National experience on **WATER STATISTICS**

National Technical training workshop on Environmental Statistics

3-5 December 2019

Roof of Africa

PRESENTATION OUTLINE

- Background
- Water resources
- supply
- storage
- use
- wastewater treatment, water quality monitoring.
- Conclusion

BACKGROUND - NAMIBIA

GEOGRAPHIC POSITION

- Southwestern Africa
- Southern African Development Community (SADC)

PHYSICAL FEATURES

- Namib Desert and Kalahari Semi-Desert
- Southern African Plateau

BACKGROUND - NAMIBIA

CLIMATIC CONDITIONS

•Geographical latitude (tropic of Capricorn passes Namibia)

-> **sub-tropical climate**

•Cold Benguela current creates **permanent low pressure zone in front of coast and prevents direct influx of moisture**

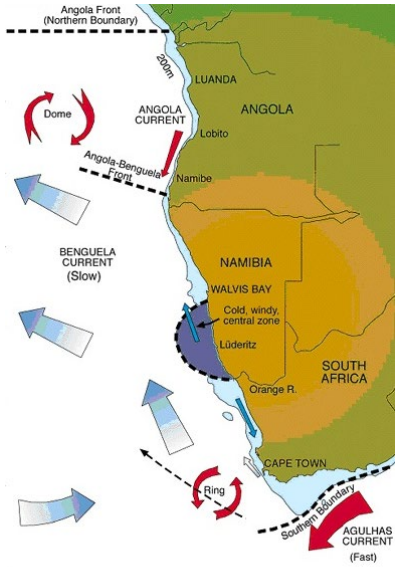
-> dry climate

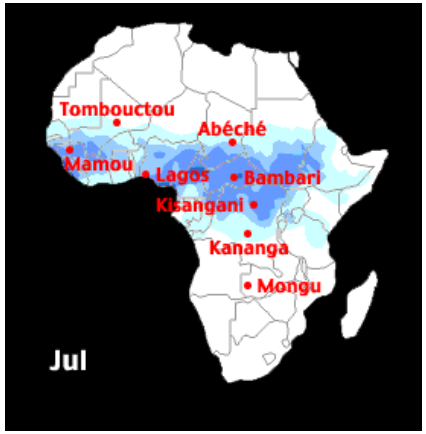
•Seasonal movement of **Inter Tropical Convergence Zone (ITCZ) creates low pressure in interior that draws in moisture from east and north**

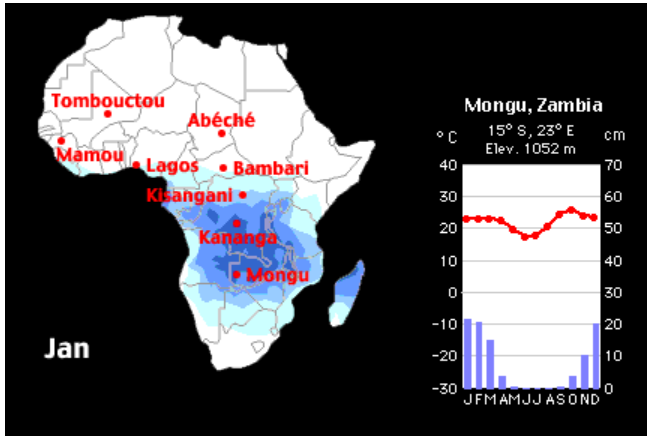
-> seasonal climate

annual cycle of dry and wet seasons

(**rainy season from October to April**)







WATER RESOURCES IN NAMIBIA

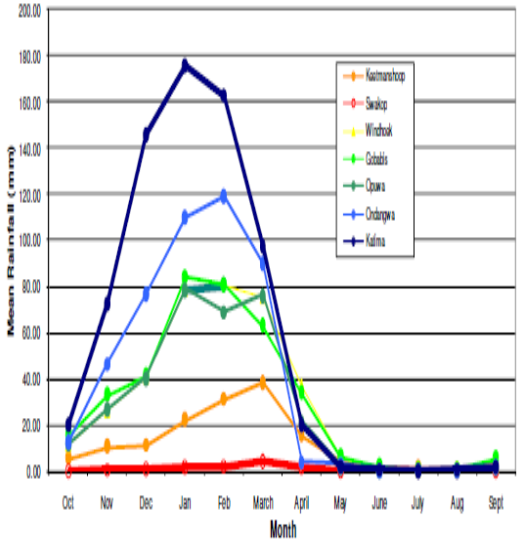
CLIMATIC DRIVERS

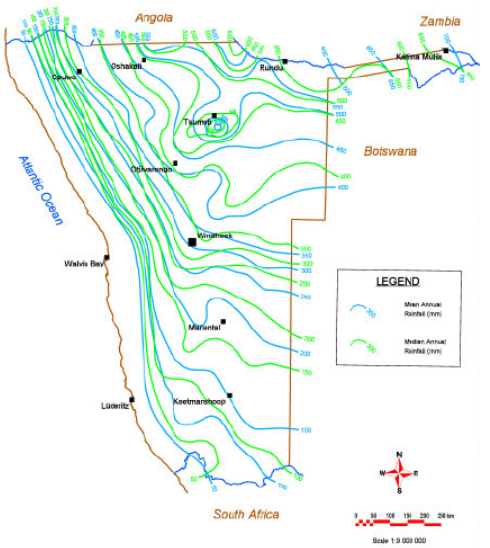
Rainfall

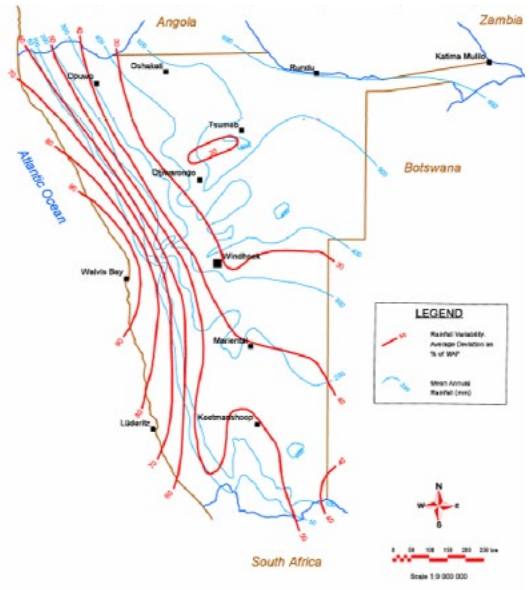
- **Seasonal** convective thundershowers in rainy season from October to April
- **Low** with average range from virtually zero at coast to over 600 mm / year in far northeast
- **Highly variable (and unreliable)**
  - within rainy season
  - between rainy seasons
    - (Windhoek from less than 100 to more than 1,000 mm)

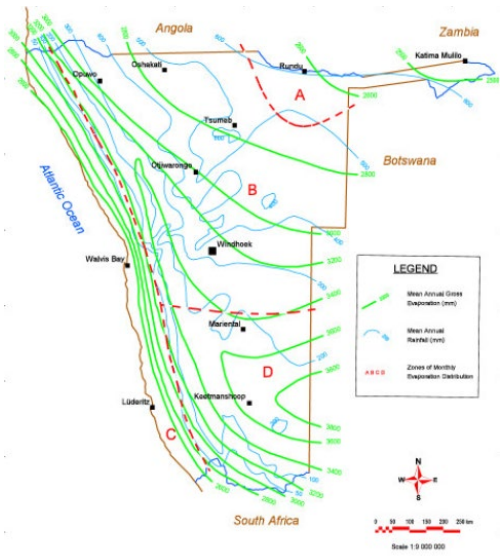
Evaporation

- **High** with average range from less than 2,000 mm / year at coast to over 3,400 mm / year in southeast
- Potential evapotranspiration exceeds rainfall by far -> **arid to semi-arid conditions**









WATER RESOURCES AVAILABILITY: QUANTITY AND QUALITY

- Volume from dams in ephemeral rivers is based on 95% assured yield including efficiency improvements through water transfers

- Higher volumes for Perennial rivers are subject to negotiation with river basin states – including construction of additional infrastructure such as dams

Water Source	Annual amount of Water available with Installed Capacity (Mm^3/annum)	Potential Amount of Water Available (Total Source) (Mm^3/annum)
Primary Sources		
Dams in Ephemeral Rivers	100	200
Perennial Rivers	170	1 105
Groundwater	95	360
Secondary Source		
Reclaimed Water (Potable use only)	7.5	10
TOTAL	422.5	1 515

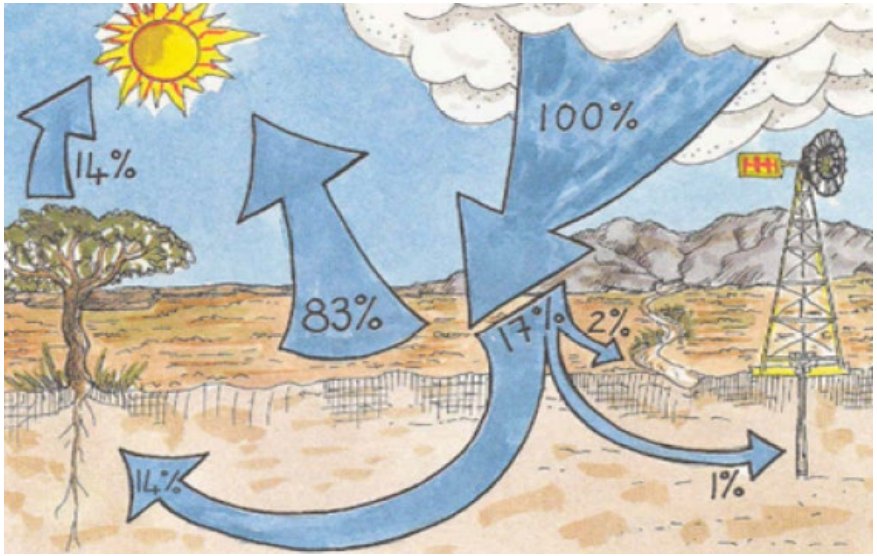
Note: Uneven spatial distribution not reflected in table

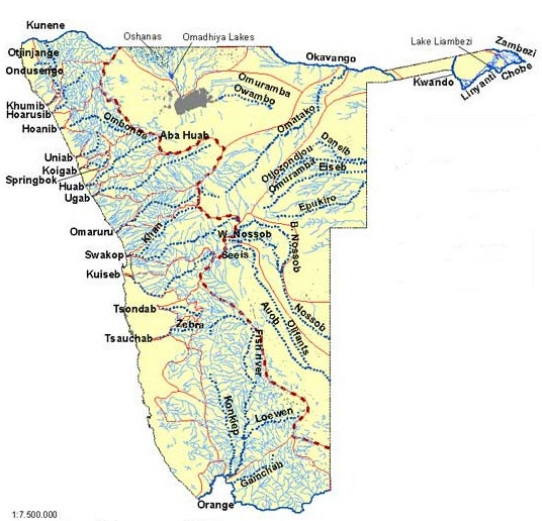
SURFACE WATER RESOURCES IN INTERIOR OF NAMIBIA

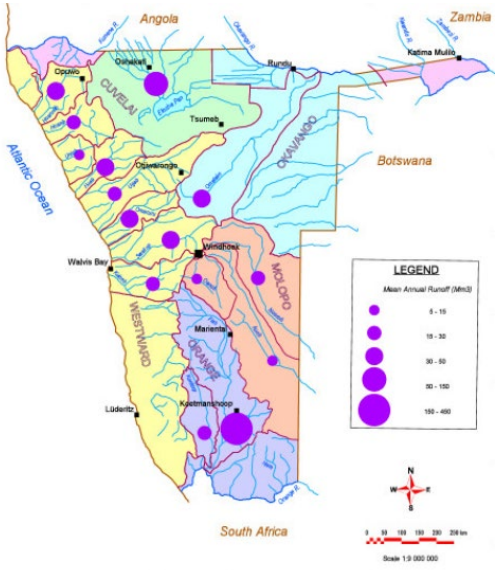
EPHEMERAL RIVERS IN INTERIOR OF NAMIBIA

- Flow for short periods (or not) in rainy season as 'flash floods'
- Good runoff only in central strip

Category	Mean annual flow (million cubic meters / year)
Western flowing rivers (occasionally reaching Atlantic Ocean)	280
Fish River and other drainage to Orange River	660
Endoreic (Omatako and Auob/Nossob) drainage	60
Cuvelai oshanas draining towards (into) Etosha Pan	200
Direct contribution to Kavango, Kwando, Zambezi rivers	(not significant)





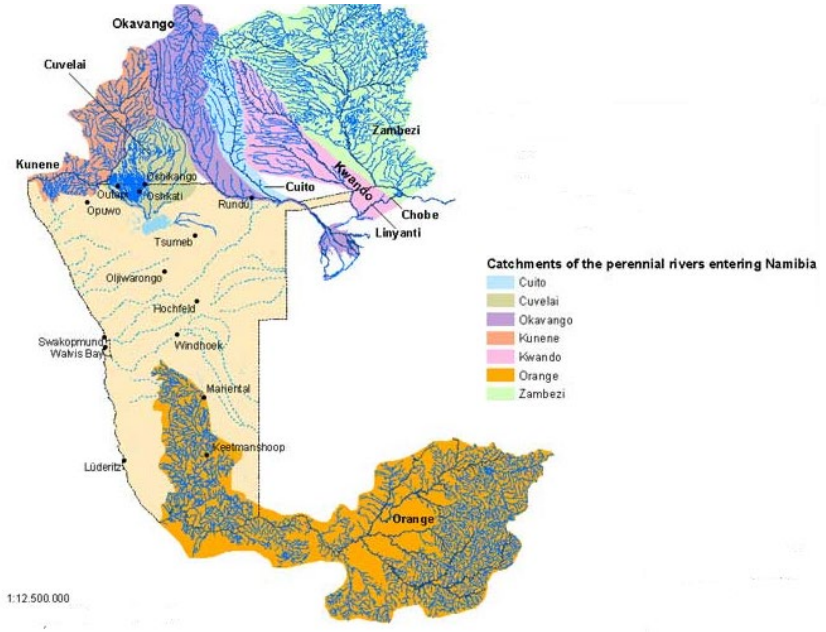


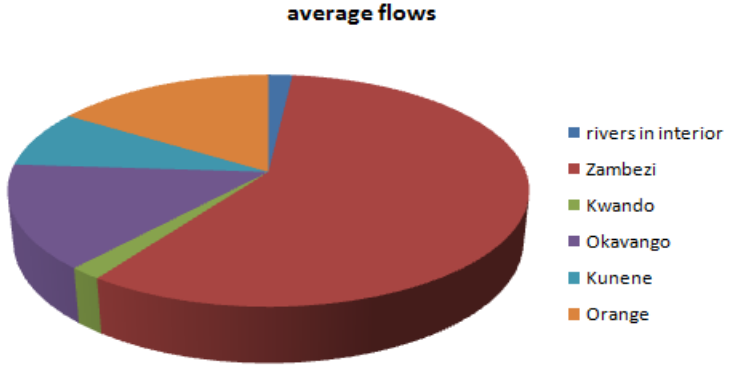
SURFACE WATER RESOURCES ON BORDERS OF NAMIBIA

PERENNIAL RIVERS ON BORDERS OF NAMIBIA

- Permanent flows
- Mainly fed from high rainfall areas in headwaters in neighbouring countries
- Shared with other riparian countries

River	Mean annual flow (million cubic meters / year)	Minimum flow (cubic meters per second)
Zambezi (at Namibia border)	40,000	180
Kwando/Linyanti /Chobe	1,500	10
Okavango (including Cuito)	10,000	80
Kunene	5,500	< 10
Orange (including Fish, natural flows)	11,000	< 10





GROUNDWATER RESOURCES IN NAMIBIA

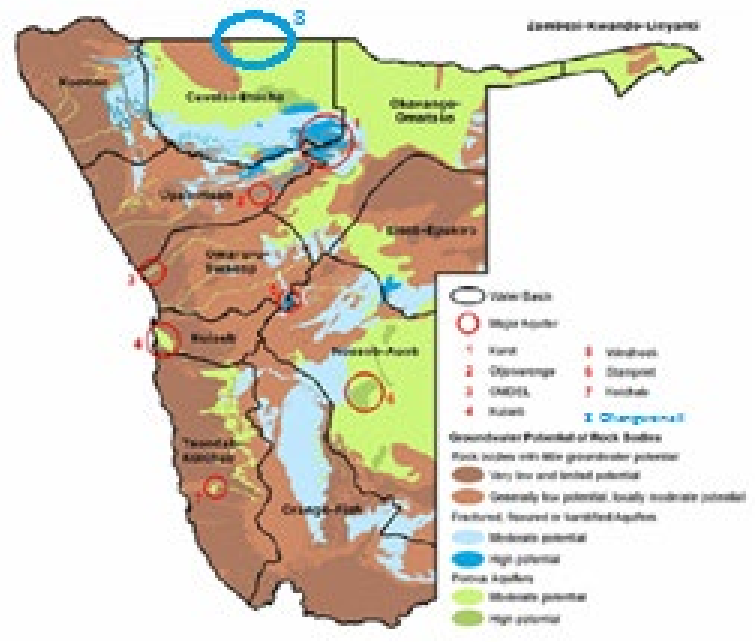
GROUNDWATER ENVIRONMENT

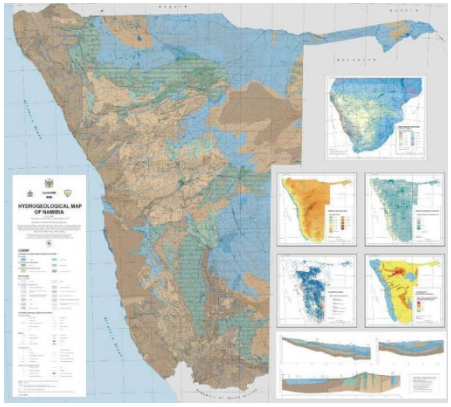
MAIN AQUIFERS

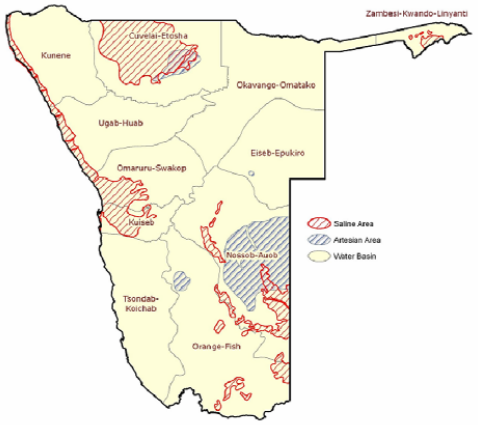
- Karst
- Otjiwarongo
- Omaruru Delta (OMDEL)
- Lower Kuiseb
- Windhoek
- Stampriet
- Koichab
- Ohangwena II

GROUNDWATER QUALITY

- Generally good
- Saline/brackish shallow groundwater in densely populated central northern areas







SUPPLY

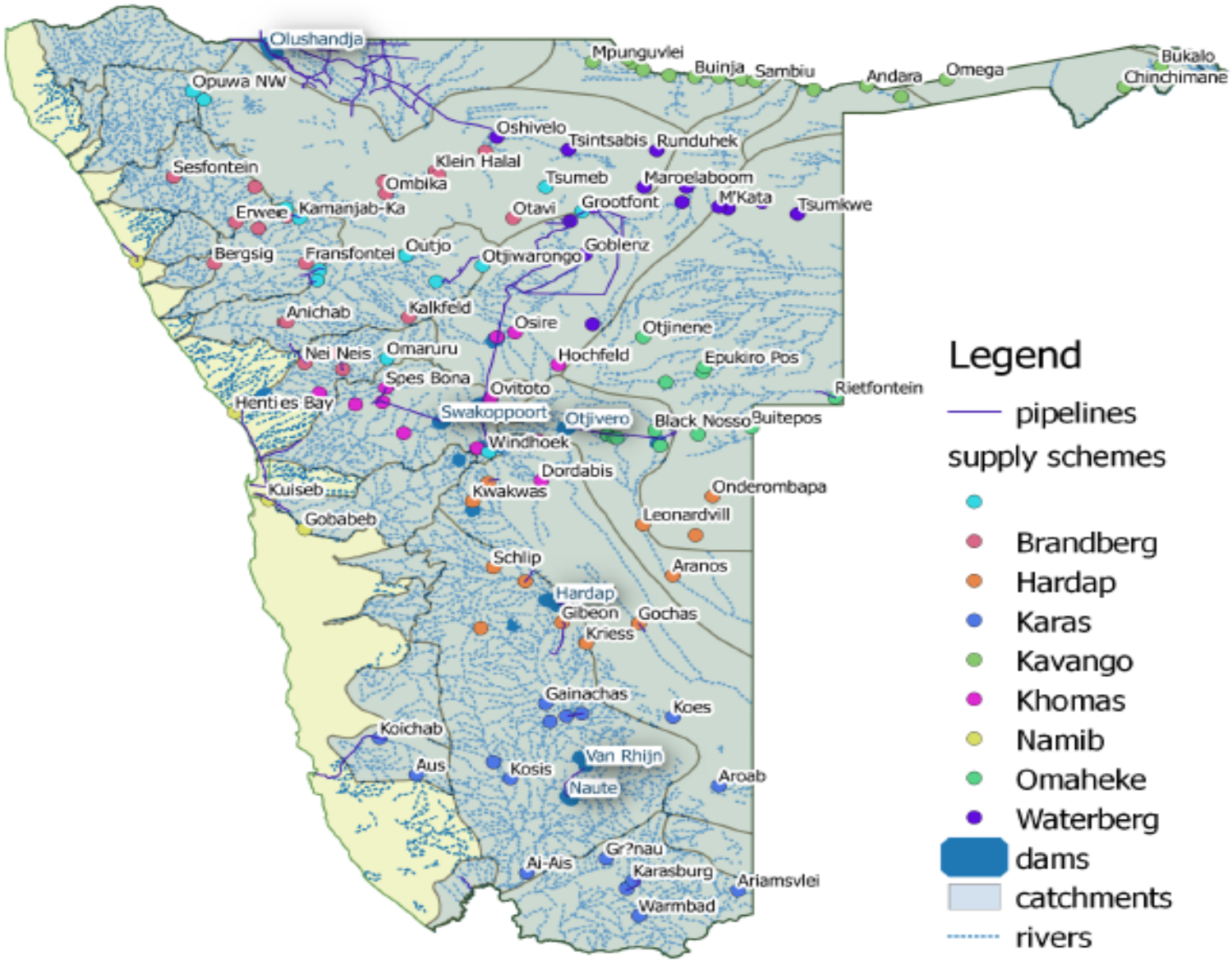
In Namibia, water supply is separated into:

- Bulk water supply, which is undertaken by the parastatal, NamWater, selected Local Authorities such as Tsumeb, Otavi, etc. And more recently the Trekkopje Mine;

- Rural water supply which is undertaken mainly by the Directorate of Rural Water Supply (Sanitation Co-ordination) in conjunction with rural communities as well as commercial farmers; and

- Private water development which is undertaken by private concerns such as mines, commercial farmers and tourist lodges. Namibia has reached the limits of easily accessible water sources and management of water supply is becoming a first priority.

Water supply schemes in Namibia with pipeline and dam system



WATER SUPPLY AND SANITATION COVERAGE IN NAMIBIA

ASSESSMENTS MADE

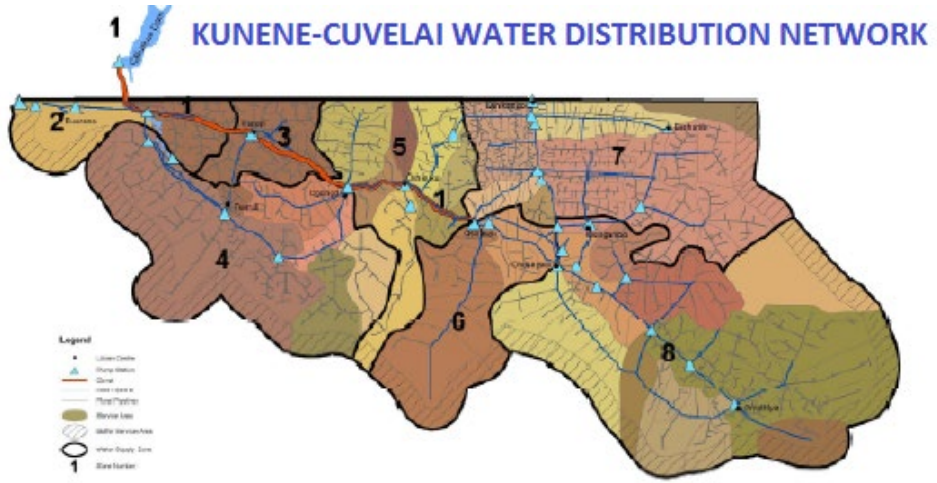
- Overall water supply situation in most urban centers is satisfactory with a reasonable coverage.
- Low service levels often prevail among lower income groups in informal areas near towns.
- Access to water in rural areas markedly increased in the first ten years after Independence, from 43% coverage in 1991 to about 80% in 2001, despite the overall population increase.
- The urban sanitation services are generally good, with an estimated coverage ranging from 95% in municipalities to about 60% in communal towns.
- The sanitation coverage in rural areas only slightly improved in the first ten years after Independence, from 16% in 1992 to 18.9% in 2000.

Baseline 2011/12	**Urban**	**Rural**
Water supply	93 %	83 %
Sanitation	65 %	25 %
Targets for 2015/16	**Urban**	**Rural**
Water supply	95%	87%
Sanitation	72%	45%
VISION 2030	**Urban**	**Rural**
Water supply	100 %	100 %
Sanitation	100 %	50 %

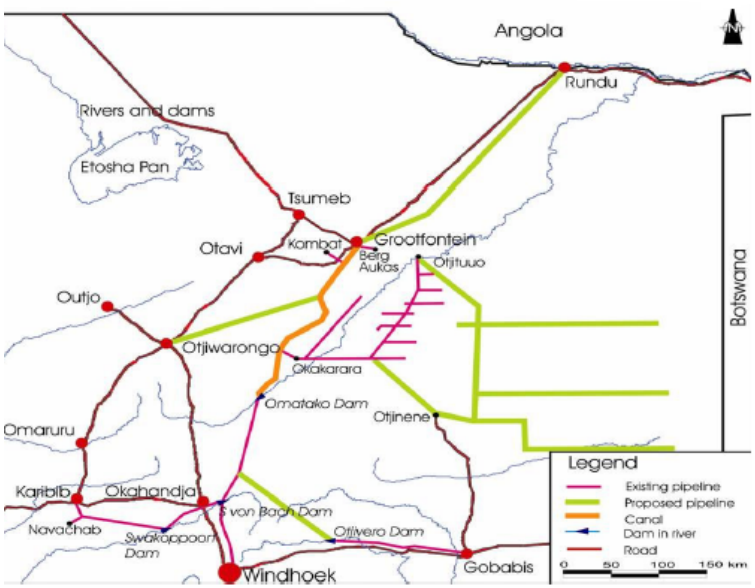
MAJOR WATER TRANSFER SCHEMES IN NAMIBIA

2012 SITUATION

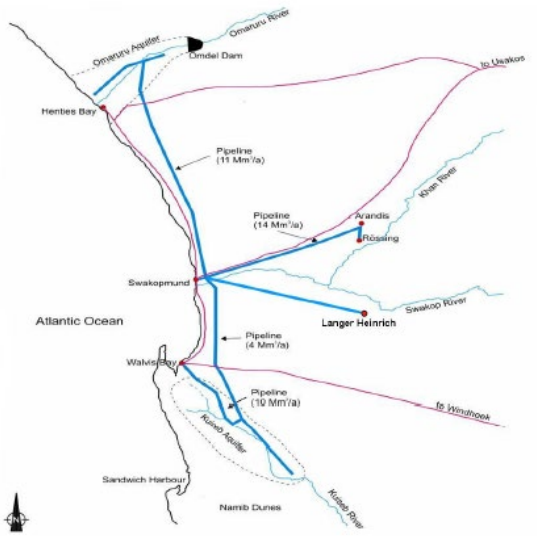
- Kunene-Cuvelai Water Distribution Network
- Eastern National Water Carrier
- Central Namib Water Supply System



EASTERN NATIONAL WATER CARRIER

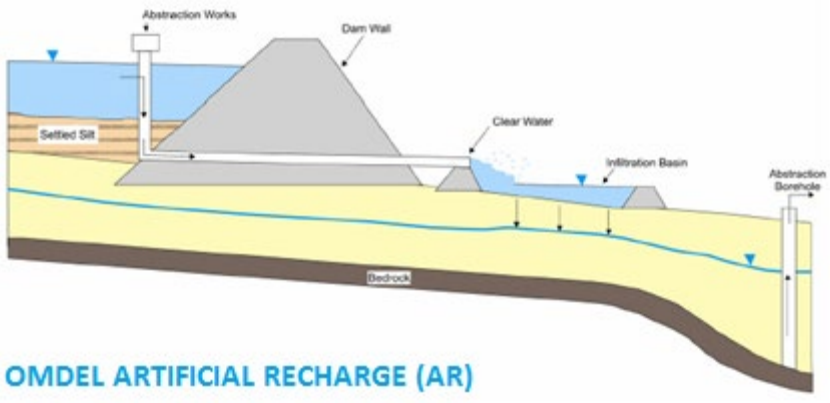


CENTRAL NAMIB WATER SUPPLY SYSTEM

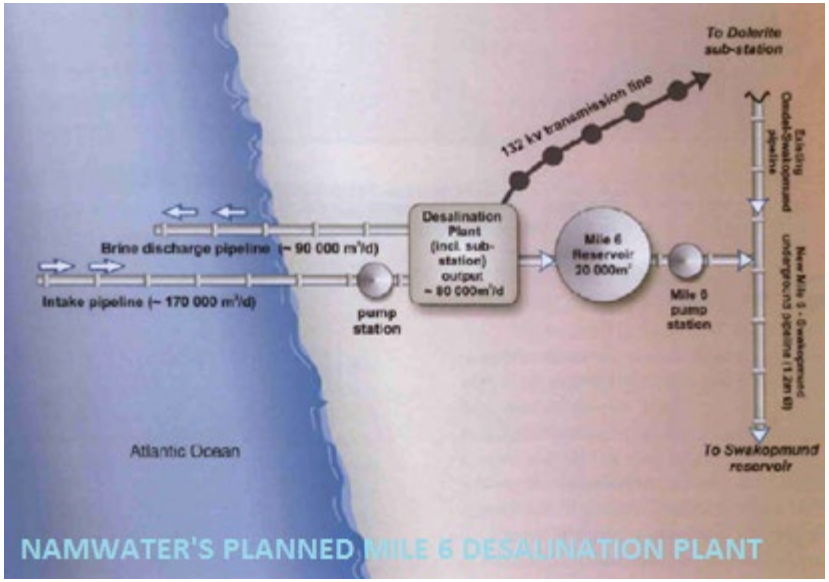


UNCONVENTIONAL WATER RESOURCES IN NAMIBIA

- Desalination of seawater
- Re-use of semi-purified water (sports grounds, parks)
- Re-cycling of industrial and mining water
- Reclamation from wastewater effluent
- Conjunctive use of groundwater and surface water
- Artificial recharge of aquifers (AR) – water banking
- Mixing of potable and brackish water
- Use and purification of brackish water
- Rainfall harvesting
- Fog harvesting
- Water demand and conservation



OMDEL ARTIFICIAL RECHARGE (AR)



NAMWATER'S PLANNED MILE 6 DESALINATION PLANT

STORAGE

Surface:

- There are many significant surface water storage dams in Namibia despite the high evaporation rates. The major dams are Hardap, Naute, Swakopport, Von Bach, Omatako, Olushandja, Omaruru Delta, Oanob, Dreihuk, Otjivero Main Dam, Otjivero Silt Dam, Friedenau, Omatjenne, Goreangab, Avis, TildaViljoen, Bondels and DaanViljoen Dams and newly build Neckartal Dam. Their 95% assured combined yield is 95.3 Mm3/a based on a single reservoir analysis.

- Most dams are generally for bulk water supply to municipalities and/or mines, but also for supply to irrigation projects. There are also countless small dams used by smaller communities and farmers for human consumption and/or stock watering.

Utilization and Demand

- Demand for water from the livestock and irrigation consumer groups are set to increase exponentially by the year 2030, with groundwater resources not increasing and these sectors depending heavily on groundwater resources

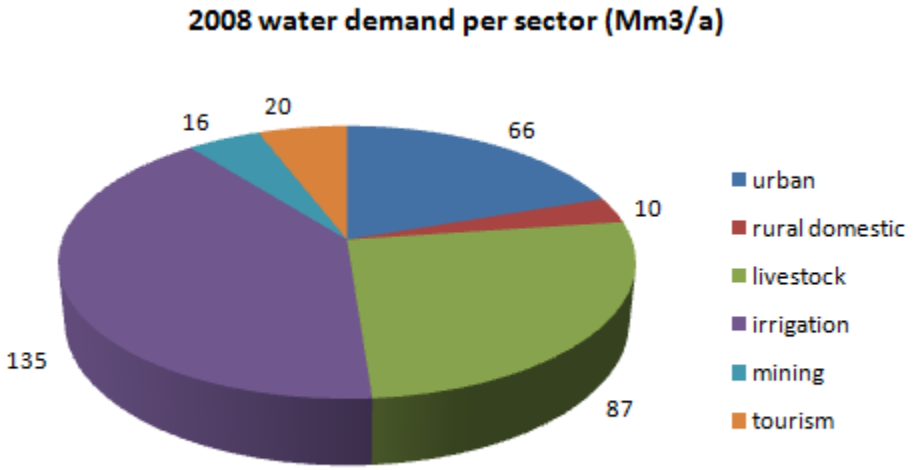
Table 4.1: Projected Water Demand for Namibia

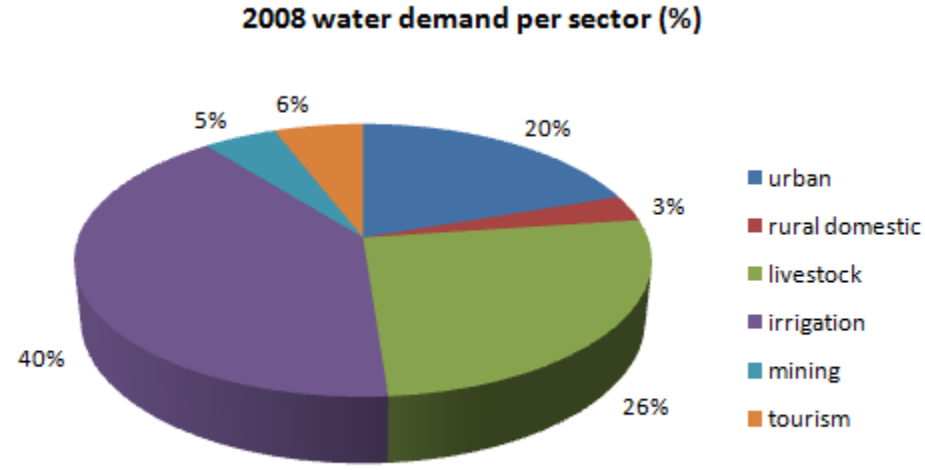
CONSUMER GROUP	DEMAND IN Mm^3/a				
	2008	2015	2020	2025	2030
Urban	66.0	80.0	91.1	103.5	117.2
Rural Domestic	10.3	10.6	10.9	11.1	11.4
Livestock	86.8	86.8	86.8	86.8	86.8
Irrigation	135.3	204.6	344.6	379.8	497.2
Mining	16.1	17.2	18.1	19.1	20.3
Tourism	19.6	27.5	31.9	35.2	38.9
TOTAL	334.1	426.7	583.4	635.6	771.7

PRESENT WATER DEMAND IN NAMIBIA

2008 FIGURES

Sector	Demand (million cubic meters / year)	Demand (percentage)
Urban (including manufacturing and industry)	66.0	19.7 %
Rural domestic	10.3	3.1 %
Livestock	86.8	26.0 %
Irrigation	**135.3**	**40.4 %**
Mining	16.1	4.8 %
Tourism	19.6	5.9 %
Total	**334.1**	**(100.0 %)**

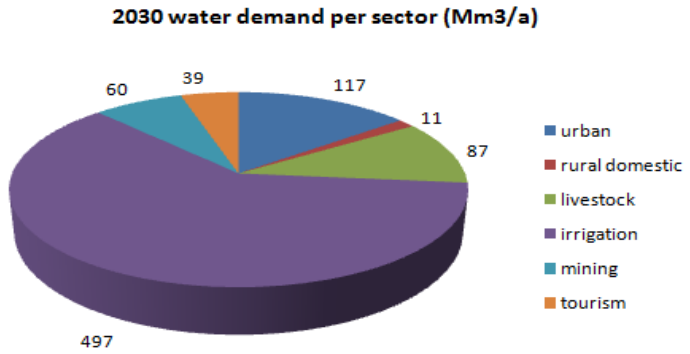


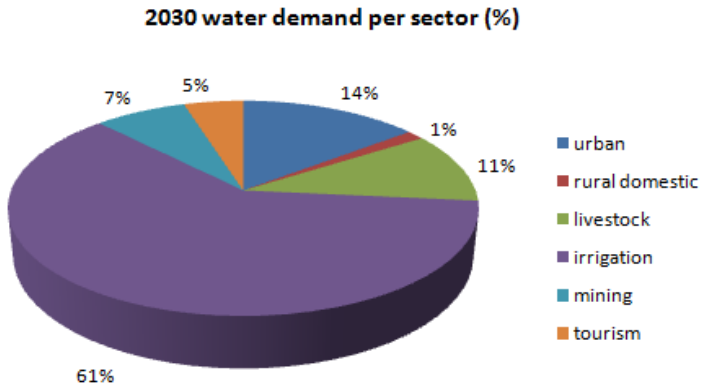


FUTURE WATER DEMAND IN NAMIBIA

2030 FORECASTED WATER DEMAND PER SECTOR

Sector	Demand (million cubic meters / year)	Demand (%)	Increase over 2008 (%)
Urban	117.2	15.2 %	+ 77.6 %
Rural domestic	11.4	1.4 %	+ 10.7 %
Livestock	86.8	11.2 %	nil
Irrigation	**497.2**	**64.4%**	**+267.5 %**
Mining	60.3	2.6 %	+ 274.5 %
Tourism	38.9	5.0 %	+ 98.5 %
Total	**811.7**	**(100.0 %)**	**+ 143.0 %**





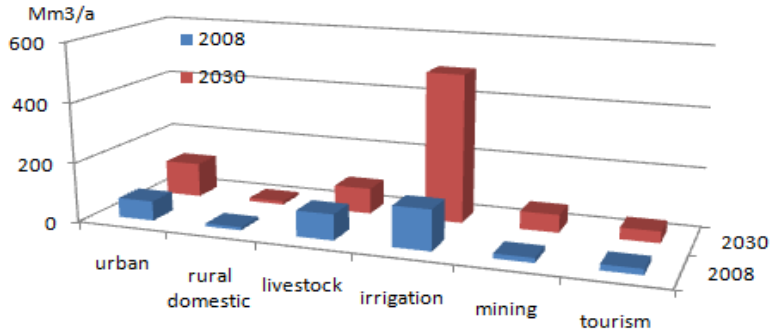
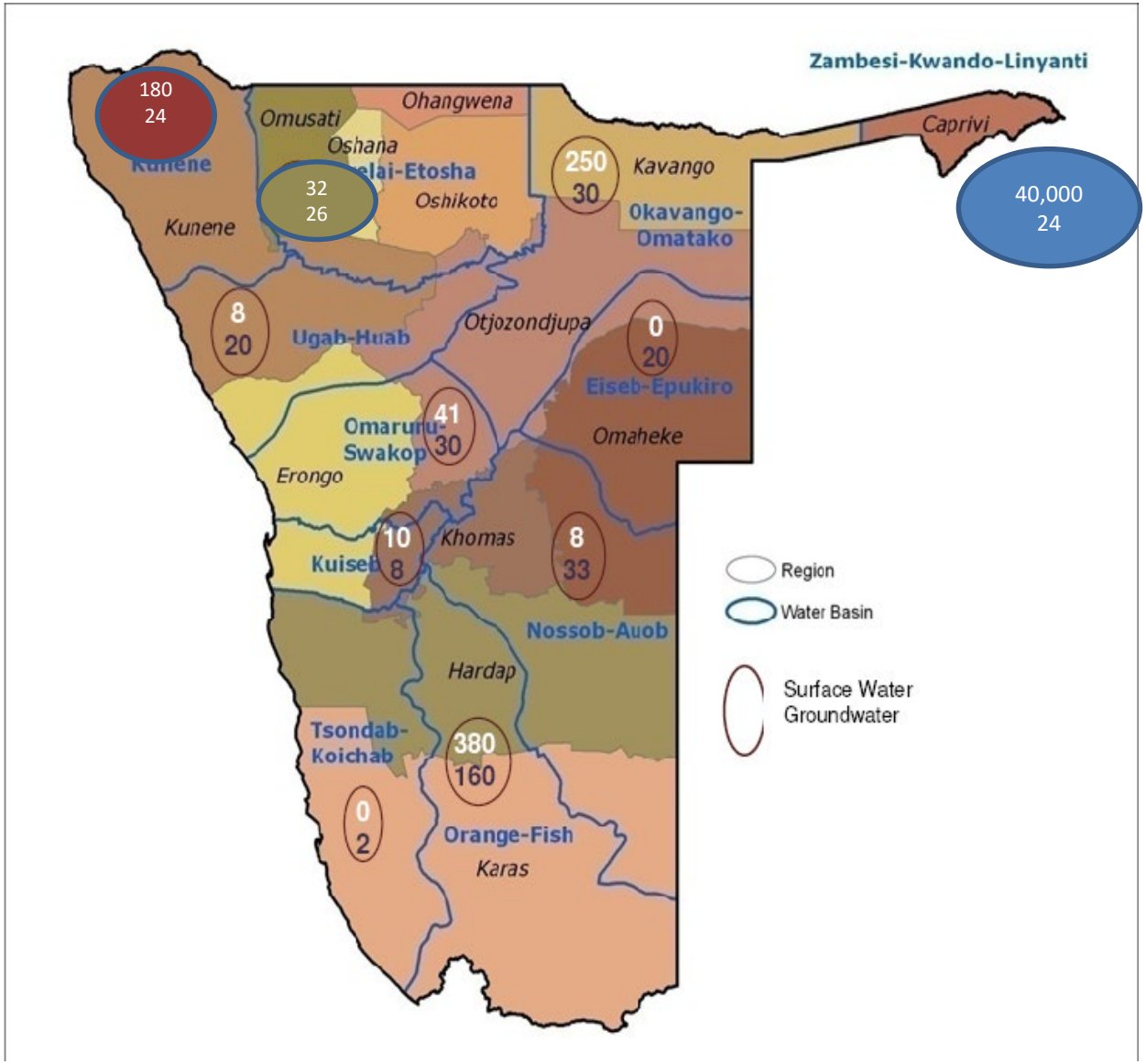


Table 2: Water Resource Potential and Utilization per Basin

BASIN	WATER RESOURCE POTENTIAL Mm³/a			DEMAND Mm³/a		SURPLUS/(DEFICIT) Mm³/a		INSTALLED INFRASTRUCTURE CAPACITY (Mm³/a)	
	SURFACE	GROUND	TOTAL	2008	2030	2008	2030	SURFACE	GROUND
Cuvelai-Etosha	180.0[1]	24.0	204.0	63.7	85.6	140.3	118.4	74.0	13.0
Eiseb-Epukiro	0	20.0	20.0	8.6	11.2	11.4	8.8	0	5.8
Kuiseb	9,8	8.0	16.8	8.4	12.6	8.4	4.2	1.0	13,9
Kunene	31,5	26.2	57.7	10.0	11.2	47.7	46.5	0	7,9
Nossob-Auob	8.0	32.5	40.5	31.1	34.9	9.4	5.6	6.2	2,8
Okavango-Omatako	250.0[2]	29.6	279.6	58.1	215.1	221.5	64.5	36.7	2,2
Omaruru-Swakop	41.0	29.5	70.5	50.6	74.9	19.9	-4.4	27.5	18,1
Orange-Fish	379,9[3]	160.0	539.9	74.8	119.6	465.1	420.3	91.3	3,8
Tsondab-Koichab	0	1.8	1.8	3.9	5.1	-2.0	-3.3	0	5,8
Ugab-Huab	7,5	19.8	27.3	14.7	22.0	12.6	5.3	0	16,6
Zambezi-Kwando-Linyanti	4 000.0[4]	10.0	4 010.0	10.3	179.6	3 999.7	3 830.4	4.75	5,6
TOTAL				334.1	771.7				

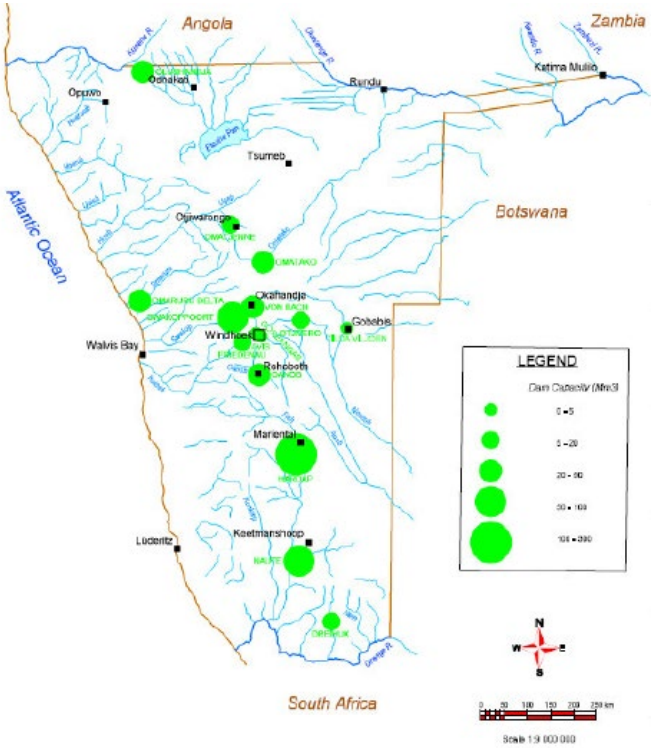
Water resources potential



DEVELOPED AND POTENTIAL SURFACE WATER RESOURCES IN INTERIOR OF NAMIBIA

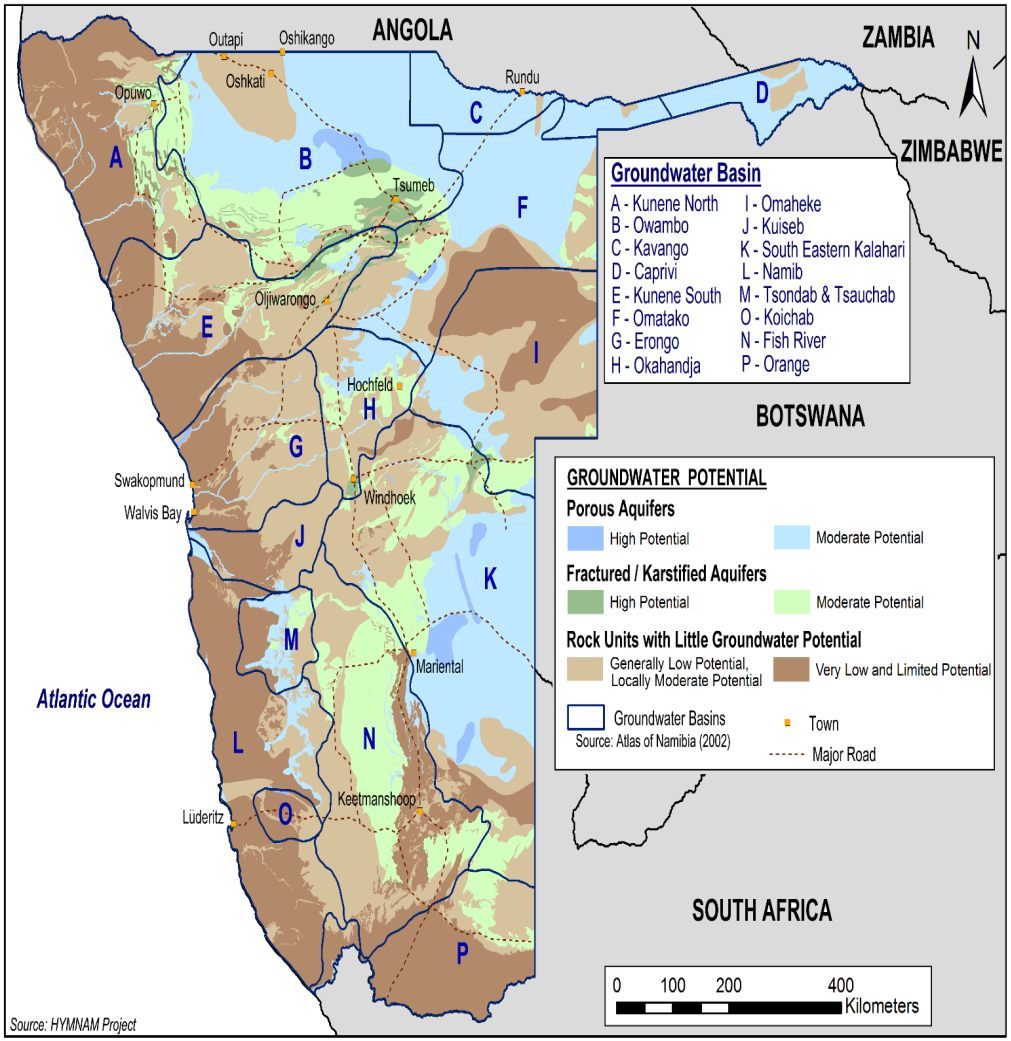
2012 SITUATION

- No potential for run-of-river schemes
- **Large storage reservoirs** required to bridge dry periods
- **Low efficiency** (assured yield typically less than 25 % of mean annual flow)
  - High variability of flows
  - High evaporation (and overflow) losses
- Estimated 500-1,000 small dams ("farm dams", "earth dams") in rural areas – total storage capacity ≈ 50 million cubic meters



	Combined storage capacity (million cubic meters)	Combined assured yield (million cubic meters / year)
Present developed	750	100
Additional potential (max)	1,000 (1,500)	150 (200)
Total	1,750 (2,250)	250 (300)

Groundwater Potential



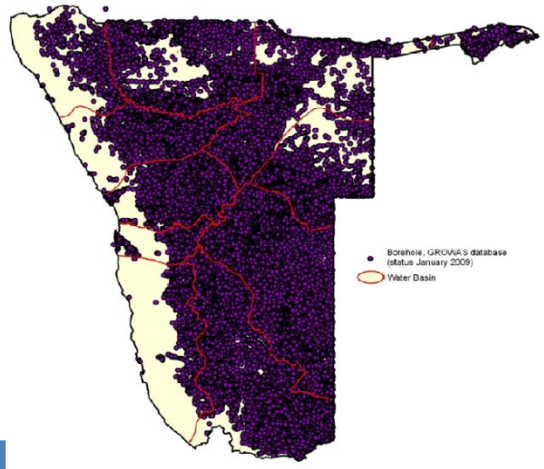
- Potential of groundwater resources depicted by the different shades and has been accounted for per Basin
- 360 Mm^3/a is accounted for by rechargeable and extractible groundwater resources

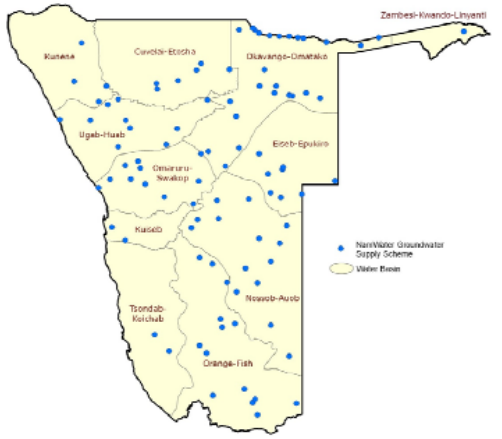
DEVELOPED AND POTENTIAL GROUNDWATER RESOURCES IN INTERIOR OF NAMIBIA

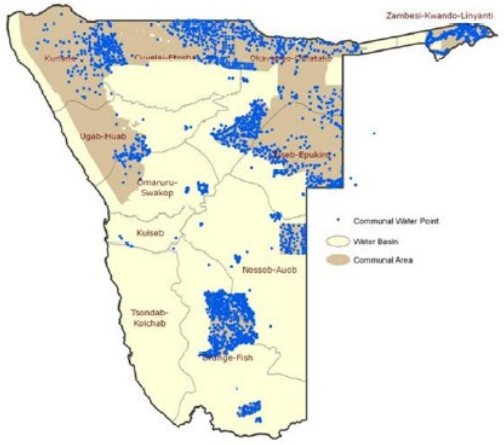
2012 SITUATION

- Groundwater accounts for 50-60 % of water supply in Namibia
- Geographical distribution covers most parts of country

Present use (million cubic meters / year)	Installed capacity (million cubic meters / year)	Sustainable potential (million cubic meters / year)
90	95	360



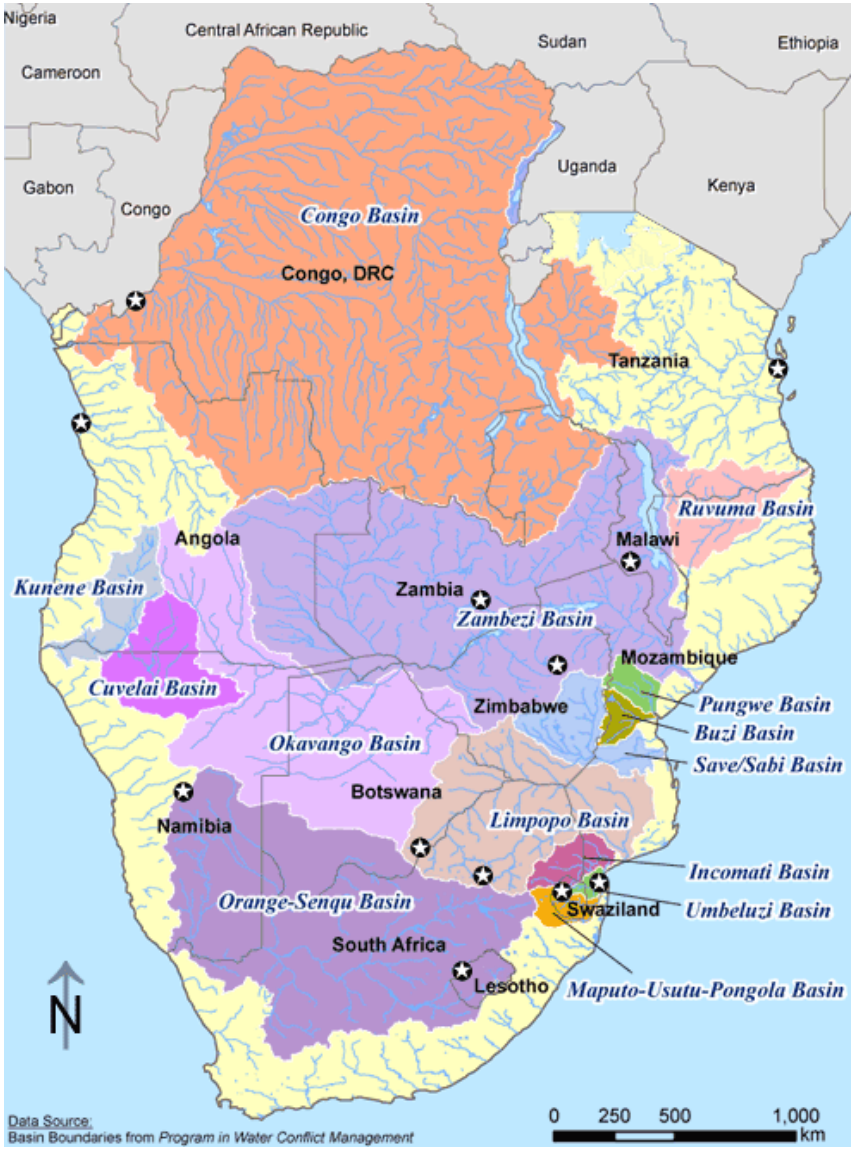




PRESENT AND POTENTIAL USE OF SHARED WATERCOURSES ON BORDERS OF NAMIBIA

Drainage basin	River basin commission	countries
Zambezi	ZAMCOM, 2011	8
Okavango	OKACOM, 1994	3
Kunene	PJTC, 1969 (1990)	2
Orange-Senqu	ORASECOM, 2000	4

Main shared river	Present use (million cubic meters / year)	Fair share (million cubic meters / year)
Zambezi	5	4,000 ?
Okavango	40	250
Kunene	70	180 (agreed)
Orange	50	224



Wastewater treatment

- **routine inspections** at wastewater treatment systems at local authorities, mines, lodges and fishing factories
- **permit system** in place to efficiently control water pollution through formulation of discharge conditions.
- **Wastewater Treatment Technologies**: Bio filter, Septic tanks, Pond system, Upflow anaerobic sludge blanket (UASB)

PURPOSE	NAME IDENTIFCATION	QUANTITY (No of monitoring points)
WASTEWATER TREATMENT SYSTEMS		
.Compliance with National Effluent Quality Standards and Control of Water Pollution	all the regions countrywide	
	Total registered with Water Environment	**450**
	Valid permits	**75**
	Expired permits	**153**
	Never had permits	**73**
	Did not apply	**149**

Water quality monitoring.

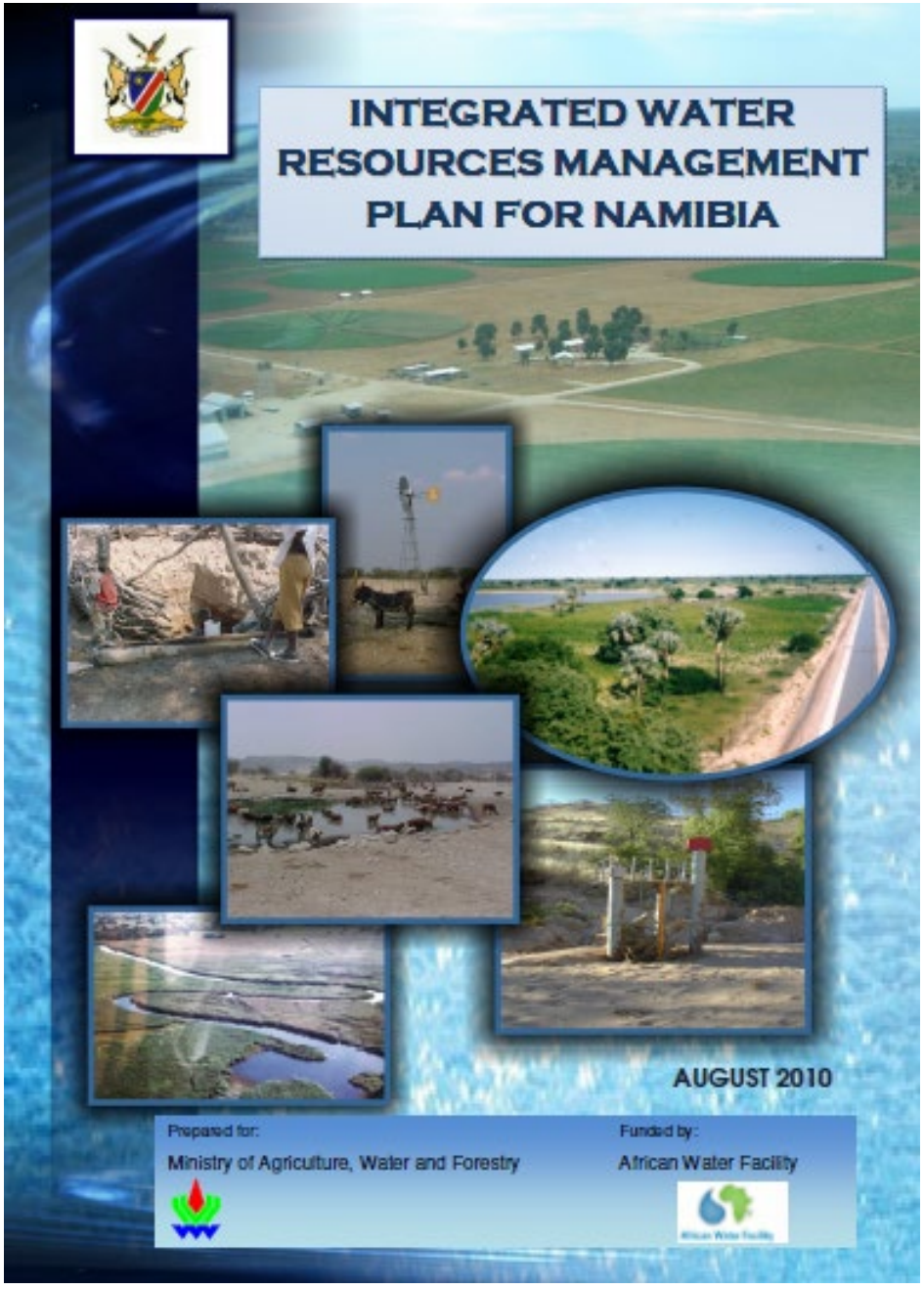
The two methodologies applied for water quality assessment are:

- measuring concentration of chemical, physical and microbiological parameters in a water sample, and
  - pH , Conductivity (µS/cm) TDS (mg/L) Nitrate (mg/L) , Turbidity (NTU) Total Phosphate (mg/L), Chlorophyll a (µg/l
- macro invertebrates indicators assessment
  - Protocol used: South Africa Scoring System version 5 (SASS5) ; Namibia Scoring System (NASS)

PURPOSE	NAME IDENTIFCATION	QUANTITY (No of monitoring points)
RIVERS/WETLANDS(DAMS, PANS)		
1.River health of perennials systems	Kavango, Orange, Kunene, and Zambezi system	**46**
2. River health of ephemeral systems	Swakoppoort dam, NyaeNyae pan, Fish River	**23**
GROUNDWATER		
3.Impacts of Agrochemicals from the major Irrigation Schemes in the Aquifers	• Karst • Stampriet	**15** **13**
4.Impacts of land-use activities in the aquifer	• Khan and Swakop Rivers	**16**
5. Impacts of the Smelter activities on the water resources	• Dundee Precious Metal Tsumeb Smelter	**35**
POTABLE WATER TEATMENT SYSTEMS		
6.Compliance with the National Potable Water Quality Guidelines	all the regions countrywide	**61**

The overall long-term goal of IWRM in Namibia is:

- ***to achieve a sustainable water resources management regime contributing to social equity, economic efficiency and environmental sustainability***



Conclusion

- Data gaps
- No data collection framework
- IWRM plan to be updated
- Core dataset to be established for provision to international organization (currently data provided to AMCOW and UNESCO -SDGs??)
- Capacity building needed

- issues of data reporting to the UNSD/UNEP Questionnaire on Environment Statistics?
- Is the attached data compiled from international sources (please see sheet 10) coherent with national data?