GROUNDWATER RESOURCES
GOVERNANCE
in TRANSBOUNDARY AQUIFERS
(GGRETA Project)

Stampriet Transboundary Aquifer System (STAS) assessment
Preliminary findings

United Nations Educational, Scientific and Cultural Organization
International Hydrological Programme
Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra
Swiss Agency for Development and Cooperation SDC
igrac
International Groundwater Resources Assessment Centre

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Outline

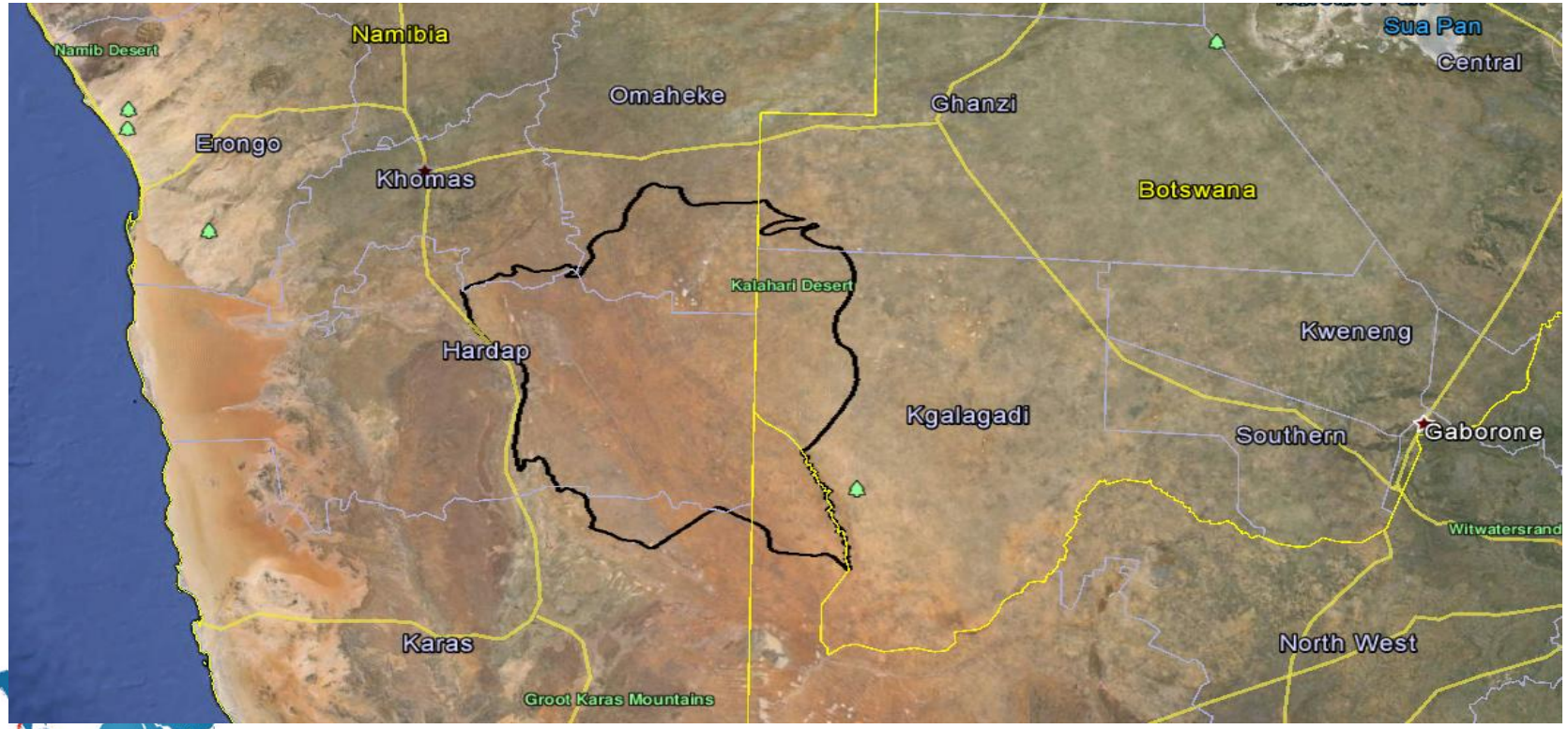
1. The STAS area

2. Overview of the STAS

The STAS area

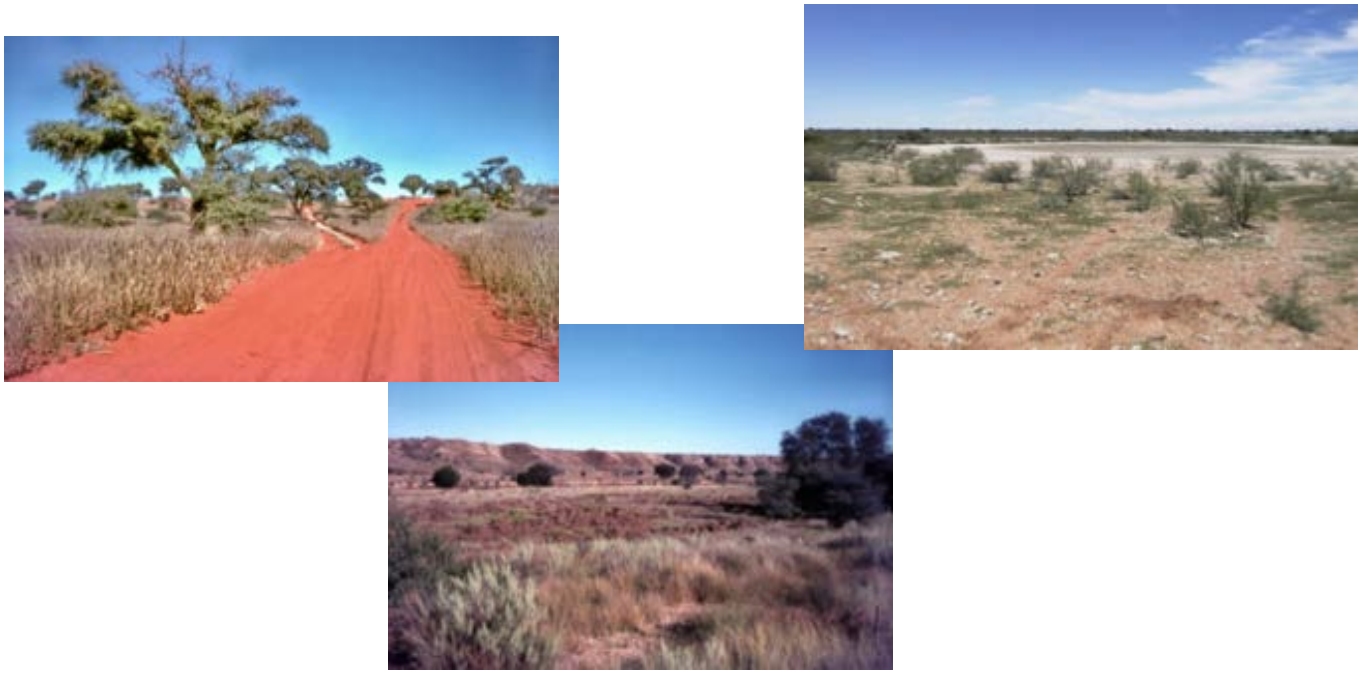
Location

- The Stampriet Transboundary Aquifer System (STAS) is named after the discovery of artesian water at Stamprietfontein during coal explorations in 1910.
- The STAS stretches from Central Namibia into Western Botswana and South Africa's Northern Cape Province, and lies within the Orange River Basin.
- The STAS covers a total area of 86 647km2, of which 73% of the area is in Namibia, 19% in Botswana, and 8% in South Africa



Landscape

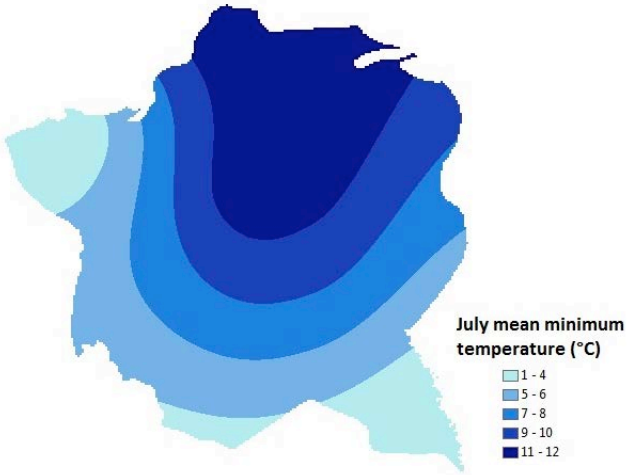
- The STAS is characterized by various landscapes, including sand dunes in Namibia and South Africa, calcrete/sandy surface area with shrubs and in some cases thick bushes. Seasonal pans are also important features found across the STAS.

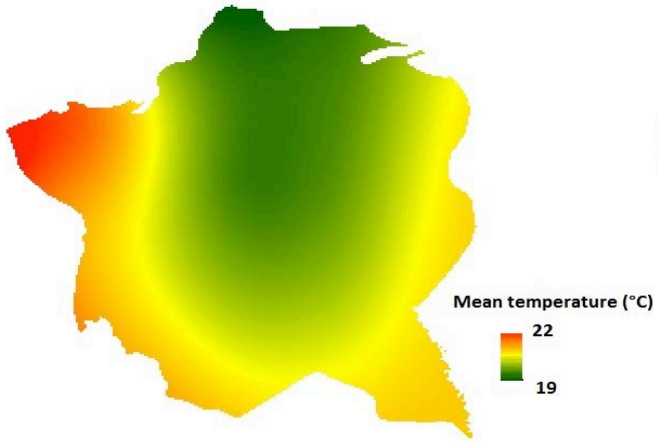


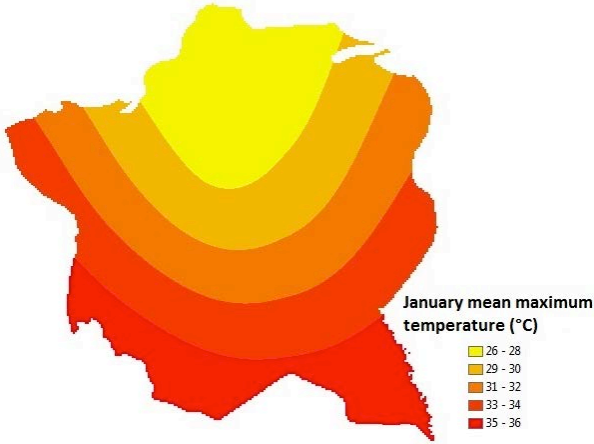
Common landscapes in the STAS: dune area stretching from the Auob to the Nossob River (top left), calcrete/sandy surface where pans are quite common (top right), deep cut in the Auob and Nossob Rivers (bottom center) (Source: J. Kirchner)

Climate

- Temperature:
  - High temperature time fluctuations owing to the semi-arid conditions
  - Mean temperature: 19-22°C
  - July mean minimum temperature: 1-12°C
  - January mean maximum temperature: 26-36°C
  - **Only 2 temperature stations within the study area (Aranos and Bitterwasser)**

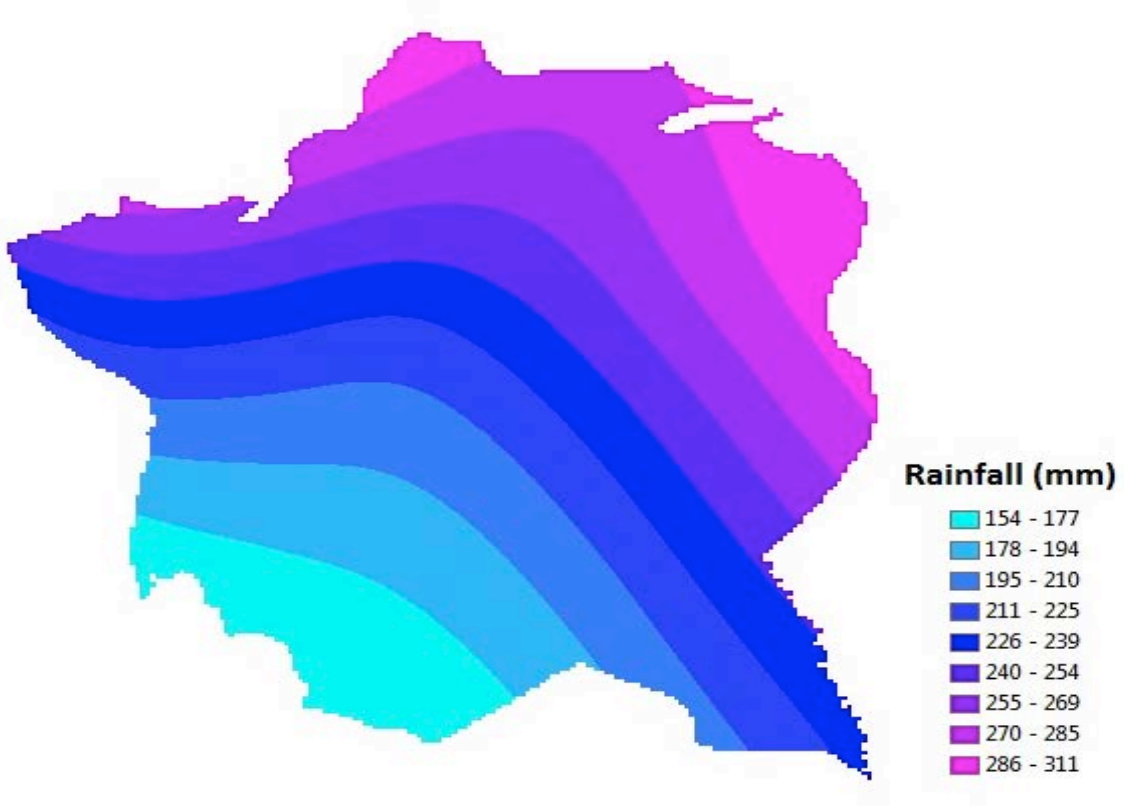






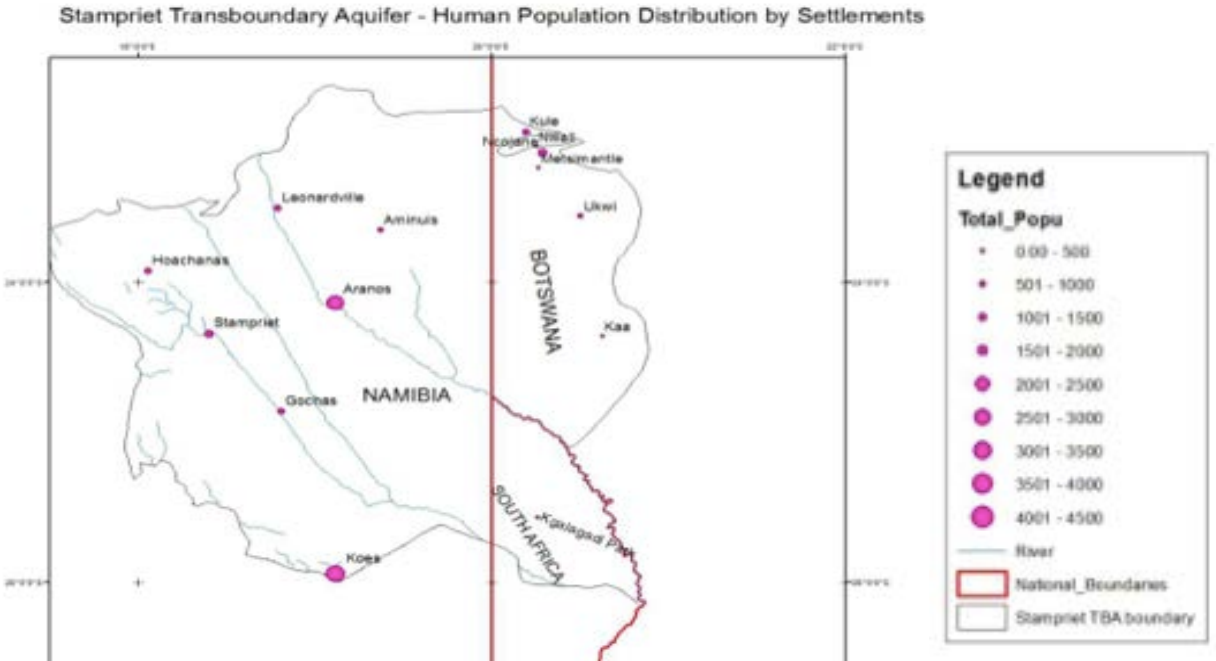
Climate

- Rainfall:
  - The average rainfall for the STAS is 150 - 310 mm/y
  - Maxima of up to 310 mm/y in the north and northeast Botswana area of the STAS and decreases to about 150 mm/a in the South Africa and south-western Namibia portion of the study area.
  - From December to April: predominantly in the form of thunderstorms (high intensity and short duration).
  - **Only 2 rainfall stations within the study area (Aranos and Ncojane)**



Demography

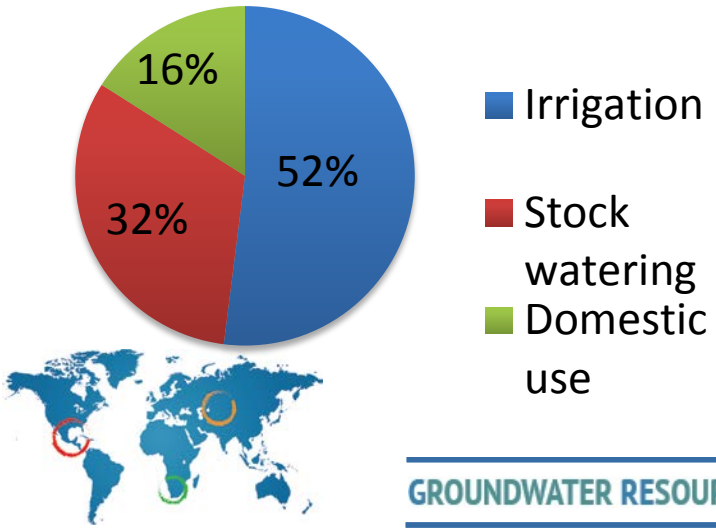
- The STAS area is lightly populated with population concentrated in small rural settlements.
- **Population is estimated to be over 45,000**
- Significant settlements:
  - Namibia: Koes, Aranos, Stampriet, Hoachanas, Leonardville
  - Botswana: Ncojane, Kule
- Total population of the area is difficult to estimate because it includes an itinerant population that move into and out of the area.
- **Demographic growth from STAS 1991 to 2015 is estimated at 50%**

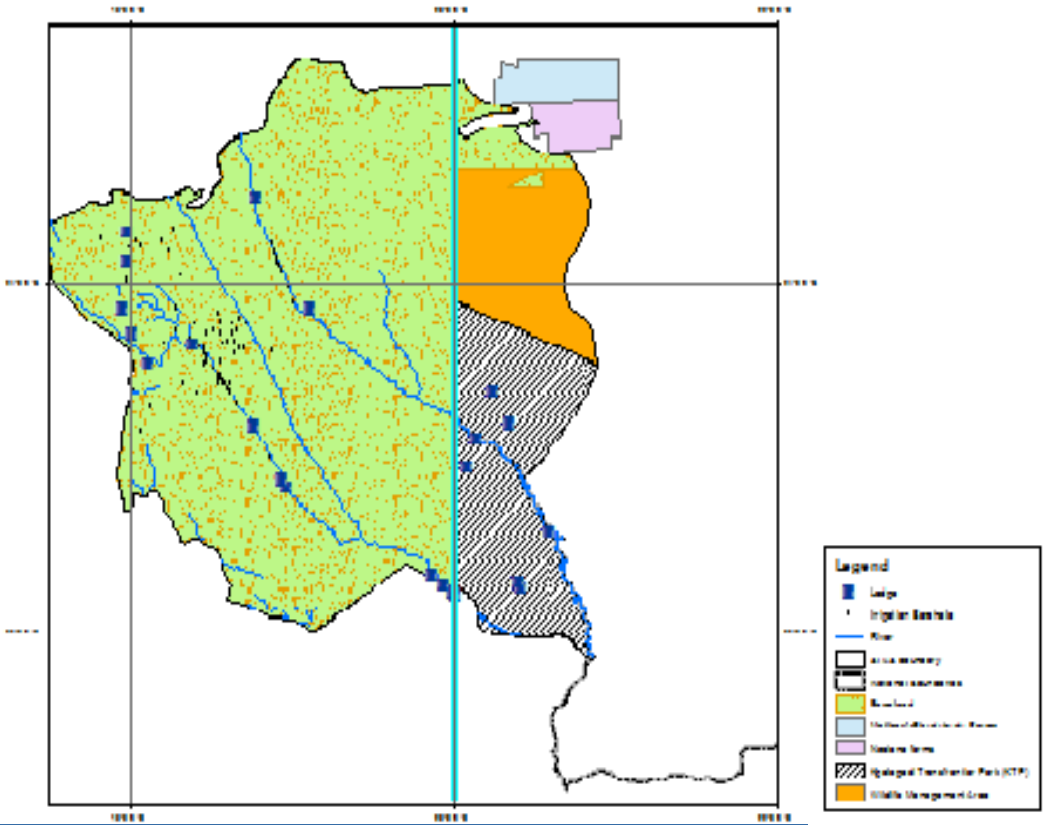


Economy

- Groundwater is the major only source of water in the STAS, to provide portable water to the people, livestock and for irrigation.
- Total abstraction estimated at **20 Mm^3/y**
- Approximately **95% of total abstraction occurs in Namibia**
- **High water losses,** e.g. in Stampriet 60% loss as percent of water supply (DWA, 2006)
- **Borehole leakages**
- **Illegal abstraction occurs**

Groundwater use





Economy

- Approximately 160 irrigation farms (13,5% of total) have been identified in Namibia (DWA 2001)
- Irrigation represents approximately 0.008% of the study area (DWA 2001)
- Livestock:
  - Large stock: approximately 100 000
  - Small stock: approximately 1 300 000
- Employment:
  - 364 estimated people direclty employed on farms owing to the existence of irrigation technology
  - Approximately one extra worker per hectare of irrigated land
- Questions that still need to be addressed:
  - **Little information on variability and variations in time, i.e**.
    - *Is it possible to estimate evolution of irrigated land?*
    - *Is there any up to date economic valuation of the STAS? (information obtained back to 2001)*
    - *Can we roughly estimate how/where groundwater is being abstracted (from which aquifers?)*

Prosopis

- Prosopis is an alien invasive species which is posing negative impacts to the environment (e.g. reduction in grazing land and groundwater)

Prosopis covered Nossob River upstream of Leonardville (Namibia) (Source: J. Kirchner)

Prosopis

- Projected Prosopis density will stand at 3549 trees/ha in the Auob Basin and 12911 trees/ha in the Nossob Basin in ten years time (DFRN, 2012)

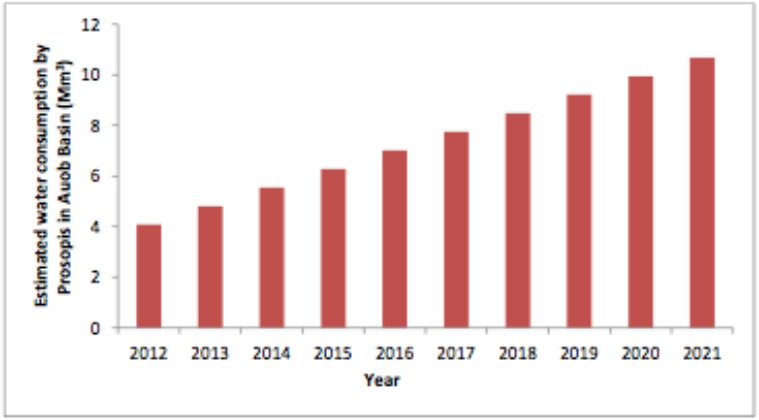


Figure 15: Estimated water consumption by *Prosopis* in the Auob Basin in ten years

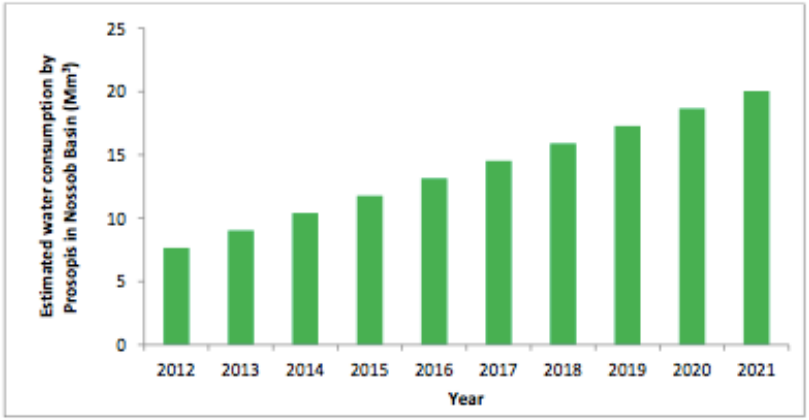


Figure 16: Estimated water consumption by *Prosopis* in the Nossob Basin in ten years

Prosopis

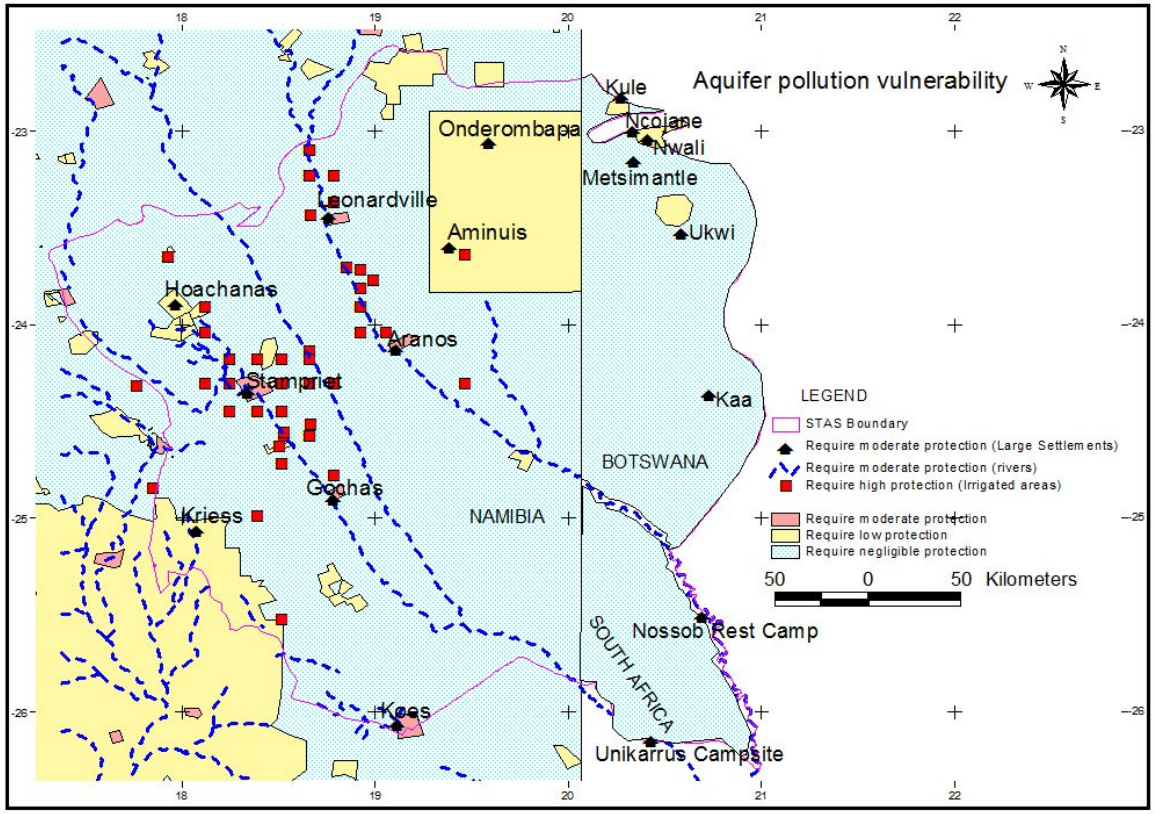
- Although *Prosopis* seems to be posing negative impacts, it has a great economic potential which is not being fully exploited. Currently, N$121 189.00/annum and N$43 017.86/annum is generated from the sale of pods in the Auob and Nossob Basins.
- If fully exploited, the current density of *Prosopis* (4612trees/ha and 1191trees/ha) can generate an income of approximately N$7 378 560.00/annum in the Auob Basin and N$1 906 048.00/annum in the Nossob Basin from the sale of pods. At present only 1.64% of the potential income from the sale of pods is earned in the Auob Basin and a mere 0.02% is earned in the Nossob Basin.
- If *Prosopis* is fully exploited it can contribute to employment opportunities for some of the poorest people in the Auob and Nossob Basins, especially considering the low employment rates.

- **Recommendation: Develop and implement policies and legislation on alien invasive species to guide control measures for *Prosopis* and other alien invasive species.**

Groundwater quality & Pollution

- Groundwater quality decreases southeasterly (Salt Block)
- Pollution vulnerability in the STAS is generally negligible at the current levels of development
- However, TDS levels have increased by 10% in the last 30 years
- There are some localised potential sources of pollution to the shallow aquifers (close to settlements)
- Special attention should be given to irrigation boreholes (along the Auob and Nossob rivers)
- Recharge zones in Namibia should also be addressed.

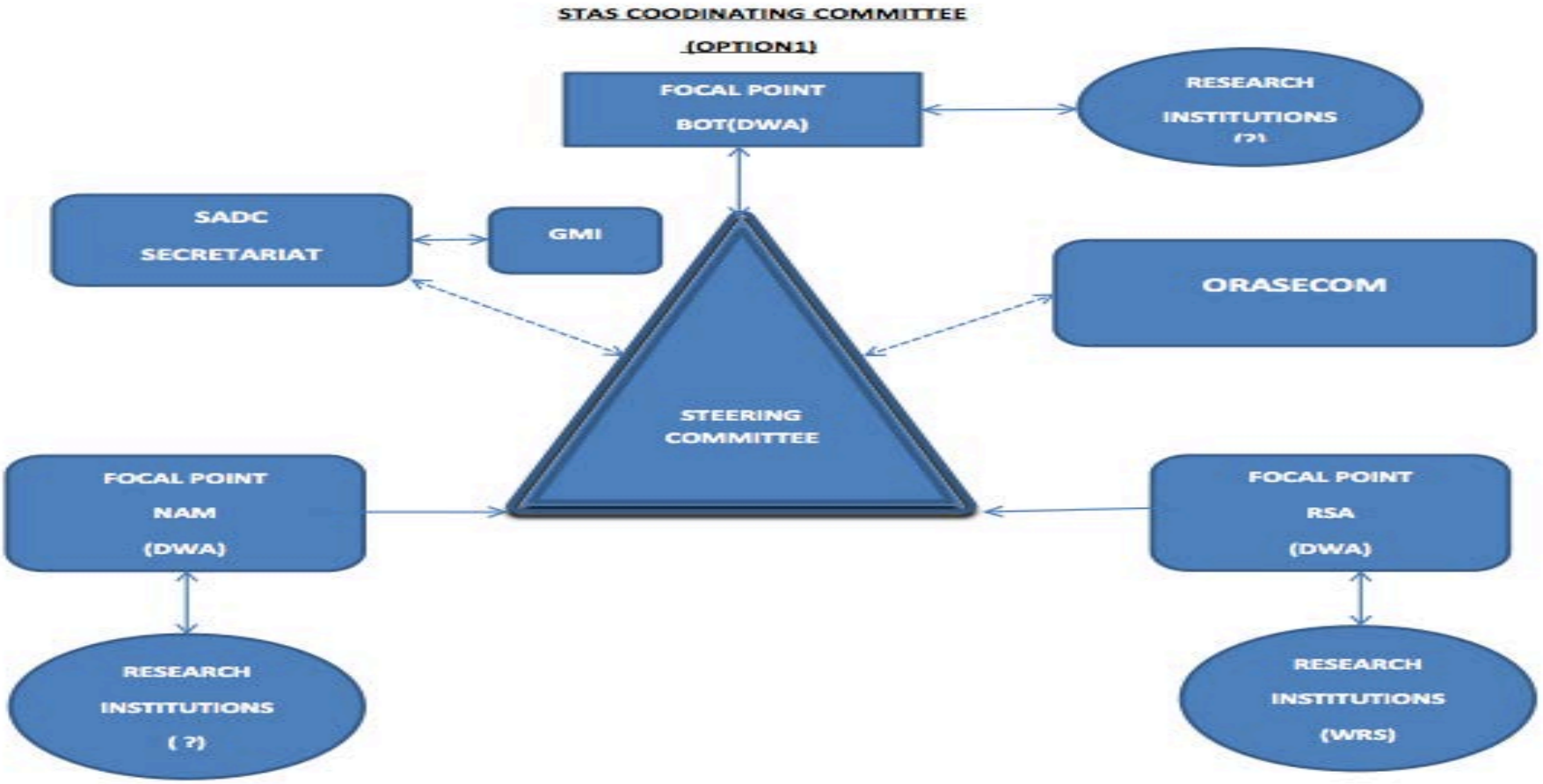
Groundwater risk map



- Map still needs to be finalized in order to include recharge zones

Options of MCCMs

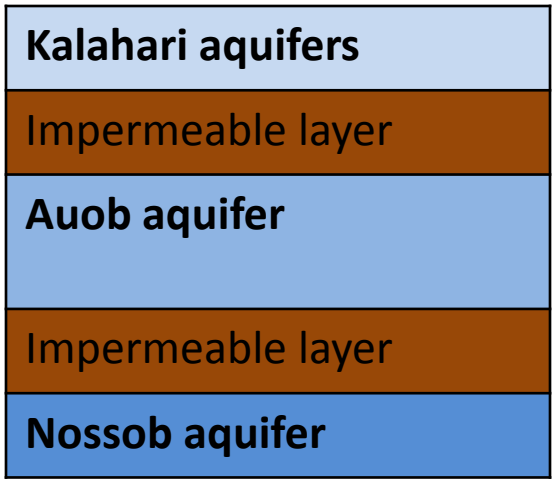
- **2 options:**
  - Option 1: Coordinating STAS Committee
  - Option 2: Standing ORASECOM Committee



Overview of the STAS

Geology

- STAS = unconfined aquifers (Kalahari) + confined aquifers (Auob and Nossob)

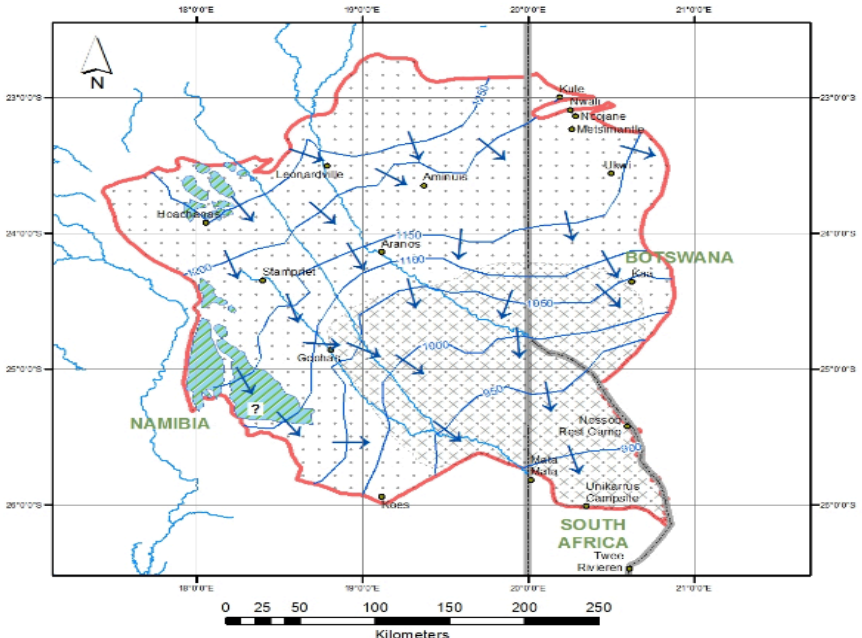


- **Kalahari aquifers:** hundreds of individual aquifers more or less loosely connected forming an unconfined aquifer system - **NOT TRANSBOUNDARY**
- **Auob and Nossob aquifers:** confined aquifer with isolated outcrops in the extreme western part of the STAS in Namibia – **TRANSBOUNDARY**

- **Recommendation: The Kalahari and the Auob and Nossob have different dynamics and need to be treated separately, especially from a policy point of view**

Conceptual model

- Recharge:
  - Kalahari aquifers = 0.5% of rainfall
  - Auob and Nossob aquifers = almost non-existant. Noticeable recharge occurs in heavier rainfall events through numerous sinkholes in calcrete near the north-western and western boundaries of the STAS
- Discharge:
  - Kalahari aquifers = evaporation
  - Auob and Nossob aquifers = draining into Kalahari aquifers (Salt Block)
- Groundwater flow:
  - Auob and Nossob aquifers = from northwest to southeast
  - Kalahari aquifers = follow the same pattern



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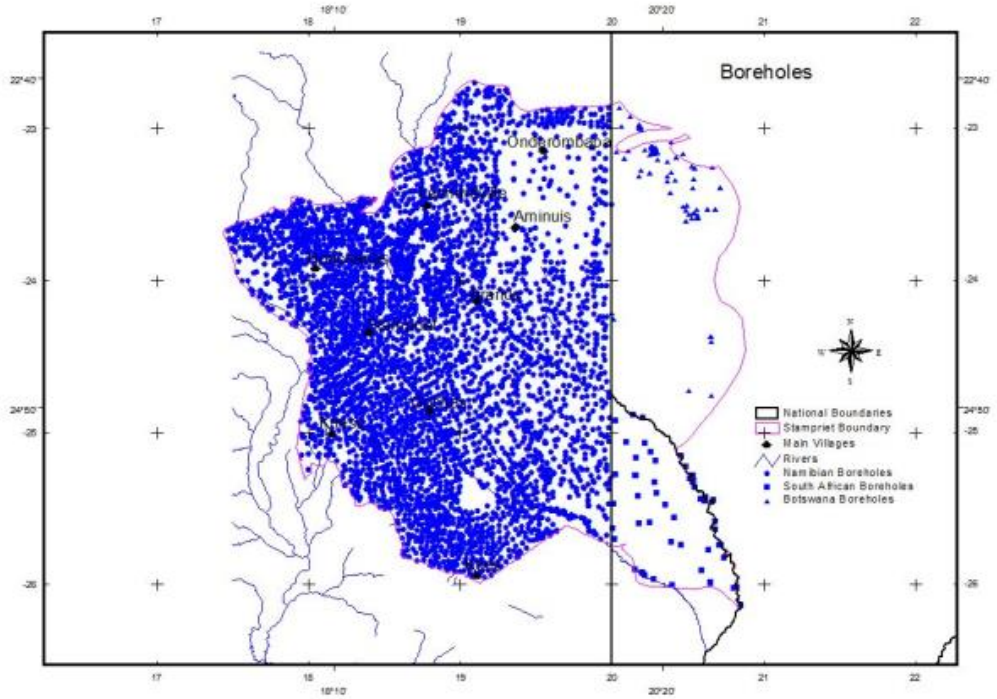
Stampriet Transboundary Aquifer System
Conceptual Model

Legend

- Villages_and_settlements
- Water Level Contours
- Groundwater flow
- Rivers
- TBA Recharge
- Kalahari Recharge Area
- TBA Discharge into Kalahari
- National Boundaries
- STAS Boundary

Challenges

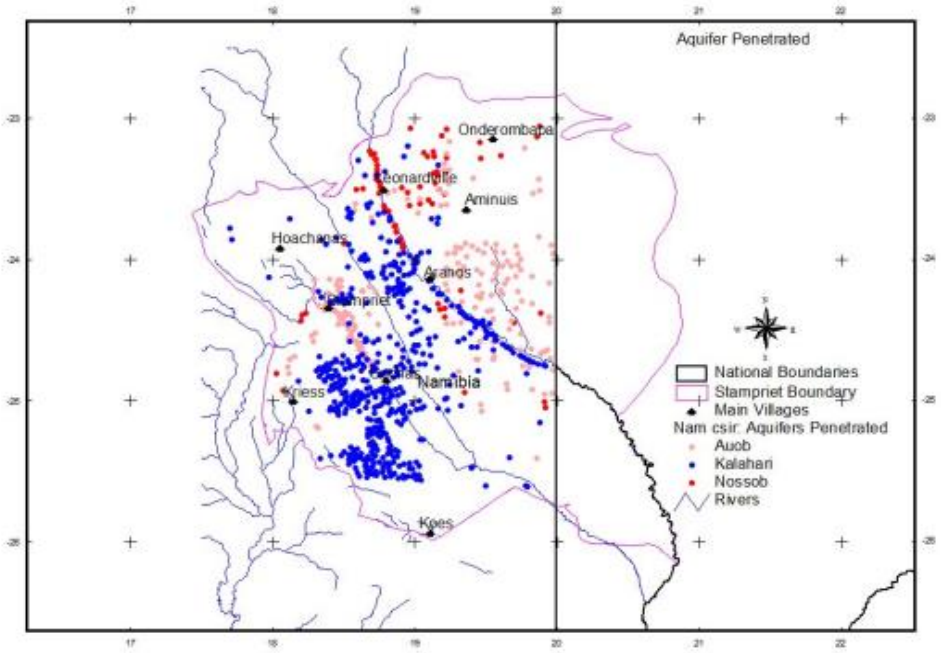
- Approximately 6000 boreholes have been identified in the STAS…



Country	Number of boreholes	% of boreholes
Namibia	5403	97
Botswana	137	2
South Africa	57	1
Total	5597	100

Challenges

- … However information on which aquifers we're tapping in is very limited **(i.e. only 15%)**



	Namibia		Botswana		South Africa		Total	
Aquifer penetrated	Number of boreholes	% of total boreholes	Number of boreholes	% of boreholes	Number of boreholes	% of boreholes	Number of boreholes	% of boreholes
Kalahari	518	60	N/A	N/A	57	7	575	67
Auob	203	23	9	1	0	0	212	24
Nossob	74	9	N/A	N/A	0	0	74	9
Total	795	92	9	1	57	7	861	100

Challenges

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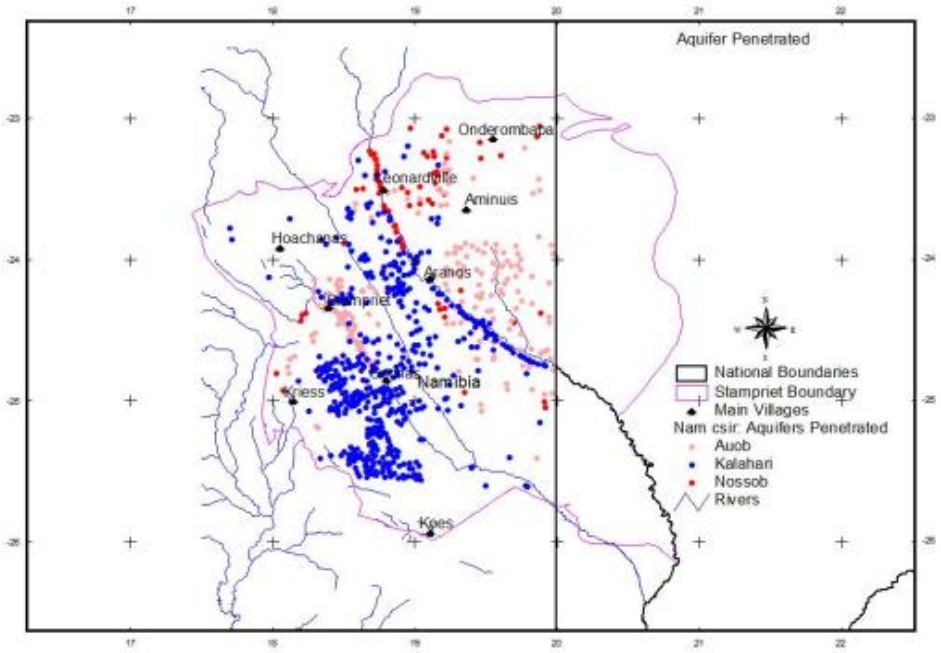

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Total	795	92	9	1	57	7	861	100

Challenges

- **Questions that still need to be addressed:**
  - Having in mind the lack of data, how to take into consideration groundwater pollution treating separately the Kalahari and the Auob and Nossob aquifers?
    - ✓ 1 map for the Kalahari aquifers and 1 map for the Auob and Nossob aquifers?
  - Having in mind the lack of data, how to take into consideration policy-making treating separately the Kalahari and the Auob and Nossob aquifers?
    - ✓ Kalahari > more domestic policy oriented?
    - ✓ Auob and Nossob > more transboundary policy oriented?
  - How to take into consideration treating separately Is it possible to have a map with STAS artesian conditions?