. RESULTS AND DISCUSSIONS

4.1. Identification of problems and issues

4.1.1. Regional stakeholders meeting

Introduction

The Namibia Water Resources Management Review (NWRMR) has been conducting workshops and consultations meetings with stakeholders on the integrated water resources management issues addressed in the National Water Policy and the Draft Water Resources Management Bill. The Policy calls for the adoption of an integrated basin scale framework for water resources assessment and management and the Bill provides for the establishment of Basin Management Committees (BMC). The concept of water resources management on basin level and the intention to pilot the idea of basin committees has already been highlighted during those consultations.

The Cuvelai together with the Kunene and Kavango basins have been identified by the Honourable Minister of Agriculture Water and Rural Development as stressed and vulnerable basins in urgent need of attention. The Kuiseb basin stakeholders have indicated the need to start a basin management committee and are in the processes of establishing such a committee.

As such the process to establish the Cuvelai Basin Management Committee started with stakeholders meetings. The objectives of these meetings were to get the issues of concerns from the people on the ground and to get ideas of who should be included in the BMC membership. Most of the stakeholders have already been introduced to the concept of water management at basin level, during the consultation on the water resources management bill. The short overview, objectives, and functions of the BMC was presented and explained. All stakeholders liked the idea of being in charge of their resources management, instead of being told what is to be done for them without giving their own input.

Most of the issues raised were crosscutting the regions. The main ones being keeping water in the basin, either by harvesting it before it disappear to the Etosha Pan and being used mainly for human consumption and agricultural development. And getting the people in Angola to open up the dams so that water can flow towards Namibia (the Government is urged to intervene in this issue). The quality of groundwater is saline in most area, and the some Oshanas, due to infrastructure development.

The rest of the issues of concerns and questions raised during the meetings are elaborated below as per discussions in each region.

4.1.2. Main problems/issues identified: stakeholders' view

Oshana Region

- Disappearance of floodwaters to Etosha Pan/Park before it is utilised for different purposes (agriculture) in the basin/region.
- People shouldn't depend too much on pipeline water especially for livestock drinking and other agricultural purposes.
- Rumours that Omatala River in Angola has been blocked, therefore most of the water does not get to Namibia anymore.
- The possibility of diverting water from the Kunene River, before it reaches the sea to the Etaka Canal (an artificial channel).
- If the Angolans have blocked the rivers upstream, what are the research agenda in that issues, can the Government not do something? Someone should go there and investigate. Namwater representative mentioned that there has been a meeting in Ondjiva with the Minister and the Angolan counterparts to discuss the issue of getting clean water from Namibia. It was mentioned to them that they should investigate the issue of blocked rivers, so that Namibia can have extra water to supply to them.
- At the same time, an agreement between the two governments should be made on water sharing. Use the SADC-Protocol on water.
- MLRR-NRIS (Natural Resources Information Service) has some information on the four regions and can provide maps.
- Wastewater discharge, what is the law saying about it?
- Membership of the Committees? Suggested were Regional Councillors from each region to be represented in each sub-basin committee, especially for planning purposes. Traditional authorities, Youth, Church leaders, disabled, women etc.
- How about training of the Committee members?
- Global warming/El Nino. Recent low rainfall in the country contributes to lack of water in the region. How about the old tradition of fetching rain from Evale (passing comment), but more about rain inducing techniques (cloud seeding) should be investigated.
- New ploughing methods in the region also contribute to the flooding of the fields. When people used hoes it was not that bad. Maybe Department of Agriculture can recommend or give training.
- Conservation of the environment, more trees are still being chopped, resulting in desertification. Communities need to be sensitised and educated towards that issue.
- Funding for research and development should be sought for the whole basin. Set political boundaries aside and work together.
- Population is growing and water demand is on increase. If there is no water, there will be no job and no basin committee.
- Cost of water is high, should be considered. There are poor people in the basin and should be subsidised.

Oshikoto region

- Overgrazing at the water points.
- Broken infrastructures, such as boreholes and pumps/taps.
- Registration of boreholes and some of the nicely done hand-dug wells. Who and when should it be done.

- Environmental issues – overgrazing – desertification – conservation.
- How will the existing committees be included in the BMC?
- Who will facilitate the establishment of BMC?
- Membership should be traditional authorities, regional councillors, farmers (communal and commercial), NGOs – Nolidep, Urban Trust, Church leaders, Etosha Ecological Unit.

Omusati Region

- They would like to see better maps of the basin.
- Would management include surface and groundwater?
- WAD (Women's Action For Development) will sent their issues after discussion with other colleagues in the office.
- Farmers are concerned about floodwaters that pass without being harvested. They have ideas of pointing out good location for building a dam without jeorpadising access to downstream users.
- Because of high salinity, deeper dams seems impossible- new techniques should be investigated to allow larger quantity storage of water with no threat to salt water intrusion.
- Will small-scale desalination for saline water be possible?
- Some of the farmers in this region have their cattle in the Omutsegwonime/Oshivelo area. They seem to experience shortage of water. Pipeline does not go near the cattle posts.
- Olushandja/Etaka dam area poses a problem with birds – they come to drink and live there during the summer season. In the process they feed on people's crops, they have no rights.
- How is BMC different from CBM water point committees?
- There seem to be lots of water in the region but the quality is poor especially if one digs deep. They want more surface dams.
- Membership – the fear is that, language problem may pose threat to limiting wider representation.

Ohangwena Region

- They mentioned that the council has some information on rainfall.
- Northeast of Eenhana at Onakalunga is a good catchment for water harvesting as well as Northwest of Ohangwena. They want a feasibility study into potential of building large dams.
- A monitoring network for the whole basin should be established.
- Epembe and Omundaungilo have a problem of high seepage due to sandy area – even wells are hard to dig without collapsing.
- Location of graveyards and wastewater discharge from hostels and hospitals may pose problem of water pollution if not properly planned. Village/town plans should be done in conjunction with water resources planning and aim to protect the water sources.
- There has been a misunderstanding that rainwater harvested from roofs is polluted and not fit for human consumption.
- More feasibility should be done on building large dams – get input from local people.
- Groundwater quality – where can it get tested if one finds suspicious looking water in the well?
- Environmental requirement - most people seem to think that letting water to go all the way to Etosha Pan/Park is a waste.
- Water rights – conflicts between users – with Angola as well as internal – Ohangwena is upstream of some of the rivers.

4.2. Problems analysis

Looking at what people have to say, water shortage is the basis for all concerns. Some think that enough water comes into the basin but is not properly utilised or harvested. Most of floodwaters disappeared a few days after the flood, leaving the area dry again. This is a result of evaporation and the fact that it is flowing water. The suggestions were to excavate dams such that some water is retained before it all disappears completely. Some people have indicated few catchments whereby they see a potential for large dams. They feel a feasibility study should be done. This water can be used for agricultural purposes, which could alleviate poverty in the region. The fact that groundwater in most area is saline has not escape the people's knowledge. This is one of the things they mentioned, that one can dig and dig, very deep, just to find a lot of brackish water. Because it is plenty, can it be treated, desalinated, to make it consumable at least by animals?

Another issue that came up in most discussion is the fact that water does not flow freely from Angola as it used to. Some people feel or heard rumours that the rivers have been blocked upstream on the Angolan side. As this is an international basin, research and investigations should be done to substantiate the matter. The Government should be involved to negotiate with Angola our equitable share. The Etaka channel, most people feel that it can be deepened so that water from Olushandja dam can be diverted into the channel to flow to the downstream users, or any other artificial channel. People in the west are especially experiencing drought already, and feel that the little pans like Uuvudhiya can be better utilised for cattle watering.

Although some region has information on rainfall on their part of the region, and MLRR-NRIS has maps and reports on the regions, they indicated the need for flood recording and measurements for future development. Therefore a monitoring network should be established in the whole basin.
Water pollution and water sharing came up especially in the southern part of the basin.
On piloting of the Cuvelai basin Management Committee, most of the people welcome the concept and because some have already been aware of it from the consultations on the water bill, it was not hard for them to understand what they have to do. Since they are the people who live and depend on the basin resources it was important that they be in charge of its management as well. Gone are the days when decisions are made for them.

4.3. Possible measures

The first meetings were to introduce the concept and get the discussions on the issues and possible measures going. Follow up meetings was to share information and pave way to the work of committees once established. However some possible measures have been brainstormed as follow:

- To better assess the amount and spatial patterns of available water resources in the basin, the water balance model must be done for the whole basin including the areas in Angola. Co-operation with the Angolans has to be solicited for this project.
- More investigation into groundwater potential is needed and its economic and technical viability for water supply in the whole basin determined. Attention should be given to the Oshivelo aquifer where most communal farmers take their cattle for grazing and the pipelines does not go till those points.
- A monitoring network should be established to monitor the water flow and rainfall in the basin, therefore better accounting.

- Silt and soil must be removed from the excavated dams to augment the piped water during the rainy season and to be used especially for animals drinking.
- More research should be done on land use management to curb overgrazing, deforestation and bad farming practices.

With respect to water quality problems:

- Desalination of the saline or brackish water throughout the basin must be investigated.
- Permits for wastewater discharges must be introduced and effected.
- Towns and rural villages need to have a good sanitation and sewage system, especially at rural schools and clinics, to avoid polluting the water sources.

Other measures to be taken will depend on the kind of institutional arrangements prevailing. The concept of managing water at basin level is being introduced. Basin management Committees once established will be able to help with overall management of the basin and draw up basin management plans. This will also encourage stakeholders' participation at different levels of decision making and management. Once the water Bill is enacted, it will be easy for the committee to have control of who get issued a permits and licences.

5. STRATEGY FOR INTEGRATED WATER RESOURCES MANAGEMENT IN THE BASIN

5.1. Introduction

It is essential to identify and integrate all issues relating to the resource base, both for reasons of efficiency and to address the socio-economic and environmental challenges Namibia faces. For this reason, Namibia is moving towards the adoption of an integrated, basin-scale framework for water resources assessment and management. Such a framework will take into account all the variables - physical, climatic, ecological and human - which affect both the quantity and quality of the resource (MAWRD 5, 2000).

Developments in Namibia with regards to changes in the institutions involved in water resources management and the launching of a water sector reform programme has put emphasis on decentralisation of water resources management. This process which has been initiated by government; aims at devolving more power and responsibilities to the regional councils.

The reform process has developed comprehensive set of recommendations. These recommendations involve new approaches within the institutional framework e.g. separation of functions (management from regulation and service provider), establishing new laws, and putting in place a coherent training strategy. The new water policy and water law support the issues like integrated water resources management, and management along hydrological boundaries. This involves the setting up of basin management committees to manage water at a lowest appropriate level and supports the government initiative of Community based Management (CBM).

In Namibia water is most of the time the most constraining natural resource and development of water infrastructure for specific purpose in an area of the basin may affect alternative expansion in other areas (Van Langenhove et al., 2000). Development of water and other natural resources is therefore preferably done at basin level, and it is necessary to carefully introduce this new concept for the specific conditions of Namibia, which is the driest sub-Saharan country in Africa. Already, some basins are under stress regarding availability of water and environmental degradation, and basin management should be piloted without delay, in order to deal with these challenges and also to build up competence in the field. The most sensitive area in Namibia is the Cuvelai Basin which covers the central northern parts of the country and where more than half of the population lives, mostly under conditions of subsistence farming, because the area lacks other natural resources or industry.

5.2. A basin framework to integrate water resource issues

Namibia's surface and groundwater circulation system is very complex, making the application of conventional water resource management approaches, which have largely been developed in temperate climates with predictable rainfall regimes and perennial flows, a difficult task. By the same token, the identification of trends requires good quality historical data with high temporal and spatial resolution to be combined with accurate and relevant abstraction data from all major users.

An accurate understanding of Namibia's climate as well as the interaction between climatic and physical determinants is at the heart of the water environment, especially as these relate to the availability of fresh water resources. The quantity of flow in an ephemeral stream depends on the frequency and intensity of rainfall as well as the condition of the catchment. In turn, infiltration and recharge depend on the quantity of rainfall falling directly on the ground and the quantity of water entering aquifers from flowing streams and perennial rivers. However, infiltration rates are also related to soil types and levels of silt load in the stream. The latter of these is, in turn, also related to catchment condition, including vegetation cover. An understanding of these processes is essential for developing and managing the resource base. A failure to address any of the issues related to knowing and understanding both physical and climatic determinants and their interaction will inevitably result in socio-economic and environmental degradation

The primary challenge for resource managers is to anticipate and manage system behaviour and abstractions during prolonged periods of drought. Not only does drought mean reduced rainfall, it also generally leads to a shortage of grazing, overgrazing and hence catchment degradation and ultimately the erosion of topsoil. High sediment loads in the river result in a reduction of aquifer recharge. Under these circumstances, a holistic approach to basin management is essential.

Namibia's surface and ground water resources can be divided broadly into two types, those derived from ephemeral (seasonal, non-permanent systems) and those derived from perennial systems. With the exception of short lengths of the Okavango and Kwando Rivers in the north-east of Namibia, all the rivers in Namibia's interior are ephemeral. They therefore represent an important lifeline for many people throughout the country either directly in the form of surface water, or indirectly as the groundwater sources, which they recharge. At the same time, the perennial rivers along Namibia's northern borders support many people living in relatively large numbers along their banks or close to them. The identification and integration of water resource issues across these broad physiographic limits is essential if water resource management is to address root causes of the socio-economic and

environmental problems Namibia faces. For these reasons a broad basin-scale framework can be established for Namibia. Such a framework takes into account all the variables, physical, climatic and human, which can affect both the quantity and quality of the water resource base (MAWRD 1, 2000).

5.3. Definitions

A river basin sometimes referred to as a watershed, catchment or drainage basin is the area contributing to the drainage or discharge at a particular river cross-section (De Laat et al, 2000.). Water basins are separated by topographic features such as ridges or hills that determine the direction of the flow. In areas with negligible surface runoff water basins must be defined in a broader way by considering the underlying groundwater systems. Other factors such as interbasin transfers may also have to be considered. It is therefore thought to be more appropriate to refer to a "manageable" water basin (Van Langenhove et al, 2000).

5.4. Management on basin level

Basins are the appropriate units for operational management. River basin management refers to management of all activities aimed at better function of the river basin (Savenije, 2000). The soils, geology, water and vegetation within a catchment are all interrelated; actions in one part of the basin can affect other parts of the basin.

There is very little human activity that does not have an effect on the basin in some way. Any use and development related to the abstraction, supply or discharge of water affects the health of the ecosystem, the well being of the people elsewhere and the quality and quantity of water environment.

- In a direct manner because it determines the quantity and quality of water available for other activities.
- In an indirect manner because any development activity has socio-economic and environmental impacts.

All land use, natural processes and environmental disturbances interact in either direction with the hydrological cycle and balance within a water basin. Environmental problems are not confined to particular features or areas. If, like in Namibia's case, water is the most constraining natural resource for development, then a decentralized development and management policy is logically to be organized on a water basin basis. Natural resource development and management strategies are more effective if implemented over a whole water basin, reflecting the relation between water, land, vegetation and fauna, and the water basin's ecosystems (Van Langenhove et. al, 2000.).

5.5. Community based management

In Namibia Community Based Management (CBM) refers to communities and the government being partners in the process of planning, construction and/or rehabilitation and managing of the water points and water supply systems. CBM is about the way which communities and government will run rural water supply in the communal areas of Namibia. The principle of CBM has been introduced in the Water Supply and Sanitation Policy (WASP) and been broadened by the Water and Sanitation Co-ordination Committee (WASCO).

Other components of CBM include, cost recovery of rural water supply, both the financial side of managing water points and water supply systems and also the replacement of equipment when it is worm out. The new aspect to this is also paying for the water itself. Coverage component refers to access to water points as well as the quality and quantity of the resource. Within CBM, community structures are made up of different institutions with different function and powers and consequently different composition. These are either advisory institutions (Water Point Associations) who facilitate the implementation of CBM or executive institutions (Local Water Point Committees) who have the authority to carry out their decisions (MAWRD 2, 1999). These institutions and other existing local related committees have to be considered when the BMC are set-up as to be included in membership.

5.6. Demarcation of manageable units

The fact that water is shared and integrated, the country has been divided into manageable units through which Basin Management Committees will be established. Certain criteria have been developed and used to demarcate the basin in such units.
In the beginning, 24 basins have been delimited and these are grouped under 7 main groupings. It should be emphasised, and this is clear from the map, that the basins do not cover all of Namibia. The areas not included are grouped together as the low potential western desert basins and this can be considered as basin # 25. For management purposes 24 basin were seen too many for a small country as Namibia. Therefore a technical workshop was held to:

- Review existing water basins and propose new ones.
- Discuss and get consensus on the framework or criteria for delimitation of water basins.
- Formulate proposals for water basins including both surface and groundwater.

The outcome of the workshop included the consensus on the principles or criteria for delimitation and 13 preliminary basins have been proposed and delimited.
These criteria are:

- **Bio-physical Conditions & Characteristics**
  (Geographical Units-both surface- and ground- water, Nature of the catchment, river links, Size of the basin, soil types.)
- **Sharing of Water**
  (Transfer of water from water rich area to poor area, impact upon down stream users, who will benefit?)
- **Demand for Water**
  (Population density, type of users, economic value)
- **The availability of water**
  (Amount of rainfall, reliability of water resource, availability of surface & ground water, water quality in the area)
- **The involvement of Stakeholders**
  (Consider needs of poor, local/community involvement, realistic partners, equitable representation, cultural relationship)
- **The Future Development**
  (National development strategy, long term plans, industrial/economic development)
- **Sources of Water**
- **Existing Infrastructure**

(Development of Water Resources, existing infrastructure)

- **Policy Framework**
- **Ecological Units**
  (Appropriate unit to determine ecological reserve, ecological integrity, and environment)
- **Economic viability**
  (Financial resources)

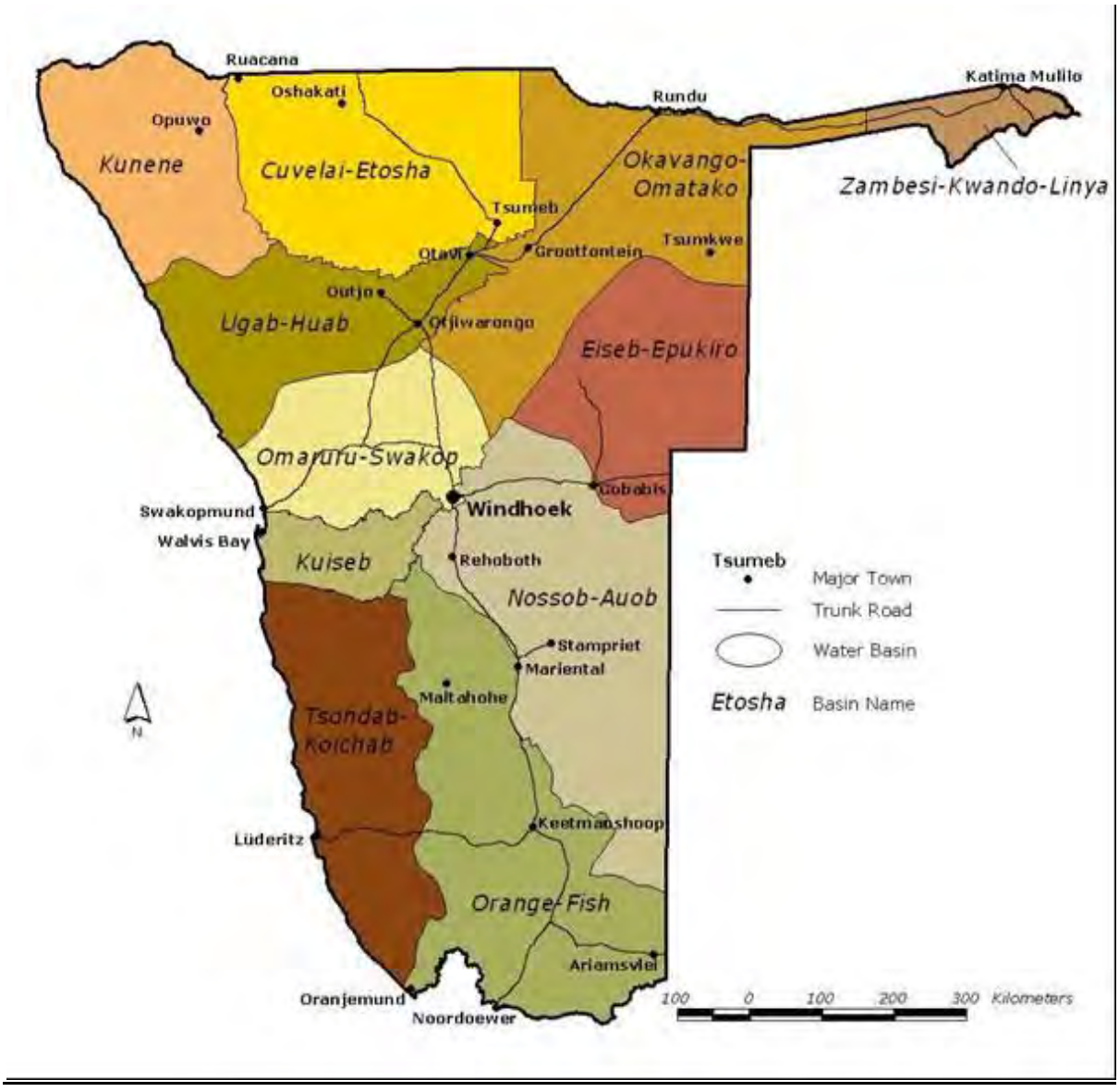

Figure 6: Basin Management Areas

5.7. Basin Management Committees

The draft Water Resources Management Bill provides for the establishment of the Basin Management Committees by the Minister may, upon his or her own initiative, or upon the application of stakeholders within a basin. This will facilitate better management of water resources of the basins within Namibia. The basin management committees provide the opportunity for communities and government to work together to assure that total water basin management is achieved. Their main function will be to advise on the way water, soil, flora, fauna and land is used, by integrating the interests of the direct stakeholders, the development plans of decentralised government institutions, the expertise of technical specialists, and the concerns for the environment.

Their **objectives** are:

- To oversee and co-ordinate natural resource management activities at the water/river basin level
- To plan for achieving sustainable natural resource management for the water basin in partnership with Government at all levels
- To encourage the most beneficial use with a view to maximising social and economic benefits
- To embody full consultation and participation by local committees and stakeholders
- To incorporate wide sectoral involvement in relation to the impact of development on the natural resource base in a river basin (MAWRD 3, 2000.)

Their main **functions** are:

- to promote community participation in the protection, use, development, conservation, management and control of water resources, including groundwater in its water management area through education and other appropriate activities;

- to prepare a water resources plan for the basin which plan shall be submitted to the Minister for consideration in the development of the National Water Master Plan provided for in Chapter 6 of Water Act;

- to make recommendations regarding the issuance of licenses and permits under this Act;
- to promote community self-reliance, including the recovery of costs for the operation and maintenance and replacement of waterworks;
- to facilitate the establishment of an operation and maintenance system of waterworks and the accessing of technical support for associations within its water management area;
- to monitor and report on the effectiveness of policies and action in achieving sustainable management of the water management area;
- to collect, manage and share such data as are necessary to properly manage the basin in co-ordination with the agency provided for in section 17 Water Act;
- to develop a water research agenda, together with the Water Resources Management Agency, appropriate to the needs of water management institutions and water users within its water management area;
- to assist with conflict resolution within its water management area; and
- to exercise any such additional functions as the Minister may delegate under sections 14(1)(d) and 15 of Water Act.(MAWRD 4, 2002)

The **membership** will include:

- The direct stakeholders, i.e. the land and water users and other people who are dependent on, or affecting the availability and quality of water within the water basin area. To be included are representatives of the private sector.
- Officials of government departments or authorities being competent in and responsible for natural resource management within the water basin area.
- Representatives of regional and local authorities within the water basin area.
- Persons with an interest in environmental matters, in the broader sense, within the water basin area.

Members should have the full competence and mandate to represent broad groups of stakeholders and should keep effective liaison with them.

Management committees should be limited to maximum 12 full members, with the provision that associated members are identified who may be called to attend meetings to discuss specific matters where their expertise or input is required, or who may be asked to perform particular activities in their field.

The Water Resources Management Agency within MAWRD should be the leading agency and will be responsible to ensure that all required responsibilities are duly executed. This will include the regular supervision of environmental monitoring and remedial activities and implementing of basin plans.

Their **operating criteria** are:

- The Committee shall administer the development by the leading agency of a suite of natural resource policies and strategies for the basin that will be the guideposts upon which development proposals will be evaluated to ensure basin sustainability.
- Any development plans or other envisaged action by responsible authorities that have a significant impact on the natural resources of a basin will be forwarded to the Committee for review. The Committee's role will be advisory.
- These plans should be discussed during regular and /or ad-hoc committee meetings with members present, either being full members or being associated members called upon to report on specific issues.
- The purpose of the discussions should be to establish whether additional information is required and whether the proposed plans will contribute to the sustainable development of the water basin, or whether the plans will be contrary to this.
- Proposed environmental and other monitoring and remedial action should be given due attention.
- During the meetings, the committee should also discuss any development or potential development within the water basin, as well as the reports on monitoring and remedial action, and other relevant activities within the water basin.
- The committee should attempt to arrive at consensus, but in case this is not possible make use of normal majority-vote procedures, and accordingly make recommendations to the Water Board or, if applicable, to another responsible institution. In this process the committee should closely liaise and harmonise its position with the other institutions involved, such as the proposed Environmental commission and Land Board.

- The committee should also forward the annual assessment of the ecological health of the water basin to the same institution, together with its comments and recommendations for additional activities.
- The committee may have sub-committees.
- The members of the committee are responsible to provide funding for their own operational activities (MAWRD 3, 2000).

5.8. Cuvelai Basin management Committee

Following research and study tours, the concept of managing water on basin level, and establishment of basin management committees, have been introduced in Namibia. In the National Water Policy it states that "*Namibia is adopting an integrated basin-scale framework for water resources assessment and management, to take into account all variables which affect both the quantity and quality of the resource"*. The establishment of basin management committees is included in the Water Bill, where, "*for the purpose of better managing the water resources of the basins within Namibia, the Minister may, upon his/her own initiative, or upon the application of stakeholders within the basin may establish a basin management committee*". As a result the Minister has indicated the need to establish the Cuvelai Basin Management Committee, to start of the process and because of it vulnerability and degradation of the natural resources. Consultations with stakeholders have taken place to introduce the concept and they have accepted it. So far, only the Cuvelai and the Kuiseb (upon application by stakeholders) basins are being piloted. This report dealt mainly with the Cuvelai Basin.

The main objective of the study was to follow the establishment of the Cuvelai basin management committee, and the whole basin-wide approach can work in Namibia. Several meetings with stakeholder indicated their agreement with the need to better manage their water resources. During these meetings, and once they understood the concept of managing on basin level, stakeholders were involved in discussing the issues and problems they faced and what can be done to alleviate most threats. Later they were able to come up with the Vision and draft Terms of Reference for the Cuvelai Basin Management Committee.

Vision

Ensure that the water and other natural resources of the Cuvelai basin are managed and utilised in an integrated and sustainable manner with equitable access and participation by all stakeholders.

Members

To cater for all stakeholders in the basin and not to congest the Committee it was decided to come up with two groups of core and forum members. The core members will do the most of the works and report to the Forum members once a year or as need arise. The forum members will be those who have less direct involvement but effected, associated, connected and they hold some stake in the basin.

Core Committee Members

- Farmers unions/co-operatives e.g. NNFU/NAU
- Traditional Authorities – Forum of 8
- Regional Councils – 4 or 5
- Local Authorities/ Municipalities – 1 L/A per each Region
- MAWRD – RM, DEES, DRWS
- MET – DEA – Forestry
- MLRR – Landboards
- Ministry of Works
- Namwater
- Ministry of Health
- Ministry of Women Affairs

Forum Members

- WPCs
- Nangof – NGOs, CBOs
- NAMPOWER
- Colleges – Schools – University
- CCN
- NCCI
- Ministry of Home Affairs - Police

Terms of Reference

The main function of the Committee should be to plan basin activities and advice Minister towards ensuring that water, natural resources and the overall environment of the basin is accessed equitable, managed and used in the sustainable manner, through:

1. Co-ordinate the research and investigation into environmental issues such as deforestation, overgrazing, and obstruction of flows.
2. Liase with local, regional and national representatives to foster stakeholders' involvement through identification of stakeholders, relationship with existing committees and clear definition of roles and functions.
3. Create awareness and education – to educate water users and community in general on water management issues.
4. Address water pollution and ecological protection problem.
5. Establish international co-operation with Angola.
6. Investigate further feasibility of excavating dams and drilling of boreholes and wells especially for stock drinking.
7. Monitoring networks – establish a database.
8. Deepening of Etaka canal to allow water to flow further downstream for optimal utilisation of the Olushandja Dam.
9. Protection of groundwater from overexploitation by irrigators.

5.9. Iishana Sub-basin Management Committee

Throughout the pilot process of establishing Cuvelai basin management committee, observation was made on the size of the basin especially population wise. In order to get a proper result of piloting, it was suggested that the smaller area be selected to carry out the pilot process. The Technical support team embarked upon a process to demarcate the water management area for the whole country. This included the Cuvelai basin. A meeting with stakeholders was held to present the new demarcation as per criteria described in Section 5.6 and starting the process of dividing the Cuvelai basin into subbasins and to decide which of the subbasins will be piloted. The stakeholders agreed to divide the Cuvelai basin into four basins, namely: Olushandja, Iishana, Niipele and Tsumeb sub basins, using the same criteria. It was also decided to start piloting in the Iishana sub basin. Between June 2004 and October 2005, the Iishana basin management Forum prepared itself to forming a committee. Once the demarcations were clear, list of potential stakeholder in the Cuvelai was revisited and the ones whose organisation falls with the Iishana basin selected and invited to attend further forum meeting.

Figure 7. Iishana Sub-basin Management Area

Representatives with input from stakeholder groups were identified to initiate communication. The concept of representation was stressed as representing ideas and information from their organisation and carries them back to their organisation. Representatives should serve on behalf of their organisations not own ideas on their behalf. From that group of stakeholders, an executive committee was elected to run the day to day activities of the Iishana subbasin. They embarked upon drawing up objectives, vision and terms of reference for their committee, without divert too much from those of the Cuvelai Basin. There was a discussion on what the overall goal or vision for Iishana sub- basin should be. The vision and Terms of Reference of the Cuvelai basin still applies for the sub- basins, but a more specific vision for the Iishana sub- basin be formulated.

Vision for the Iishana sub-basin:
The natural resources of Iishana sub-basin are managed and utilized in an integrated and sustainable manner with equitable access and participation by all stakeholders by 2015.

Throughout the process information sharing, presentations and fieldtrips were included to get stakeholders capacity and knowledge of their basin. Meeting minutes were also recorded. The committee also developed Operational plan and constitution. By the end of October 2005, the Minister officially launched the Iishana Basin Management Committee and has been carrying out their activities in the Plan of Action.

6. INTEGRATED LAND AND WATER MANAGEMENT IN BASINS

6.1. Background to the Project

Namibian German support in the water sector has started shortly after independence. Technical cooperation since 1999 supported the "Namibia Water Resources Management" (NWRM). The project concentrated on the elaboration of a comprehensive policy for the Namibian Water Sector (including proposals for a new institutional framework as well as the draft for a new Water Act). The first phase of the NWRM project ended with the adoption of the National Water Policy White Paper by the Namibian Cabinet in August 2000. The second phase of the project supported the government of Namibia in the implementation of the policy, legal and management recommendations of the Review as approved by the government. Following a project review in September 2003, it was concluded that the German Technical cooperation shall continue to support the ongoing reform process in the Namibian water Sector but should concentrate this support in the area of integrated basin management, putting emphasis on integrated land and water management. Such a reorientation will be in line with the new focal areas of Namibian-German development cooperation.

The concept of integrated water resources management on basin level is part of the Namibian reform process in the water sector. It is expected that natural resource management strategies are more effective if implemented in the context of a water basin, reflecting the relationship between water, land, vegetation and fauna, and the water basin's ecosystems. Land use and environmental processes interact with the hydrological cycle and balance within a water basin. Implementation of the basin approach under NWRM has so far concentrated on steps towards the establishment of Basin

Management Committees in the Cuvelai to manage water along hydrological boundaries and to involve the local communities more actively in the planning, operation and management of their natural resources. Substantial basin management experiences have been generated in the Kuiseb basin (DRFN). These experiences will be utilised in further planning. A comprehensive concept for project support to basin management, including the identification of the basin development priorities and processes was developed for the project.

The overall goal and project goal for the German supported NWRM and activities are stated below. The process has started to develop plan of operations and annual participatory update and review the activities had followed.

Overall Goal:

Water resources in Namibia are managed according to efficient, effective and environmentally sound principles on a consultative process involving all stakeholders.

Project Goal:

The capacity of Namibians to manage their water resources in an optimal way with special consideration for water related resource protection is strengthened.

Result 1: Institutional changes to promote integrated land and water management in basins are implemented

No.	Activity
1.1	Support the establishment of the Basin Management Committee in the Cuvelai.
1.2	Demarcate the sub-basins in the Cuvelai
1.3	Establish links between basin management and land use planning
1.4	Build on experience in the Kuiseb Basin and link it with the Cuvelai Basin.
1.5	Elaborate on the composition of the membership of the composition of the stakeholder forum and solicit member commitment.
1.6	Monitoring and documenting of results of the Cuvelai basin management concept.
1.7	Conduct comparative analysis of piloting experience in the Cuvelai.
1.8	Work out institutional modalities for the operation of the Kuiseb Basin Management Committee with links to the national and regional level.
1.9	Work out financial support mechanism for sustaining the functiong of the CBMC.
1.10	Improve coordination of support for BMC at national level.
1.1	Asses existing approaches, such as FIRM, for their usefulness in promoting ILWM.
1.12	Monitoring and documenting of the results of the Kuiseb basin Management concept.
1.13	Conduct comparative analysis of piloting experience.

Result 2: Capacity of institutions and individuals is strengthened to promote integrated land and water management in basins

No.	Activity
2.1	Prepare facilitators in a process for the establishment of the basin committees and plans development
2.2	Provide existing information to resource management bodies with respective interpretations.
2.3	Organise exposure trips and reciprocal visits for BMC members on topics related to ILWM.
2.4	Strengthen links to the Ministry of Environment and Tourism and Ministry of Land Resettlement and Rehabilitation for capacity building on issues related to ILWM.
2.5	Develop mechanisms and capacity for improved inter-ministerial coordination at national level for the promotion of the cross-sectoral issue of ILWM.
2.6	Promote ownership and capacity building in the Ministry of Agriculture, Water and Rural Development for ILWM.
2.7	Conduct public awareness measures for educating and informing the public on the merits of basin management and ILWM.
2.8	Improve the knowledge base on other Namibian basins.

A new project proposal within the focal area of natural resources and rural development for submission to the German Government was prepared and the project was extended to three more years. This is mainly to continue on the started work in the Cuvelai basin especially the Iishana Sub basin Committee, whose main support in the establishment support came from the GTZ-NWRM project. The project should also start with identification of new basin, for stakeholder involvement in water and natural resources management and further institutional strengthening.

7. CONCLUSIONS

The concept of integrated water resources management on basin level is part of the Namibian reform process in the water sector. Regional consultations have taken place to raise awareness on the concept. Functional responsibilities for this type of management are vested in Basin Management Committees to be established in major or problematic basins in the country. Basin Management committees provide opportunity for government and communities to work together to assure that total water basin management is achieved. It also enhances local empowerment and involves effective public and stakeholder participation in decision making and planning. Empowering local people to manage own water resource will increase capacity in the basin, not only is water resources management, but also in overall developments as water is the basis for all development. This will not only adhere to decentralisation policy, but also to the Water Policy and Water Act that support these initiatives. As a government initiative, supported by stakeholders, government and political commitment is very

necessary to encourage full participation, and moving away from the old system when people where not involved in the management and planning of their resources.

The main objective of establishing basin management committees is to take water resources management and decision making to lowest possible level (subsidiarity). The objectives and functions have already been stipulated, in Water Act. The BMC are advisory statutory bodies, whose main roles are to carry out strategic planning, co-ordinating, assessment and advising on management of natural resources of the basin. Once fully established, the Cuvelai Basin Management Committee, as a statutory body, endorsed in the Water Act, will be enabled to advice the minister and report on the management issues in the basin. Committees will develop plans in accordance with all other national plans, policies and legislation; forward them to the minister of water for approval and then given to the Water Resources Management Agency (DWAF) for implementation. Because of their wide range of expertise in membership, it is expected that thorough and integrated planning is achieved at this level. These plans are co-ordinated by the PSU (Policy and Strategy Unit or DWAF planning) which will be in charge of overall national master planning and policies, and developing a template to be followed by all BMC when it comes to planning. This will help with consistency, although each basin has it own unique characteristics and issues of concern. The plans should indicate the budget for each project and implementing agency and order of priorities. As mentioned the aim is to manage on hydrological basis, on an integrated manner and through participatory approach.

The challenge for the Cuvelai Basin Committee is to manage and utilise their scarce water resources on sustainable manner through a participatory approach. Their functions and terms of references are already given. However support from policy and decision makers at higher echelon is needed to make this national approach a success.

8. RECOMMENDATIONS

It has been stressed that the reasons for managing water on basin level is to manage water resources better, on integrated manner and involving all stakeholders at lowest possible level, through Basin Management Committees. Two possible ways to involve stakeholders have been studied. One is giving Basin Committees full decision-making power and implementation role and two is simply giving them an advisory role where they are involved in planning activities of the basins. Because of low capacity level and pending situation, the later is more suitable to Namibia. However, before these committees can function properly as such advisory committees, the followings are recommended.

- For the reasons of empowering the BMC and as by provision of the Water Act and their membership to WAC, they will report directly to the Minister of Water. The main things to report on should be their Plans as they develop them for approval, findings on the basin status through continuous monitoring and achievement progress as they come.
- Government through the budget of the Agency/Department must provide funds towards the basin activities. Each BMC should be allocated funds to run their everyday activities and meetings. The BMC should also be allowed to generate own funds through different means.
- The structure should allow access to the Minister. The Regional Councils are represented and will present their water plans and problems. The Chairs of BMC will also be members of WAC that will meet twice a year.

- Mechanism to introduce integrated water resources management is done through membership of the BMC which allow for intersectoral representation. As integrated planning is to be practised, all development within the basin has to be approved by the BMC. BMC should have power to demand plans from other sectors as they affect water resources.
- Capacity building needs to be developed to allow day-to-day functioning of the BMC. This can be done by launching an effective human resources development program. Incentives should be given to retain and attract experienced members.

It is important that the process should not be rushed but that the implementation should carried on cautiously bearing in mind the lack of resources and capacity to effectively devolve responsibilities to the basin communities.

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