Okavango River Basin Transboundary Diagnostic Analysis Technical Report

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Transboundary Diagnostic Analysis: Specialist Report Country: Namibia

Discipline: Water Quality Requirements for Human Health in the Okavango River Basin

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Environmental protection and sustainable management of the Okavango River Basin

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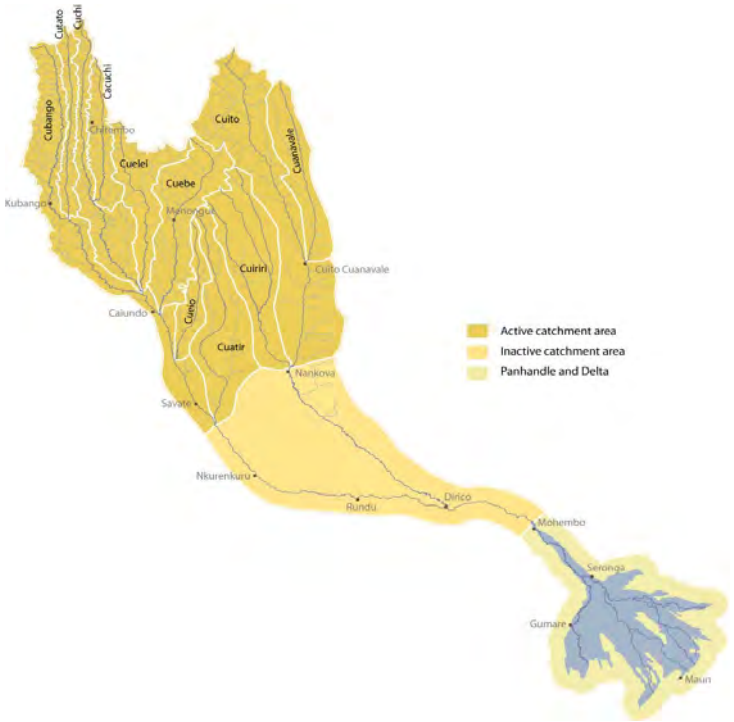

TRANSBOUNDARY DIAGNOSTIC ANALYSIS

Specialist Report

Discipline: **WATER QUALITY REQUIREMENTS FOR HUMAN HEALTH IN THE OKAVANGO RIVER BASIN**

Country: **NAMIBIA**

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Global Environment Facility

OKACOM

EXECUTIVE SUMMARY

The Okavango River Basin (ORB) remains one of the few rivers in Africa to have low levels of pollutants and contaminants. This is because the water has almost no industrial waste, very little chemical runoff and a fairly low level of sewage effluents. Even though the river supports a mainly rural population of over 600,000 across the entire basin from Angola through Namibia and Botswana, who utilize this river on a daily basis for domestic and livestock needs, there are only few rural-urban areas of any significance in the River Basin (RB), (namely In Angola; *Menongue, Kapiko, Savate, Kwatwitwi, Kwangar, Dirico and Mucusso.* In Namibia; *Nukrenkuru, Rundu and Divundu*; In Botswana; *Skakawe, Etsha, Gumare and Maun*). There are currently few to no commercial industries of any note and any impact from several agricultural projects is considered low. The pollutants and contaminants that do enter the water, mainly come from sewage, (solid and liquid waste), livestock manure, soap and detergent. Currently these are readily absorbed and diluted in the large and diverse river system. In the Angolan highlands there is a rapid flow rate which has a cleansing affect on effluents in the river causing them to break down and disperse quite quickly. Also even in the young river rapid flow areas are interspersed with “sponge-like” flood-plains that act as natural filters. In the mid-lower flow areas from Angola through Namibia to Botswana the river becomes an increasingly slow and meandering, with extensive flood-plains that filters water through reed beds, riverine grasslands and papyrus beds that enable the river systems to clean itself along its course from the Angolan highlands to the Delta in Botswana. The river is unique in that not only is it a large, long perennial river it does not flow into any ocean but drains into an alluvial fan called the Okavango Delta which is also an international Ramsar site.

The river does of course carry water dependent bacteria, protozoa, parasites and vectors that cause water borne diseases and these are influenced by seasonal flooding and ebbing in the rate of flow, as well as water temperature. Slow flowing water, trapped or standing water with stagnant pools in a sub-tropical climate are ideal breeding grounds for parasites and bacteria. However, to date, according to health history there has been almost no Cholera, Typhoid, Botulism, Lead Poisoning and Hepatitis; while there is a high incidence of Malaria, Bilharzias and Dysentery; (although Malaria is not river dependent it is worsened by standing water and stagnant pools). In Namibia and Botswana (information on this from Angola was not verifiable) Dichlow-difphenyi-trchorethylene (DDT) is used by their respective health departments, to spray homesteads, clinics and structures to combat Malaria, however both Governments have strict policies on how they manage this activity and care is taken not to contaminate the river?

Information in this report is not limited to the two sites were selected as part of an Environmental Flows Assessment (EFA) research done in the Okavango River Basin. However a thorough review of reports produced during the Transboundary Diagnostic Analysis (TDA) was done to substantiate the findings in this report. Rivers and water borne diseases is a well studied field particularly in Africa and Namibia, several publications and reports including those relating to river quality, sanitation and the socio-economic papers completed during the EFA study were used.

Nevertheless, even though Okavango River is one of the cleanest rivers in Africa, it does have threats and challenges. Currently issues around solid and liquid waste, increased incidence in some water borne diseases and chemical pollutants used for agricultural projects (fertilizers and insecticides) are factors that need management and control. In the future along with general population growth the threats are going

to increase in keeping with socio-economic development. These include expansion in commercial areas, tourism, industry, proposed dams, hydro-electric schemes and agricultural projects that are planned, especially in Angola and all this needs to be taken into consideration for future management strategies.
There are both human and environmental influences that will impact the riparian health status and threats to the spread of human water borne disease will logically increase in keeping with these trends, health after all is directly connected to water quality. Those most likely to be negatively affected are the very people, whose lives development is trying to improve; particularly those depend on the river for their livelihoods in relation to anticipated deterioration in water quality and cleanliness related to industrial, agricultural, rural-urban growth. Any hydro-electric schemes and dam development on the river system will influence the current balance of the ecological integrity of the river basin. Balance between the needs of the people who depend on the river and the potential impact on the water quality requirements for human health is essential. Communicable water borne disease will exponentially increase in keeping with interference caused by socio-economic growth and strategies that mitigate this potential should be foreseen, developed and implemented by the relevant health and water administrations in the river basin in all three countries accordingly and OKACOM remains a good forum to drive this process forward.

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ABBREVIATIONS

ABBREVIATION	MEANING
Aids	Auto-immune-deficiency Syndrome
CD4	cluster of differentiation 4
DDT	Dichlorodiphenyltrichloroethane
HIV	Human immunodeficiency virus
EFA	Environmental Flows Assessment
Gastro	Gastroenteritis
MAWF	Ministry Agriculture, Water and Forestry
MET	Ministry Environment and Tourism
MoHSS	Ministry of Health and Social Services
Min	Ministry
Moz	Mosquito
NR	Natural Resources
ORB	Okavango River Basin
RB	River Basin
Rx	Treatment
STD	Sexually Transmitted Diseases
TDA	Trans Boundary Diagnostic Analysis
VIP	Ventilated Pit Latrine
WASSP	Water Supply and Sanitation Policy

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1. Background

The methodology used to collate this report is from a range of resources. It presents information provided by the Health Environmental Practitioner who is the Control Health Inspector for the Kavango Region, Mr. Herman Mughongora and has tapped into the reports completed for the EFA, namely the Socio-economic, The Water Supply and Sanitation, Water Quality and the Ecosystems TDA reports. In additional data from an internet search and literature review has been incorporated along with personal knowledge and experience.

The Okavango River begins its journey in highlands in Central Angola, where it has a rapid flow rates interspersed with slower flowing areas and floodplains as it drops into the Namibian belt, where it is a relatively slow flowing river. It traverses through extensive flood-pains that enable the river to cleanse its waters through a filtration process reliant on reed beds, grassy flood plains and further down stream papyrus beds/islands. This intensifies as it goes through Botswana an area where the river spreads out starting with the Shakawe pan-handle ending in the Delta, which is described as a low gradient alluvial fan. During its more than 1000 km journey it provides water, life and livelihoods to its riparian population of over 600 000 of which 200 000 reside in Namibia. The ORB (Okavango Rive Basin) encompasses over 120 000km^2. Has a sub-tropical climate with an average rainfall of between 400 to 700mm p.a. which falls normally during the months of September through to April, peaking in December, January, February and March. Along this journey it goes from a wetter, more tropical Angola to the increasing arid and the highly water dependent environments of Namibia and Botswana. The river basin carries a wide range of biodiversity in terms of fauna and flora. It supports a range of largely rural livelihoods i.e.; fishing, harvesting of natural resources (NR) e.g. Grass, reeds, wild fruits, livestock etc. Supports a burgeoning tourism industry (growing in Namibia and intensive in Botswana but only emerging in Angola), irrigation for agricultural/horticultural endeavours and most importantly is the main water supply for human consumption and domestic/livestock use. Plans are afoot for increasing water utilization in the form of dams, irrigation for mainly agricultural purposes and hydro-electrical power, particularly in Angola. There are currently no known major industrial developments planned, although there is discussion around both biodiesel and the cotton industry. However any increased demands made on the river have the potential to threaten the environmental balance and impact the ecosystems that sustain the good clean status of the river that is enjoyed by all today and these changes that will lead to deterioration in the water supply and water quality. While water abstraction for particularly commercial use, farming, tourism etc. is still limited throughout the river basin, Namibia currently uses more water when compared to Angola and Botswana. Water abstraction is closely monitored by the relative water authorities. Angola is keen to develop irrigation schemes and hydro-eclectic power and see these options as critical to address social-economic needs and improve livelihoods of its population. All of which have potentially harmful effects on the water supply and quality in the river basin particularly the Okavango Delta.

Access to safe water for domestic use and clean drinking water are basic needs for survival and has an overwhelming impact on the health status of any community. Fortunately this river is able to provide a sustained level of overall clean good quality water and this is proven by the absence of serious water borne disease such as Cholera, Typhoid, Botulism and Lead Poisoning. There is a low incidence of Hepatitis and occasional Meningitis/Encephalitis outbreaks. Polio has been recorded in the North West of Namibia and with the extensive immunization campaigns is not considered a health problem in the Kavango Region. However the increase in the

Schistosomiasis (Bilharzias'), there are two strains, urinary and intestinal has been alarming and a major cause for concern. The main human disease areas of highest concern are listed in table 1.1.

1.1 The main health areas that need to be addressed are as follows:

Table 1. 1: Summary of main Communicable Diseases

TYPE OF INFECTION	DISEASES	SOURCE/CAUSE	SYMPTOMS	MANAGEMENT	COMMENTS
Protozoan: These are not river dependent can occur in any type of water	Amoebiasis Micro-organisms	Faecal to mouth, contaminated water, including ground water sewage, manure.	Gastroenteritis, i.e. diarrhoea, (travelers tummy) vomiting, abdominal pain, symptoms are often self limiting and subside spontaneously	Hygiene, wash hands, clean eating utensils and water purification (filtering and boiling)	More common than recognized Not only in river water, any unclean water can be contaminated Of concern for HIV/Aids suffers as condition can become chronic and debilitating
Parasitic: None of these are not river dependent can occur in any type of water. Bilharizia is spread along water courses. Malaria occurs in all tropical and sub-tropical areas and not dependent on river	Schistosomiasis (Bilharzias') In ORB only 2 Urinary Bliharzia Schistosoma haematobium Intestinal Bilharzia Schistosoma mansoni	parasitic illness caused by a Schistosoma "fluke" or Snail-worms. Infection occurs when people swim, paddle, bath, wade in any open fresh water, rivers, canals, etc. fluke burrows under skin infection is not only in stagnant waters but less likely in rapids 5 types world-wide incl.parts of Asia favours tropics & sub-tropics, higher prevalence in Africa	Skin itch/ rash at time of infection, can be asymptomatic for years, symptoms present with gastroenteritis, bloody dysentery blood in urine pain on micturition (urination). Back & abdominal pain fever, malaise	Medical treatment (Rx) Campaigns to break cycle. Rx with Praziquantel (Biltricide), single dose on weight. Small water bodies can be treated with chemicals e.g. copper sulphate. Awareness & education to avoid contamination, e.g. not to urinate in water, as is dependent on both human and fluke cycles. Be alert to first symptoms and prompt Rx	Spread of disease has increased dramatically with pop. growth & mobility Dept Health does regular monitoring, testing & large scale Rx campaigns when symptoms present intestinal or kidney damage may have occurred
	Malaria (Plasmodium falciparum)	Bite from an Anopheles mosquito (female), is corpuscular (active evening and early morning), silent and dependent on warmer climate, dies off in winter. Requires human to moz. cycle	Body pain, high fever, rigors, nausea & vomiting severe headache, malaise	Prevention, use moz repellent, burn coils, treated moz nets. Prophylactic not used by residents in an endemic area, but quick diagnosis and prompt Rx is key. Dept Health sprays with DDT	Has highest mortality rate in Africa. Develops drug resistance
	Worms	Faecal to mouth transmission.	Gastro. weight-loss, weakness & malaise	Common particularly in children. Deworm all family members and pets regularly	Under estimated in adults, severe infestations can be debilitating

Bacterial: None of these are not river dependent can occur in any type of water.	Gastro-intestinal Tract infections: Chorea, E-coli (Escherichia coli), Typhoid, Dysenteries (Salmonella and Shigella). Etc	Faecal to mouth, sewage, stagnant putrid water source, contaminated water	Gastro symptoms	Clean water and Sanitation. Chorea and Typhoid are notifiable diseases. Rx antibiotics, important to keep hydrated	Encourage use of well placed VIP. Proper sewage disposal/septic tanks. Boiling and filtering of drinking water.
	Tuberculosis (Tubercle Bacillus.	Airborne transmission, poor ventilation, overcrowding	Most common is respiratory, but can infect most organs. Tiredness, coughing, night sweats, weight loss. Is a chronic condition	Isolation until disease is under control. Long term drug therapy, improved nutrition,	This is a notifiable disease. Prone to drug resistance. Is complicated when patient is HIV positive
Viral	Respiratory Tract infections, Polio	Faecal to mouth, sewage, stagnant putrid water source, contaminated water	Flu-like symptoms With Polio pain and paralysis	Medical Rx and immunization, sanitation and hygiene	Min of Health run extensive immunization campaigns
	HIV/Aids	STD spread through unprotected sex with an infected partner, blood and mother to child transmission. (while pregnant and through breast milk)	After an initial slight fever and a feeling of being unwell HIV can be asymptomatic for years. Blood test registers antibodies when HIV positive. Aids presents with auto immune symptoms when recovery from illness is prolonged. CD4 drops and it becomes increasingly debilitating, with weight loss, weakness and persistent illness until death occurs from inability to recover from an disease e.g. pneumonia	Prevention & awareness, safe sex practice. Voluntary Council ling & testing is encouraged. Once diagnosed patients are closely monitored, when HIV positive status progressed to Aids, under close supervision ARV's are given, there are 3 regimes of different drug combinations used to enhance response and reduce resistance. Healthy lifestyle improves remission. There is no cure	Prevalence is increasing throughout Namibia. Mobility & transboundary travel seem to increase prevalence.

2. Findings

All of which are linked to seasonal slow flow regimes, climatic conditions, absorption of sewage and waste into the river system and population densities and is directly linked to water supply and sanitation. Therefore, pertinent to water quality and health requirements for human consumption is this inclusion (Appendix 2) taken directly from the TDA/EFA report by Ms Ndinomwaameni Nashipili covering Water Supply and Sanitation, (see App 1 pg)

3. Water Hygiene and quality

The team working on Water Quality under Ms Cynthia Ortmann worked with seven (7) indicators to assess water quality and how these indicators varied at the EFA sites during high and low flow episodes. The finding indicated that most of the problems with water quality were during low flow periods. The report states:

> "However, as good as the quality of the river water is at this stage, there are human and environmental impacts on riverine environments which can compromise this state of affairs in future. As part of a holistic water management approach, this study aims to investigate the existing relationships between the river ecosystem and the riparian peoples' livelihoods and to predict possible development-driven changes to the flow regime and thus to the water quality of the river.
> Flow-related location: In slow flowing water, decomposition of organic material takes place faster and the nutrient concentration increases. During fast flows the nutrient concentration decrease rapidly and is leached through the water system."

Please refer to this report for further information; clearly good human health is directly influence by water quality.

3.1 Livelihoods

Poverty is one of the main vectors of disease therefore income and livelihoods are important to good health status of a population and water quality, is a perquisite to good livelihood opportunities. Any toxins, raw sewage, livestock manure, affluent, chemical pollutants that degrade the water quality will become a breeding ground for vectors of disease and this is of particular concern during low flow periods and during the times when floodplains are draining.

3.2 In relation to communicable disease, water and sanitation

According to the health inspector Herman Mughongora. Communicable health issues the Okavango River system are low relatively speaking when compared to for example the Oshana's, Kunene river and even the Zambezi riverine systems. There are few to no cases of Cholera, Typhoid and Hepatitis in the Okavango River as per the "Essential Health Indicators for Kavagno Region" he submitted as an attachment to this report. (See Appendix 3 attached). However it is proven that during low flow periods the risk of communicable disease is increased. It is also recognized that in keeping with socio-economic growth trends and as the human population increases within the RB that threats to water quality and sanitation will also increase. To this end to mitigate water deterioration Ministry of Health vets all business, lodges, ventures, schemes and projects. In order to obtain required licenses to operate, be it a registration with the Namibian Tourism Board or a Shebeen License, Ministry of Health is required to do an inspection and issue a fitness certificate. Licenses can only be obtained once a fitness certificate is obtained and in order to qualify a set of criteria are stipulated, such as proper waste and sewage management. Strict guidelines on the prevention of solid and liquid waste draining into the river system are enforced. However, it is a large river basin, with dense areas of human

population and it is beyond the means of a few health inspectors to monitor and control all aspects of pollution. Particularly when it comes to bush latrines in reedbeds, along the riverine edge and in the flood-plains. Great effort has been undertaken to ensure all schools and clinics have proper VIPs as an example of good, manageable and economic means of dealing with sewage. Unfortunately much work is needed to enlighten most of the rural population to the value of constructing, maintaining and the correct use of proper latrines.

At the more urbanized areas such as Rundu, Nkurenkuru and Divundu there are functioning sewage works, however these are ageing systems and most are not operating well enough to cope with the increased human excrement coming into them. There have been leakages into the river system, but it is fair to say that for the most part this is still leans toward the minimum and whilst the water quality immediately down stream from these leakages is contaminated, further downstream this affluent becomes diluted and filtered. At this stage the river appears to be coping as indicated in the water quality report submitted, however as population increases in the RB so will the solid, liquid waste and sewage and the existing sewage works will require up-grading and expansion.

3.3 Government policies and control

The Government through MoHSS, Rural Water Supply, Min. of Fisheries, MAWF (including veterinary services) and MET has developed policies and practices to implement good measures for human and animal diseases control within the RB. However again in many instances resources are stretched quite thin and these practices are not always fully and competently enforced. There is a large need for training, awareness and capacity building within the riparian populations and among Ministry staff.

3.4 Impact of Agricultural activities on water quality

To what extent agricultural activities may have also had an impact on the river health, is quite difficult to fully establish. There are four extensive agricultural projects in the Namibian section of the ORB. Musese in the West, Mashare and Shitemo in the central area and Shadigongoro to the East. MAWF monitors water abstraction and use of chemicals, insecticides and fertilizers. There are indications that some contaminants leak into the river system especially through the alluvial sandy soil substrate. Even so findings in the water as reported in the water quality report, showed that this had a nominal impact at this stage. Should future large scale agricultural project be implemented along the riverine area such as the Green-scheme strategies to mitigate contamination of this nature would need to be developed and implemented. What however, is of much greater concern linked directly to agricultural projects is the large scale deforestation that it encourages, for example tractor sloughing versus oxen sloughing imposes that root-stock of tertiary forest be aggressively removed to facilitate the ploughing and supposedly increase per hectare crop yield. In terms of environmental protection and integrity this may require further investigation on how sustainable is modern technology in a rural and relatively poor population? The degradation of river banks and erosion of deforested areas are already confirmed and needs to be addressed more effectively. This includes livestock trampling and degradation of river banks that occurs during watering.

3.5 HIV/Aids and Water Quality

HIV/Aids is not related directly to the water and the river system, it is an infectious disease that is spread by a mobile population. It is therefore wide spread throughout the country, how it does relate to the river is that a large percentage of the rural population live closer to the river where there is easier access to water, therefore the prevalence rate is possibly higher closer to the more densely populated zones. The highest prevalence of HIV in the country is directly influence by particular cross border transport routes.

Health awareness and education throughout the basin including Angola and Botswana are actively conducted at various levels through the relevant health care administration, at NGO level and through the private sector. In fact some of the best HIV/Aids training tools are being used in Angola and were developed by UNICEF, who also did extensive training amongst active NGO and government departments on how to make use these. (A photography copy is available from the author). Namibia operates and rolls out a top notch service in the Kavango Region through "New Start Clinics" attached to district hospitals, training of the staff is done by Intrahealth who visit these clinics quarterly. The district hospitals all have a mobile clinic unit who do primary health care. Botswana has a very similar system that is managed from their Communicable Disease Control Centre in Maun. Botswana does lead the RB in the provision of clean drinking water being made available to its rural population. Throughout the RB HIV/Aids is not managed as separate from general health issues.

4. Sanitation and sewage

With the exception of the urban areas that have municipal water borne sewage that is disposed of in functional sewage dam systems, the majority of Kavango Residents do not have access to suitable sewage disposal. In the areas where sewage is managed and either extracted or water borne to a sewage settling ponds, or through septic tanks, raw sewage getting into the river system does not occur. MoHSS and its health inspection division are particularly interested in the management of raw sewage and the impact that this has on both human health and contamination of the river. All tourism ventures and permanent dwellings are inspected to ensure that they either have properly managed septic tanks, or adequate sewage drainage including waste water, such as bath or kitchen water, is properly drained/managed. Unfortunately informal latrines are not so well controlled and this includes informal settlements in urbanized areas as well. Proper, well constructed ventilated pit latrines are actively encouraged where flushable systems are not possible.

However the majority of Kavango Region residents who live in mainly informal settlements in both the rural and urban areas do not have access to proper ablution facilities and the “bush toilet” remains the norm. Health Inspectors and Primary Health Care workers recommend that these bush toilets, all pit latrines, all flushable toilets using a septic tank and municipal sewage settling dams to be located well above high water levels to avoid any sewage effluent from being washed into the river during the high flooding periods. They also stipulate that any pit latrines be located a safe distance away from their water source. The implementation that has been initiated since the revised Water Supply and Sanitation Policy (WASSP) was adopted in October 2008. Has encouraged improved management strategies with regard to water supply and sanitation. MoHSS has the role and responsibility to develop, implement, control and enforce health legislation and policies regarding sanitation practice, this includes a monitoring and evaluation function. MoHSS is building links with Local Authorities and Regional Councils to increase responsibility for water supply and sanitation in their areas. It is hoped that this will promote the continued healthy state of the river, which is a clear indication that unmanageable amounts of raw sewage are not having an impact on the health status of the river system. This in indicated by the general absence of communicable water borne diseases such as cholera, typhoid and botulism.

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5. in Water Borne Diseases

5.1 Malaria

Malaria an endemic vector-borne, infectious disease caused by a protozoan parasite. It is the most common cause of morbidity and mortality in the Kavango Region. It is not confined or caused by the river, but is exacerbated by stagnant, or still water lying in and around the waters edge and at all water sources that enable the *Anopheles* mosquito to breed. The protozoan is carried by the female Anopheles mosquito and undergoes a cycle requiring both human and mosquito to survive. The Kavango Region has the most serious form of malaria *Plasmodium falciparum* which if untreated leads to complicated malaria and ultimate death if not treated effectively. Complications include possible cerebral malaria, kidney complications (known as black water fever) and damage to both the spleen and liver. Most vulnerable to complications and mortality are young children, pregnant women, those with positive HIV status, AIDS and underlying debilitating illnesses.

With regards to malaria prevention is the key, MoHSS spray homestead with DDT in October and January. Care is taken not to contaminate the river with DDT; they recycle the cleaning drum and do the washing out of drums above the flood line and away from other water sources. Prophylactic is not used, but all clinics are equipped to implement prompt treatment as soon as diagnosis is made. The region has predominantly chloroquine resistant malaria and the disease is currently treated with a drug combination therapy.

Reducing the amount of pools and puddles of still water, proper management of sewage and waste water will reduce the volume of Anopheles misquotes breeding substantially. However this is impossible to impose and malaria has shown to have strong resistance to control measures and remains the most common cause of morbidity and mortality in the region.

5. 2 Dysentery and Gastroenteritis

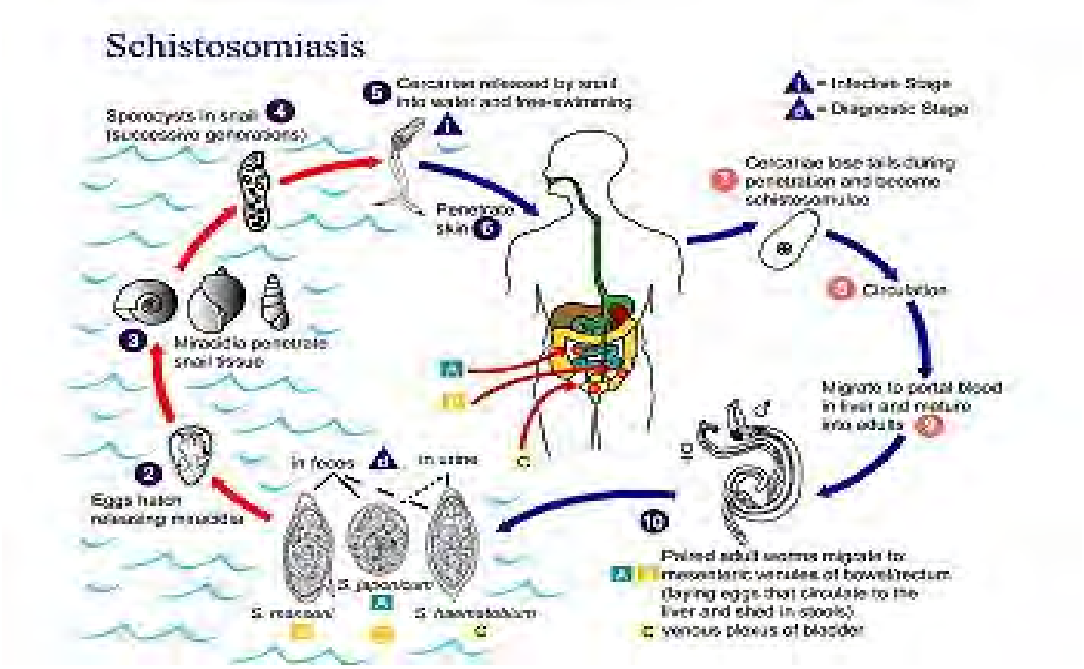
Diarrhoea is a symptom of the above condition and is caused by consuming contaminated food or liquid, often referred to as a form as food poisoning. Homestead hygiene during the preparation and storage of food are causative factors, however the main cause of Gastroenteritis) is drinking unclean water. It is most common during low water flows and the beginning of summer when the warmer temperatures and the low-slow river contribute to the breeding of the bacteria (E-coli) that cause gastroenteritis. In severe cases bloody diarrhoea (blood in the stools); the disease if untreated can be life threatening particularly in babies and young children the main cause of death is dehydration.

The main prevention is to purify the drinking water; this can be done by boiling the water and storing it to be drunk when cooled down. The prevention of manure and raw sewage from getting into the river in the first place is critical to reducing incidence of dysentery.

5.3 Schistosomiasis (Bilharzias')

There are two types of **Schistosomiasis on** the Okavango River. *Schistosoma mansoni* causing intestinal bilharzia and *Schistosoma haematobium* causing urinary bilharzia. The disease is contracted usually when a tiny Schistosomas worms burrows its way under the skin when the individual is swimming or paddling in river water. It is dependent on a small snail and requires a human to snail cycle in order to survive. The urinary form is more common than the intestinal one. The complications of bilharzias is that aside from the relatively minor itchy dotted rash that appears just after infection and slight fever is can remain asymptomatic and lie dormant for years after infection, during which the transmission of the disease between snail and human is possible, which is one of the main factors that contributes to its increased distribution. When symptoms do occur usually in the form of bloody urine (blood in the urine) organ damage has occurred. There is a high prevalence, in 2000 Dr Skitter with the primary health care department tested a random sample of school children from Nkurenkuru in the West right across the whole of the Namibian section of the OR all the way to Mohemba in the East. Over 90% of all children tested positive and were treated. It responds well to treatment and in the early stages is easy and reasonably inexpensive to treat. Periodically from the year 2000 to date spot testing of children was implemented and indicated that the response to treatment has been affective as the trend showed a slow but steady decline in positive cases among the school children. A more comprehensive evaluation is scheduled for 2009. If this disease is not detected and left unmanaged it has a tendency to increase and spread within the river basin. For example there were far less cases recorded 20yrs ago than there are today, apparently did not exist in the ORB within Namibia in the early 1970s.

Chart 5. 1: Diagram of Schistosmiasis cycle



Rash after infection

6. Recommendations

There is clearly a need to foresee threats and challenges that will affect health and water quality linked to population growth and socio-economic development. Identify these issues and develop strategies that will best mitigate the negative impacts, thereby maintain the good quality of water and in so doing best serve the quality of life, livelihoods of the riparian population who depend on the river basin. A balance is required that protects and supports both the biodiversity, environmental integrity of the river basin and the health status of the people who utilize the river on a daily basis.

6.1 Liaise and link with health workers, Ministries and NGOs active in the Region

6.2 Problems and threats need to be clearly identified

- Familiarization of OkBMC to identify issues
- Sanitation, solid and liquid waste disposal
- Sewage management, VIPs
- Filtering and boiling drinking water
- Prompt diagnosis and treatment of communicable diseases particularly Bilharzias, Malaria and Tuberculosis
- VCT for HIV/Aids
- Maternal and Child health
- Nutrition and personal hygiene

6.3 Activities and strategies need to be developed to meet this needs and best address the threats and problems identified

- Community awareness raising, training workshops, community meetings with the basin population
- Development of appropriate training materials

6.4 Implement training and capacity building activities for both trainers and the riparian communities

- Training workshops, meetings and training materials
- Training of resource people within the population to act as peer group trainers

7. CONCLUSION

The Okavango River Basin is still one of the most pristine and clean river systems in Africa, largely because there is very little industrial, chemical and effluent absorption. It also benefits from a filtration and cleansing process of water through a complex of floodplains containing reed beds, riverine grasslands and papyrus islands (papyrus occurs towards the lower end of the Namibian stretch of river increasing in amounts in Botswana). However future water utilization and demand is likely to increase with greater high-end development planned and necessary to meet livelihood needs within the riparian population. It is essential that this development is strategically planned and implemented to maintain environmental integrity, good quality water supply, the ecological biodiversity of the river basin. The Okavango River transverses three countries and how the river is utilized and managed the impacts the whole river basin.

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9. APPENDIX

9.1 Appendix 1

Seasonal and climatic influences on the riparian population;

This is dependent on climatic conditions,

1. Rainfall along the basin filling seasonal pans
2. Rainfall in the catchment
3. All affecting the rate and rhythm of flooding followed by rate and flow of drainage,
4. Seasonal temperatures, the hotter the climate, heating up slow to drain and therefore stagnating pools and pans, favours bacterial and parasite growth, the longer it is hotter the greater the bacterial load, the colder periods with less pools reduces bacteria and parasite opportunity.
5. The environmental state of slow to non flowing riverine areas, if there is a population surrounding this area, who feed into the system litter, waste and affluent then the conditions for bacterial and parasititic growth increase accordingly.

9.2 Appendix 2

Appendix 9.2.1 and 9.2.2 are direct extractions from the Water Supply and Sanitation Report; acknowledgments author Ms Ndinomwaameni Nashipili

9.2.1. Water Supply and Uses

"Water supply can be grouped into three categories:

- commercial bulk water supplied by NamWater to local authorities, regional councils and settlements and Villages;
- rural water supplied by the Directorate of Rural Water Supply (DRWS) to rural communities;
- and direct informal water drawing from the river or stream by rural communities, tourist lodges and campsite, irrigation and fish farms.

Water demand for the different users varies between seasons. For instance, water demand for domestic decreases during the cold winter months and increases during the hot summer months. Readily available water in natural ponds during the rain season reduces water demand from boreholes for livestock and in certain cases for rural domestic as communities would often opt to use the nearest water source. Water demand for tourist increased on average by 50% during the high season and decreases by 70% during low season (Kgathi, et al 2006). Likewise water requirements for livestock fluctuates between seasons, during the hot summer months livestock drinking frequency increases compared to winter months where livestock go to the water points once in two days.

Similarly water demand for irrigation increases during the growing season as the plants need more water to produce grains and decreases as the plants matures and

ripen. Though, high water demand for irrigation during growing season in summer months can be supplemented by the rainfall, due to the erratic nature of the rainfall pattern in the country, dry spells are very common, necessitating irrigation throughout the growing season. The fluctuation on water demand for the various uses during dry and wet season can impact on the available water if such increased seasonal demands coincide with low water levels in the river or drought.

9.2.2 Sanitation coverage and type

The management and responsibility for provision of sanitation services and facilities falls under the jurisdiction of local authorities, regional council and the Ministry of Health and Social Services. The Ministry of Health is responsible for ensuring that the types of sanitation in place do not pose danger to public health.

The Town Councils of Rundu and Nkurenkuru provide sanitation services and facilities to the urban dwellers. Sanitation in the urban areas consists of flushing toilets, septic tanks and wastewater treatment plants. In informal housing areas in towns such as Nkurenkuru and Rundu (Pamwe and Kaisosi settlement areas) there still a large proportion of population without proper sanitation therefore still making use of bushes.

The majority of rural communities still use bushes for sanitation purposes. The Kavango Regional Council in collaboration with the Directorate of Rural Water Supply and Sanitation Co-ordination are responsible for provision of sanitation facilities to the rural communities consisting mainly of pit latrines and VIPs. Construction of unlined pit latrines or VIP's may pollute the relative shallow groundwater along the Okavango River.

There are also places such as clinics, schools and hospitals located outside urban areas where maintenance of sanitation facilities falls under the jurisdiction of the Ministry of Works and Transport. Existing arrangements for maintenance and servicing of sanitation infrastructures often had left sanitation at many of such institutions in dare needs due to unclear line of responsibilities and budgetary constraints.

Generally access to sanitation is still very low for both urban and rural communities. The information gathered during the National Housing and Population census conducted in 2001 reveals that as high as 82% of the population residing in Kavango Region are without toilet facilities (NPC, 2007). Only 15% of Rundu residents are connected to the sewer system by 2002 (Sinime pers communication, 2008). Some residences in Rundu Town have septic tanks that are pumped out or soak away which may pollute the shallow groundwater near the river. Most of Rundu residences particularly those that are living in what is called informal areas make use of pit-latrines or green toilets (bushes). However a new wastewater treatment plant is under construction to be completed in 2009 to increase the number of residents to the sewer network.

Table 2. 1: Access to sanitation in Kavango Region

Type of toilet used	% of the population served
Private flush toilets	5
Shared flush toilets	2
Ventilated Improved Pit latrine (VIP)	1
Pit latrine (long drop)	9
Bucket/pail	1
Bushes	82

[Source: National Planning Commission, 2003]

The Okavango River Basin Transboundary Diagnostic Analysis Technical Reports

In 1994, the three riparian countries of the Okavango River Basin – Angola, Botswana and Namibia – agreed to plan for collaborative management of the natural resources of the Okavango, forming the Permanent Okavango River Basin Water Commission (OKACOM). In 2003, with funding from the Global Environment Facility, OKACOM launched the Environmental Protection and Sustainable Management of the Okavango River Basin (EPSMO) Project to coordinate development and to anticipate and address threats to the river and the associated communities and environment. Implemented by the United Nations Development Program and executed by the United Nations Food and Agriculture Organization, the project produced the Transboundary.

Diagnostic Analysis to establish a base of available scientific evidence to guide future decision making. The study, created from inputs from multi-disciplinary teams in each country, with specialists in hydrology, hydraulics, channel form, water quality, vegetation, aquatic invertebrates, fish, birds, river-dependent terrestrial wildlife, resource economics and socio-cultural issues, was coordinated and managed by a group of specialists from the southern African region in 2008 and 2009.

The following specialist technical reports were produced as part of this process and form substantive background content for the Okavango River Basin Trans-boundary Diagnostic Analysis

Final Study Reports	***Reports integrating findings from all country and background reports, and covering the entire basin.***		
		Aylward, B.	*Economic Valuation of Basin Resources: Final Report to EPSMO Project of the UN Food & Agriculture Organization as an Input to the Okavango River Basin Transboundary Diagnostic Analysis*
		Barnes, J. et al.	*Okavango River Basin Transboundary Diagnostic Analysis: Socio-Economic Assessment Final Report*
		King, J.M. and Brown, C.A.	*Okavango River Basin Environmental Flow Assessment Project Initiation Report (Report No: 01/2009)*
		King, J.M. and Brown, C.A.	*Okavango River Basin Environmental Flow Assessment EFA Process Report (Report No: 02/2009)*
		King, J.M. and Brown, C.A.	*Okavango River Basin Environmental Flow Assessment Guidelines for Data Collection, Analysis and Scenario Creation (Report No: 03/2009)*
		Bethune, S. Mazvimavi, D. and Quintino, M.	*Okavango River Basin Environmental Flow Assessment Delineation Report (Report No: 04/2009)*
		Beuster, H.	*Okavango River Basin Environmental Flow Assessment Hydrology Report: Data And Models(Report No: 05/2009)*
		Beuster, H.	*Okavango River Basin Environmental Flow Assessment Scenario Report : Hydrology (Report No: 06/2009)*
		Jones, M.J.	*The Groundwater Hydrology of The Okavango Basin (FAO Internal Report, April 2010)*
		King, J.M. and Brown, C.A.	*Okavango River Basin Environmental Flow Assessment Scenario Report: Ecological and Social Predictions (Volume 1 of 4)(Report No. 07/2009)*
		King, J.M. and Brown, C.A.	*Okavango River Basin Environmental Flow Assessment Scenario Report: Ecological and Social Predictions (Volume 2 of 4: Indicator results) (Report No. 07/2009)*
		King, J.M. and Brown, C.A.	*Okavango River Basin Environmental Flow Assessment Scenario Report: Ecological and Social Predictions: Climate Change Scenarios (Volume 3 of 4) (Report No. 07/2009)*
		King, J., Brown, C.A., Joubert, A.R. and Barnes, J.	*Okavango River Basin Environmental Flow Assessment Scenario Report: Biophysical Predictions (Volume 4 of 4: Climate Change Indicator Results) (Report No: 07/2009)*
		King, J., Brown, C.A. and Barnes, J.	*Okavango River Basin Environmental Flow Assessment Project Final Report (Report No: 08/2009)*
		Malzbender, D.	*Environmental Protection And Sustainable Management Of The Okavango River Basin (EPSMO): Governance Review*
		Vanderpost, C. and Dhliwayo, M.	*Database and GIS design for an expanded Okavango Basin Information System (OBIS)*
		Veríssimo, Luis	*GIS Database for the Environment Protection and Sustainable Management of the Okavango River Basin Project*
		Wolski, P.	*Assessment of hydrological effects of climate change in the Okavango Basin*
Country Reports Biophysical Series	***Angola***	*Andrade e Sousa, Helder André de*	*Análise Diagnóstica Transfronteiriça da Bacia do Rio Okavango: Módulo do Caudal Ambiental: Relatório do Especialista: País: Angola: Disciplina: Sedimentologia & Geomorfologia*

		Gomes, Amândio	*Análise Diagnóstica Transfronteiriça da Bacia do Rio Okavango: Módulo do Caudal Ambiental: Relatório do Especialista: País: Angola: Disciplina: Vegetação*
		Gomes, Amândio	*Análise Técnica, Biofísica e Socio-Económica do Lado Angolano da Bacia Hidrográfica do Rio Cubango: Relatório Final:Vegetação da Parte Angolana da Bacia Hidrográfica Do Rio Cubango*
		Livramento, Filomena	*Análise Diagnóstica Transfronteiriça da Bacia do Rio Okavango: Módulo do Caudal Ambiental: Relatório do Especialista: País: Angola: Disciplina:Macroinvertebrados*
		Miguel, Gabriel Luís	*Análise Técnica, Biofísica E Sócio-Económica do Lado Angolano da Bacia Hidrográfica do Rio Cubango: Subsídio Para o Conhecimento Hidrogeológico Relatório de Hidrogeologia*
		Morais, Miguel	*Análise Diagnóstica Transfronteiriça da Bacia do Análise Rio Cubango (Okavango): Módulo da Avaliação do Caudal Ambiental: Relatório do Especialista País: Angola Disciplina: Ictiofauna*
		Morais, Miguel	*Análise Técnica, Biófisica e Sócio-Económica do Lado Angolano da Bacia Hidrográfica do Rio Cubango: Relatório Final: Peixes e Pesca Fluvial da Bacia do Okavango em Angola*
		Pereira, Maria João	*Qualidade da Água, no Lado Angolano da Bacia Hidrográfica do Rio Cubango*
		Santos, Carmen Ivelize Van-Dúnem S. N.	*Análise Diagnóstica Transfronteiriça da Bacia do Rio Okavango: Módulo do Caudal Ambiental: Relatório de Especialidade: Angola: Vida Selvagem*
		Santos, Carmen Ivelize Van-Dúnem S.N.	*Análise Diagnóstica Transfronteiriça da Bacia do Rio Okavango:Módulo Avaliação do Caudal Ambiental: Relatório de Especialidade: Angola: Aves*
	Botswana	*Bonyongo, M.C.*	*Okavango River Basin Technical Diagnostic Analysis: Environmental Flow Module: Specialist Report: Country: Botswana: Discipline: Wildlife*
		Hancock, P.	*Okavango River Basin Technical Diagnostic Analysis: Environmental Flow Module : Specialist Report: Country: Botswana: Discipline: Birds*
		Mosepele, K.	*Okavango River Basin Technical Diagnostic Analysis: Environmental Flow Module: Specialist Report: Country: Botswana: Discipline: Fish*
		Mosepele, B. and Dallas, Helen	*Okavango River Basin Technical Diagnostic Analysis: Environmental Flow Module: Specialist Report: Country: Botswana: Discipline: Aquatic Macro Invertebrates*
	Namibia	*Collin Christian & Associates CC*	*Okavango River Basin: Transboundary Diagnostic Analysis Project: Environmental Flow Assessment Module: Geomorphology*
		Curtis, B.A.	*Okavango River Basin Technical Diagnostic Analysis: Environmental Flow Module: Specialist Report Country: Namibia Discipline: Vegetation*
		Bethune, S.	*Environmental Protection and Sustainable Management of the Okavango River Basin (EPSMO): Transboundary Diagnostic Analysis: Basin Ecosystems Report*
		Nakanwe, S.N.	*Okavango River Basin Technical Diagnostic Analysis: Environmental Flow Module: Specialist Report: Country: Namibia: Discipline: Aquatic Macro Invertebrates*
		Paxton, M.	*Okavango River Basin Transboundary Diagnostic Analysis: Environmental Flow Module: Specialist Report:Country:Namibia: Discipline: Birds (Avifauna)*
		Roberts, K.	*Okavango River Basin Technical Diagnostic Analysis: Environmental Flow Module: Specialist Report: Country: Namibia: Discipline: Wildlife*
		Waal, B.V.	*Okavango River Basin Technical Diagnostic Analysis: Environmental Flow Module: Specialist Report: Country: Namibia:Discipline: Fish Life*
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		Mendelsohn, .J.	*Land use in Kavango: Past, Present and Future*
		Pereira, Maria João	*Análise Diagnóstica Transfronteiriça da Bacia do Rio Okavango: Módulo do Caudal Ambiental: Relatório do Especialista: País: Angola: Disciplina: Qualidade da Água*
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