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**GROUNDWATER RESOURCES  
GOVERNANCE  
in TRANSBOUNDARY AQUIFERS  
(GGRETA Project)**



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Socio-economic and Environmental aspects

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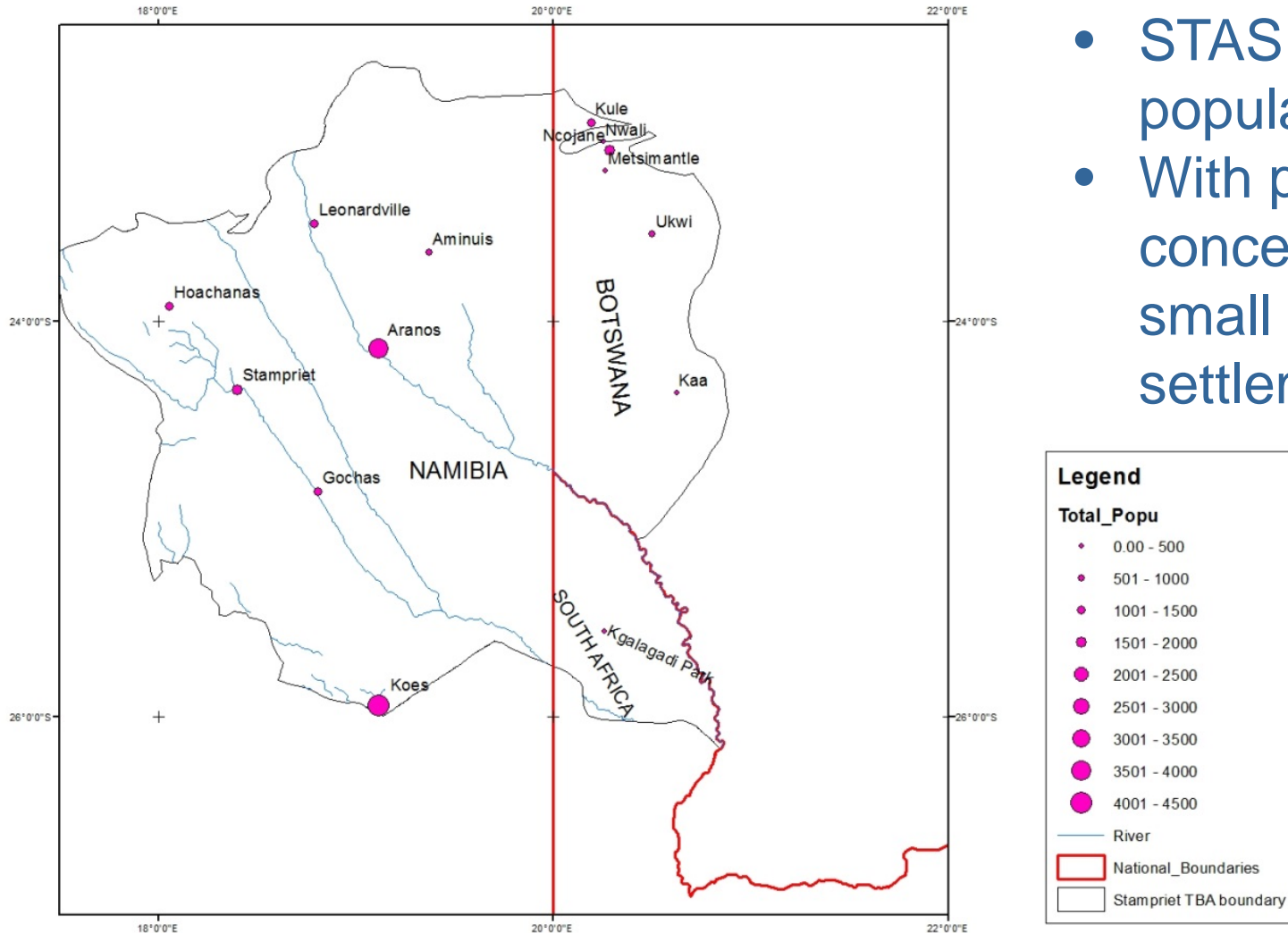
A Ross  
23 February 2015  
Johannesburg

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# Human population distribution in the STAS area

Stampriet Transboundary Aquifer - Human Population Distribution by Settlements



- STAS is lightly populated
- With population concentrated in small rural settlements

## Significant settlements within the boundary

Country	Name	District	Population	Female	Male
<b>Namibia</b>	Leonardville	Aminuis	1191	600	591
	Aminuis	Aminuis	810	402	408
	Hoachanas	Mariental Rural	1262	660	602
	Aranos	Mariental Rural	3683	1873	1810
	Stampriet	Mariental Rural	1947	1019	928
	Gochas	Mariental Rural	1163	587	576
	Koes	Keetmanshoop Rural	4500	2295	2205
	<b>Botswana</b>	Kule	Ghanzi	1,055	464
Ncojane		Ghanzi	1,958	1,029	929
Metsimantle		Ghanzi	173	70	103
Ukwi		Kgalagadi North	523	256	267
<b>South Africa</b>	Kgalagadi Park	Mier	354	160	194
<b>TOTAL</b>		<b>18620</b>	<b>9416</b>	<b>9204</b>	

## Population and Settlements cont...

- Total population of the area is difficult to estimate because it includes an itinerant population that move into and out of the area.
- STAS covers a total area of 86 647 km<sup>2</sup>, for which **73%** of the area is in Namibia, 19% in Botswana and 8% in South Africa
- Major settlements in Namibia are Aranos, Koes and Stampriet, in Botswana are Ncojane and Kule

# Groundwater availability and use

- Groundwater is the major source of water in the STAS to provide potable water to the people, livestock and for irrigation
- However, there are surface water pans [in some areas] which collect water only during rainy seasons [can last for a few months to water livestock]
- There is neither intensive industries nor mining activities taking place in the STAS area
- Over 20 Million m<sup>3</sup>/year? are abstracted in the STAS, most of which occurs in Namibia (over 95%), the largest consumer being irrigation (46%), followed by stock watering (38%) and domestic use (16%)

# Groundwater Pollution in STAS area

- To describe the types and sources (actual or potential) of groundwater pollution in the Stampriet Transboundary Aquifer System (STAS) and relating this to the water table.
- To indicate the actual levels of pollution in the STAS
- To generate maps showing groundwater pollution risk categories in the Stampriet Basin which may indicate: 1) human induced risk areas, 2) livestock induced risk areas, 3) farming/irrigation induced risk areas, and 4) others.

## Limitations

- Most of the data (if available) is at District level, making it difficult to make accurate conclusions at settlement/village level in the STAS

# Groundwater Pollution-Types-Factors

- Type/extent of pollution (actual or potential) in the STAS is associated with the (i) land use, (ii) population densities (iii) levels of development.
- The intensities of these broad factors vary within and across the three countries in the STAS
- Showing the disparities in the potential sources and extent of pollution (threats) in the STAS.
- E.g. Botswana and South African sides are scantily populated, very remote compared to the level of development and population densities in Namibia.
- A considerable number of commercial irrigation coupled with use of fertilisers and pesticides exist in Namibia compared to Botswana and South Africa



## Example of irrigation in Namibia



15ha horticulture drop-irrigation farm close to Stampriet (Namibia)  
(Source: T. Carvalho Resende)



## Botswana and South Africa

- Also noteworthy, significant portions of the Botswana and South African STAS are covered by a nature preservation land use (Kgalagadi Transfrontier Park – KTP)
- The environment is pristine and the only few developments present in the area are **tourism** related facilities and **boreholes**, camps for management of park resources or for use by park managers
- Thus, this type of land use makes groundwater pollution vulnerability in the park negligible.
- Further, in Botswana the park is buffered by a Wildlife Management Area (WMA – KD1) where the primary activity is wildlife conservation and utilization

# GROUNDWATER POLLUTION LEVELS

- Due to paucity of data, it has not been possible to establish the extent of groundwater pollution in the deeper aquifers in the STAS across the three countries
- However, there are some indications of high levels of nitrates and bacterial pollution in some boreholes (Kalahari aquifer) located in the Matsheng area settlements (Botswana), attributed to pit latrines (e.g. DWA, 2000 ).
- This had also been confirmed in the CSIR Water Quality data (finally published by Huyser 1982) in that the oldest (Kalahari) boreholes had the highest nitrate values.

# Groundwater Pollution-Sources/intensities

- Groundwater resources *(particularly shallow aquifers)* are in threat of localised pollution around settlements, i.e. around boreholes and wells.
- Main potential sources of groundwater pollution are pit latrines, wastewater facilities, and waste dumps

Pollution Source	Pollution Source Intensity (Qualitative / Subjective Scale)		
	BOTSWAN A	SOUTH AFRICA	NAMIBIA
Pit Latrines	Negligible- low	Negligible	Medium
Septic Tanks & Effluent Soakaways	Negligible	Negligible	Medium
Sewage Works & Oxidation Ponds	Non- Existent	Non- Existent	Medium- High
Livestock Excreta	Negligible- low	Negligible- low	Negligible- low
Irrigation (incl. use of fertilisers & pesticides)	Non- Existent	Non- Existent	Medium- High
Burial Sites	Negligible	Negligible	Negligible- Low
Oil/Fuel Storage & Disposal	Negligible- Low	Negligible	Medium
Dumping Sites and Unsanitary Landfills			Medium

## % of distribution of households by type of main toilet facility and area (NSA, 2012): Example of Namibia

Constituency	Households	Private Flush Connected to Sewer	Shared Flush Connected to Sewer	Private Flush Connected to Septic/Cesspool	Shared Flush Connected to Septic/Cesspool	Pit Latrine with Ventilation Pipe	Covered Pit Latrine without Ventilation Pipe	Uncovered Pit Latrine without Ventilation Pipe	Bucket Toilet	No Toilet Facility	Others
Kalahari	728	26.8	8.1	5.3	1.5	3.7	4.4	0.9	1.1	47.2	1
Aminius	2700	12.9	2.7	6.7	2.7	1.3	0.5	0.4	1.1	71.3	0.3
Mariental Rural	3883	21.3	8	12.2	4.6	1.1	2.2	0.8	4.1	45.4	0.2
Gibeon	1161	26.9	6.4	7.7	1.6	2	2.6	0.6	5	47	0.2
Rehoboth Rural	414	18.5	3.1	10	2.9	1.5	2	0.7	11.2	49.9	0
Keetmanshoop Rural	371	33.3	12	5.5	2	1.1	2	0.5	10	33.1	0.5
Berseba	125	28	4.5	2.1	1	4.7	4.3	1.1	6.5	47.5	0.2
Windhoek Rural	65	34.6	9	8.8	2.9	3.3	4.9	2.7	1.7	30.9	0.9

- There are indications that a significant percentage of sanitation involves non existence of toilet facilities

## Example for Botswana: Potential sources of pollution (Shallow aquifer)

Stampriet Settlement	FLUSH TOILET (Own, Shared, Communal & Neighbour's)	VIP (Own, Shared, Communal & Neighbour's)	PIT LATRINE (Own, Shared, Communal & Neighbour's)	DRY COMPOST (Own, Shared, Communal & Neighbour's)	NONE (Assumed to be Using Bush Toilets)	TOTAL (Households)
Kule (BW)	8	3	42	1	46	332
Nwali (BW)	*	*	*	*	*	*
Ncojane (BW)	16	12	44	0	28	786
Metsimantle (BW)	*	*	*	*	*	*

There are indications that a significant % of sanitation involves pit latrines, or non existence of any toilet facilities

## ***Groundwater pollution cont.***

- High levels of Nitrates in the Kalahari Aquifer are found in some places in Namibia
- Especially where majority of water abstraction occurs, attributed to anthropogenic activities such as irrigation and stock watering
- It is only the shallow Kalahari aquifer that might currently be under threat by pollution

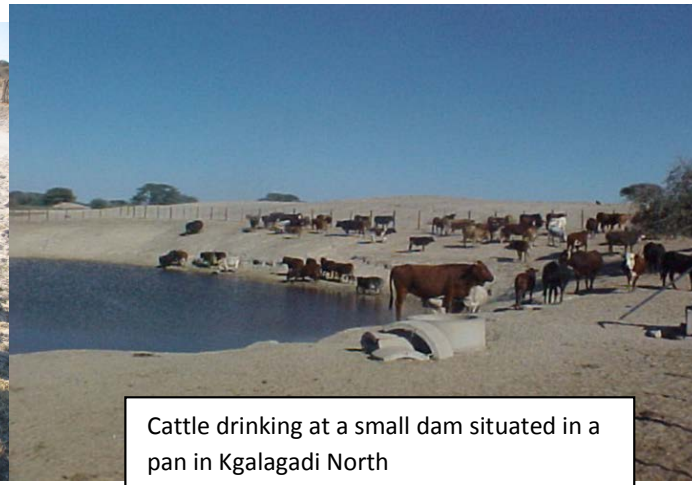
# POTENTIAL SOURCES OF GROUNDWATER POLLUTION (Kalahari aquifer) (Livestock Kraals, Hand Dug Wells, Small Dams, etc. in a Pan in Kgalagadi North) – (Mosetlhi, 2014) at Phepane Pan



Typical equipment used to draw and store water from handdug wells in pans, etc.



Researchers viewing water level in a handdug well in Phepane Pan in Kgalagadi

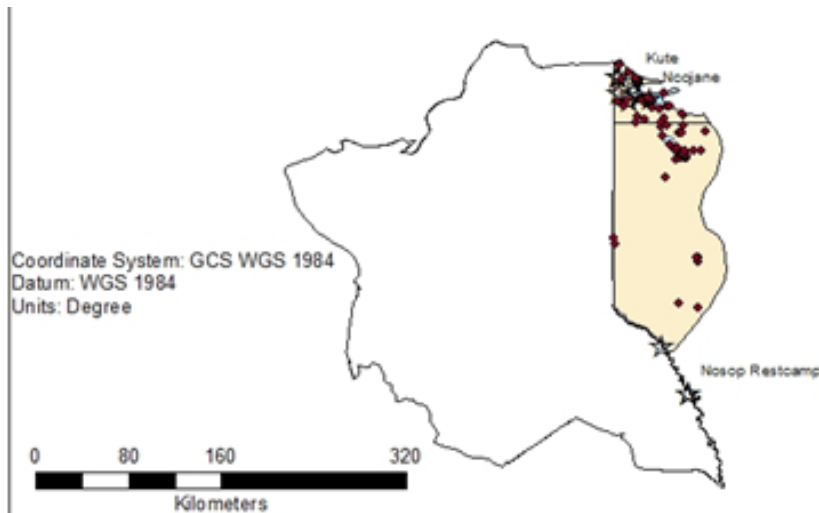


Cattle drinking at a small dam situated in a pan in Kgalagadi North



# Vulnerability Maps (To be verified with more data)

## Botswana



- **Aquifer Vulnerability: Generally negligible**

### Legend

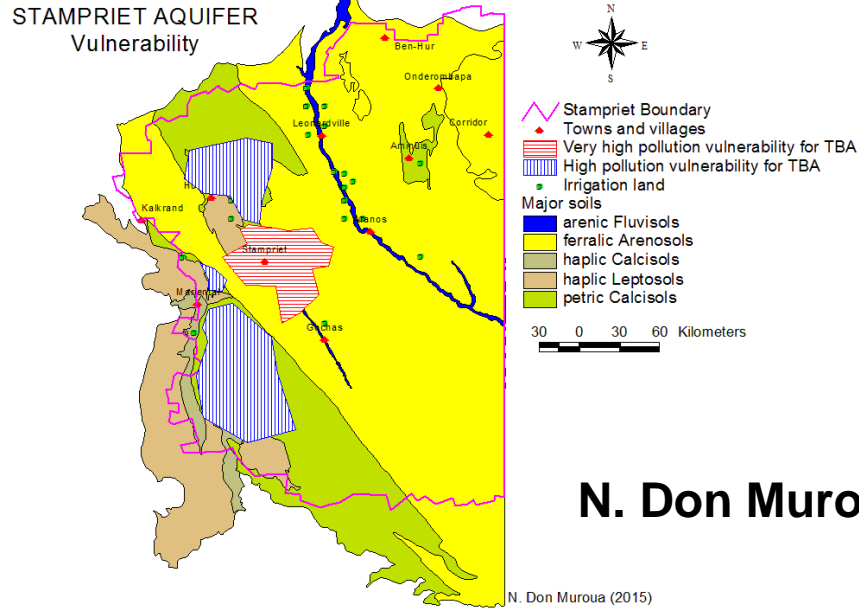
- stamp\_bots\_boreholes
- ☆ stampriet settlements BW
- admin DistrBW
- StamprietTBABoundary

### aquifer pollution vulnerability

- Groundwater Resources requiring comprehensive protection, moderate
- Groundwater Resources requiring minimal protection, low
- Groundwater Resources requiring minimal protection, negligible

**G. Lentswe (2014)**

# Namibia



**N. Don Muroa (2015)**

- **Aquifer Vulnerability (Irrigation and Urban Centers)**



**L. Joel (2014)**

- **Aquifer Vulnerability (Sinkholes and Soils)**

# Conclusions-STAS Groundwater Pollution Vulnerability & use

- The STAS is generally light populated
- No major industrial developments in the STAS
- Land use activities include small rural settlements, wildlife/national parks, cattle ranching & Commercial irrigation (Namibia in particular)
- Pollution vulnerability in the STAS is generally negligible at the current levels of development
- There are some localised potential sources of pollution to the shallow Kalahari aquifer

## Conclusions *cont...*

- Potential sources include pit latrines, livestock excreta, fertilisers and pesticides from irrigation
- While the TBA is not threatened by over abstraction or pollution at the current level of development, this might change if population, irrigation or mining activities substantially increase

# **Acknowledgement**

## **Socio economic and environmental experts**

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South Africa: B. Hanise

## **& The Project Team members**

## **Countries in the STAS**