Water Security

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Eberswalde Universi
for Sustainable
Development

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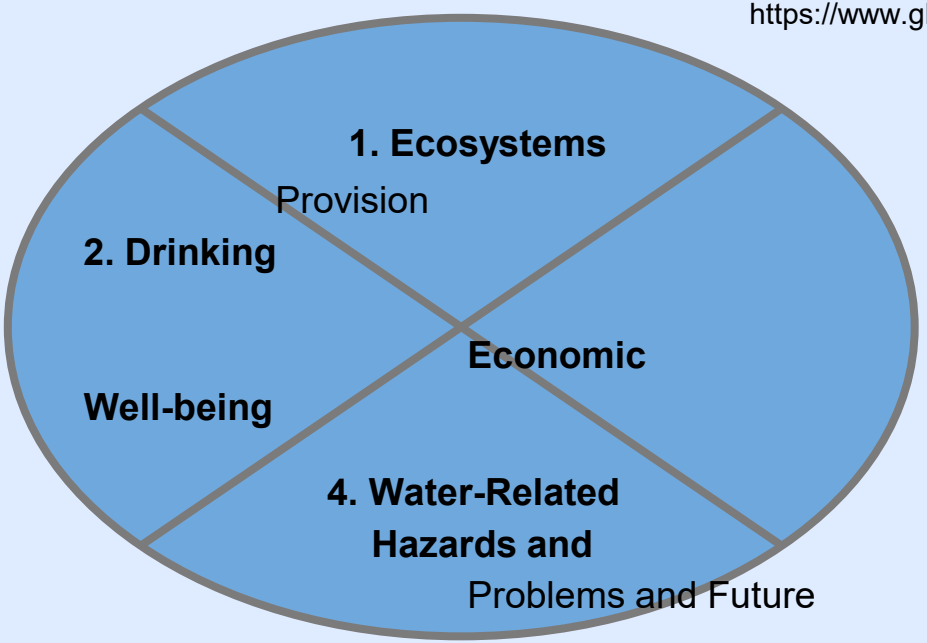
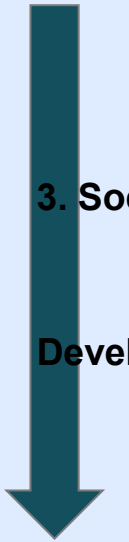
1. Definition Water Security

“Water Security is the adaptive capacity to safeguard the sustainable availability of, access to, and safe use of an adequate, reliable and resilient quantity and quality of water for health, livelihoods, ecosystems and productive economies.”

https://www.globalwaters.org/resources/blogs/swp/what-water-security





3. Socio-
Water and Human
Experienced Use
Development

Climate Change
Outlook

1. **Ecosystems** (Hydrologic environment)
   - Absolute level of water resource availability
   - Time availability
   - Spatial distribution

   - Needs of ecosystems, rivers, lakes, reservoirs and aquifers

1. **Drinking Water and Human Well-being**
   - Drinking Water
     (safely managed drinking water - basic - limited)
   - Sanitation services for cleaning and hygiene

1. **Socio- Economic Development**
   - Public, economy and government
   - Agriculture, energy production, transportation, …
   - “The poverty and hydrology hypothesis”

1. **Water-Related Hazards and Climate Change**
   - Avoiding physical risk
   - Acute and chronic impacts

Water Insecurity

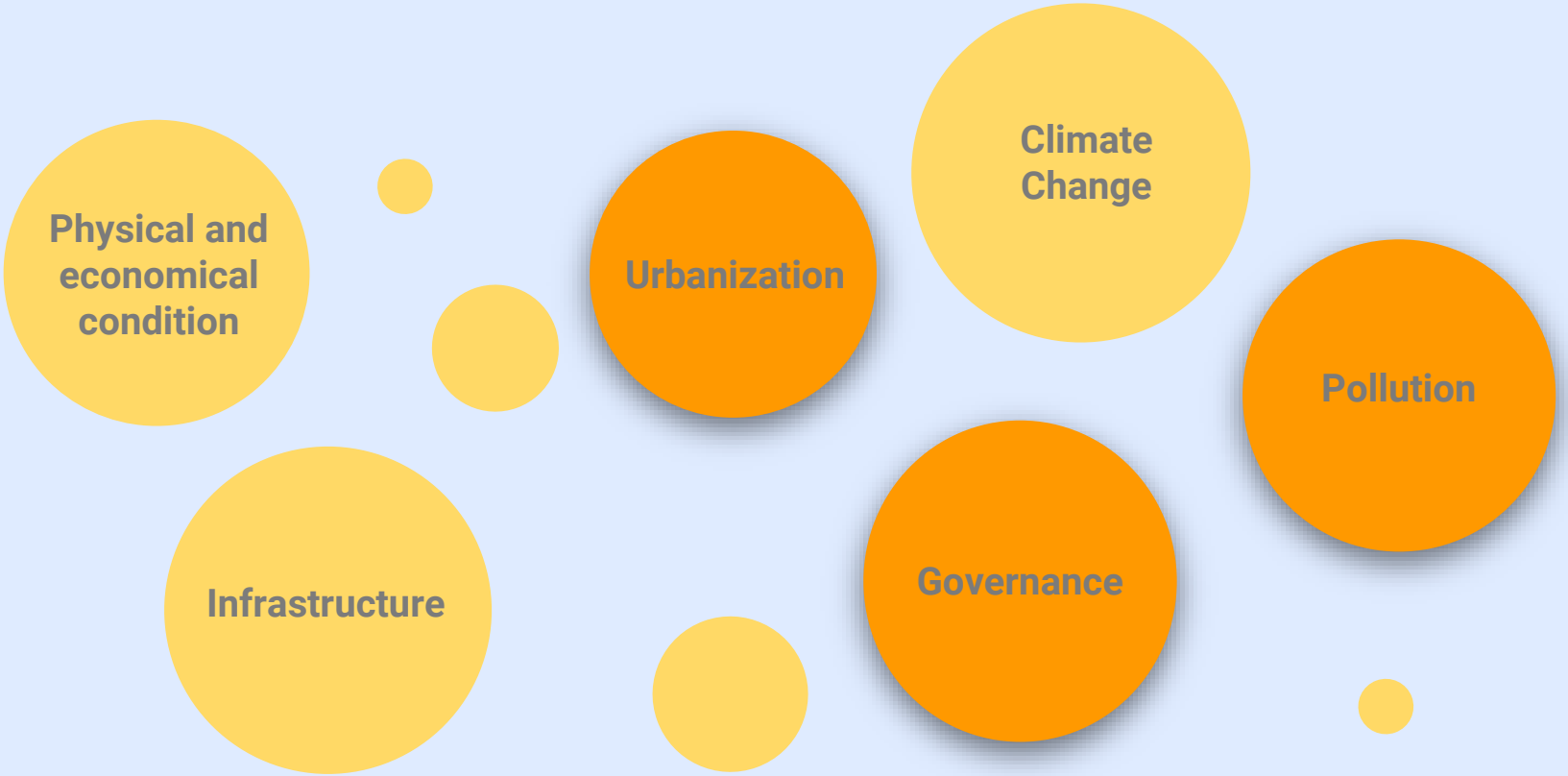
1. Changed rainfall patterns
   (specifically droughts)
   Changed river flow rate

1. Water scarcity
   lowered or polluted
   ground- or drinking water

1. Overexploitation, pollution,
   destroyed infrastructure,
   poverty

1. Natural disasters
   Climatic trends

2. Drivers of Water Security (Overview)



Driver of Water Security - Governance

Degrading Security

- Transboundary conflicts
- Centralised governance
- Lack of state resource
- Lack of mediating authorities
- Poor implementation
- Lack of communication

Water services provision

Water Manage -ment

Supporting Security

- Trust & democratic legitimacy
- Polycentric governance system
- Adequate adaptive capacity (Human, Technology and Finance)
- Clear role and responsibilities

Drivers of Water Security: Urbanisation and Waste

Degrading security

- Climate induced vulnerability
- Population growth
- Lack of water infrastructure
- Landscape change
- Competing resource interests
- **Pollution**

Water supply

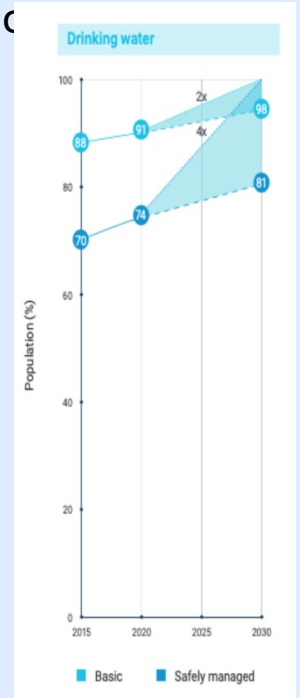
Water quality

Supporting security

- **Waste water treatment**
- Waste treatment
- Green Infrastructure

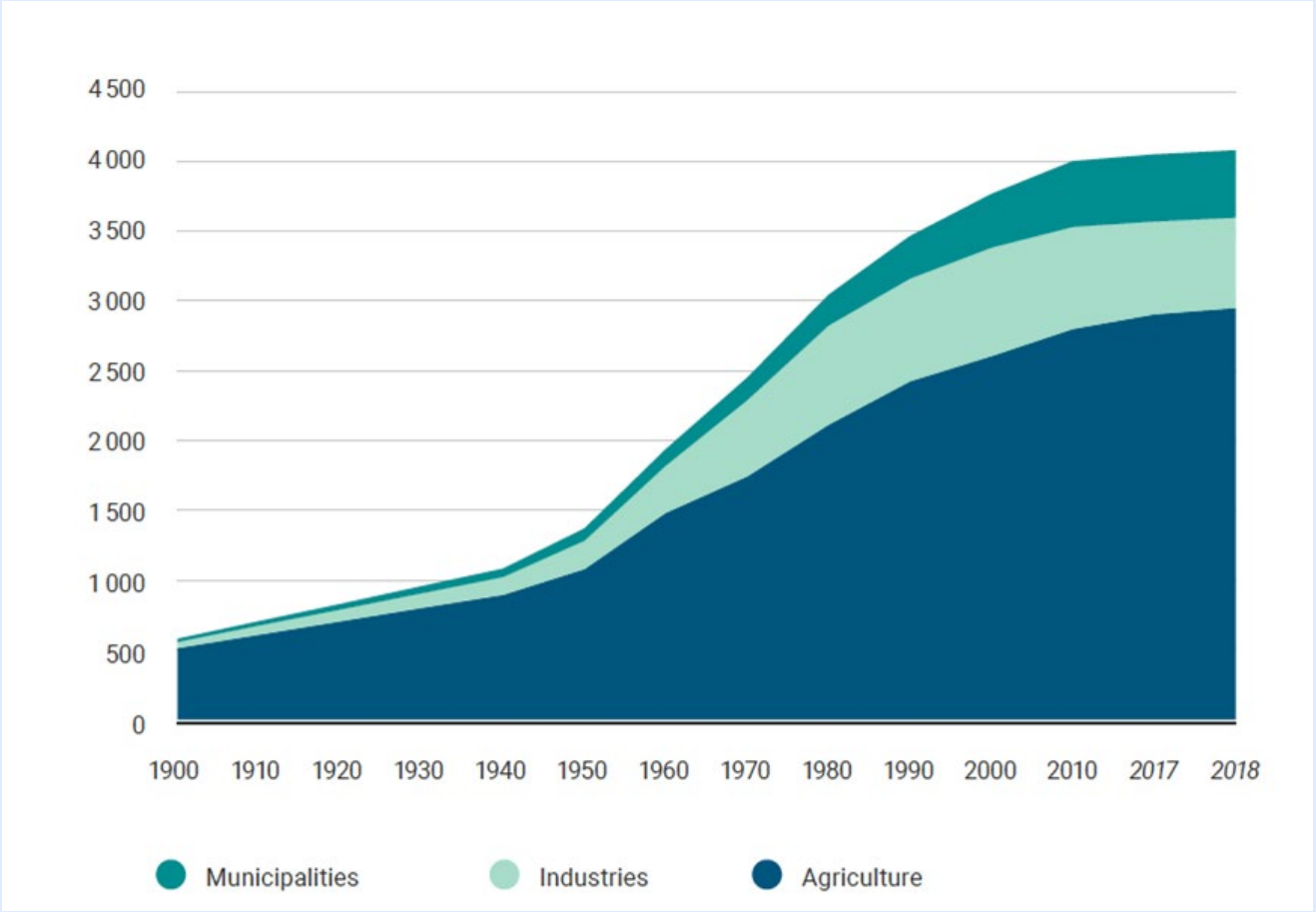
3. Current & Historical State of Water Availability

- **1900 - 2000** consumption increase due to population growth and economic development
- **1980 - 2020** changing consumption patterns and socio-economic develo
  - Main increase emerging economies
- **2000** 1/3 of world population have *safely managed drinking water*
- **2020** nearly 80%
  - Further 10 % *basic services*
  - Nearly 5 % have *limited access*
    - 771 million people lacked basic level of service
    - 282 million: limited water service
    - 367 million unimproved sources
    - 122 million collected drinking water directly from surface water sources



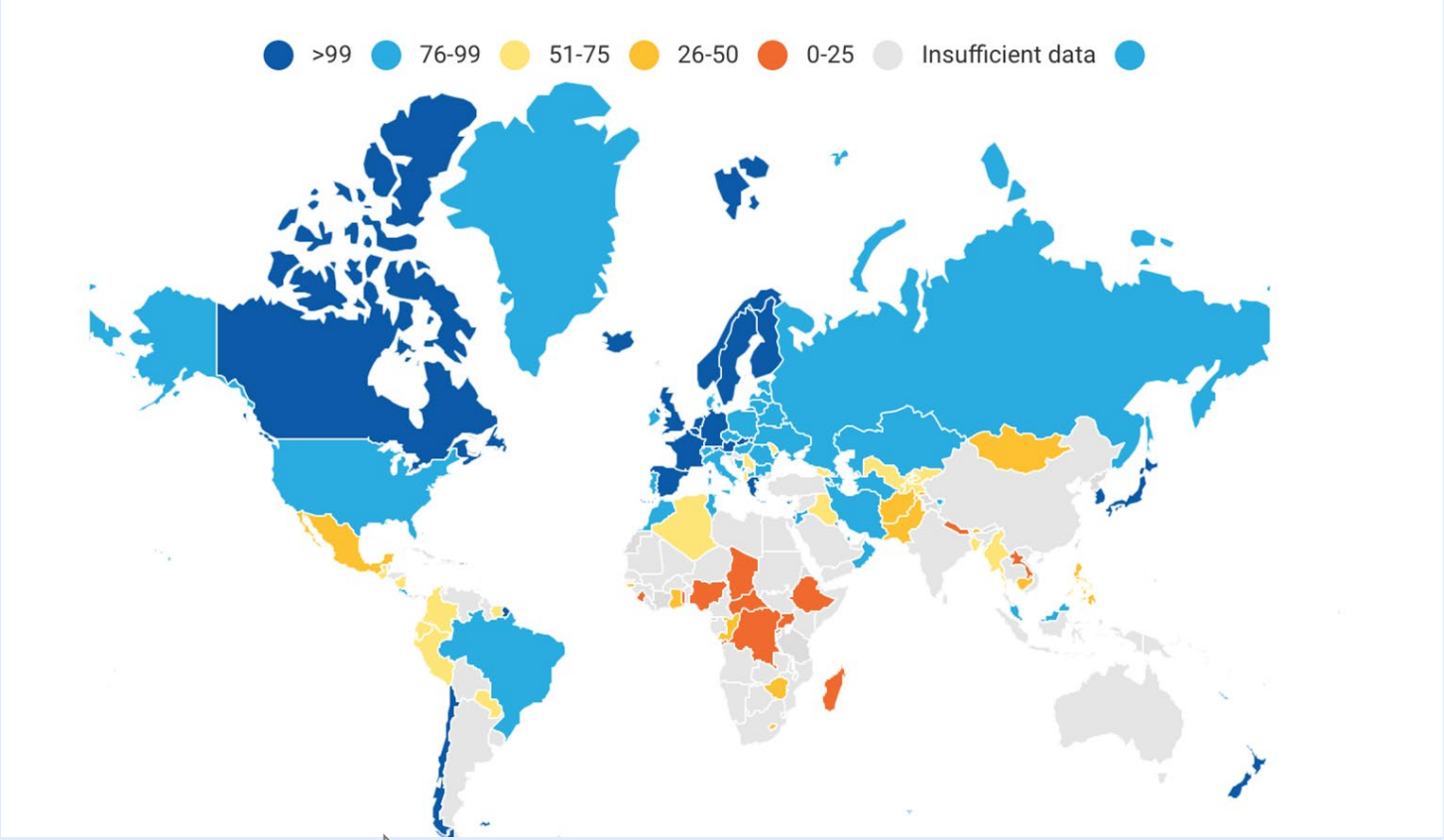
WHO/UNICEF 2021

Evolution of Global Water Withdrawal, 1900–2018 (km³/year)



FAO (2022)

Proportion of population using safely managed drinking water services, 2020 (%)



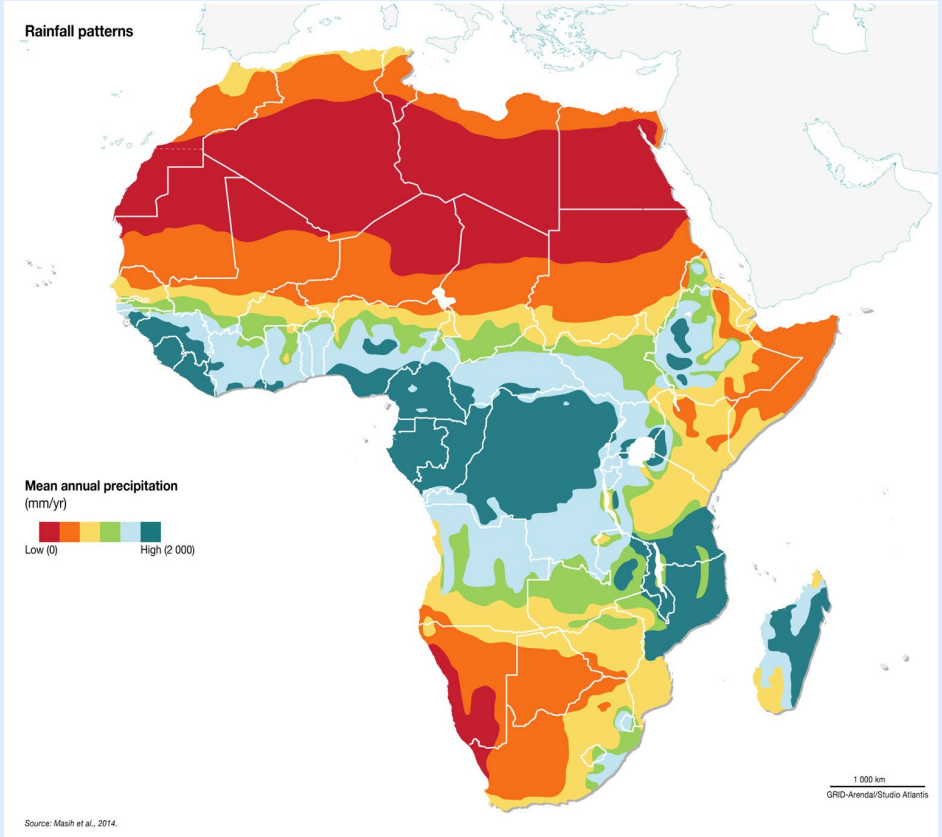
Particularly in sub-Saharan Africa

4. Windhoek, Namibia

- Capital, economic hub of region
- Population of nearly 430,000 people
- As of 2016, annual growth rate of 4.4%, doubling period of 16 years
- Population estimated to increase to 790,000 by 2050

Windhoek: Climatic Profile

- City’s avg. annual rainfall 360 mm - avg. annual evaporation is 2170 mm
- Most arid country in Sub-Saharan Africa
- Can lose 20% - 85% of water through evaporation within one season
- Intensifying droughts and annual temperatures

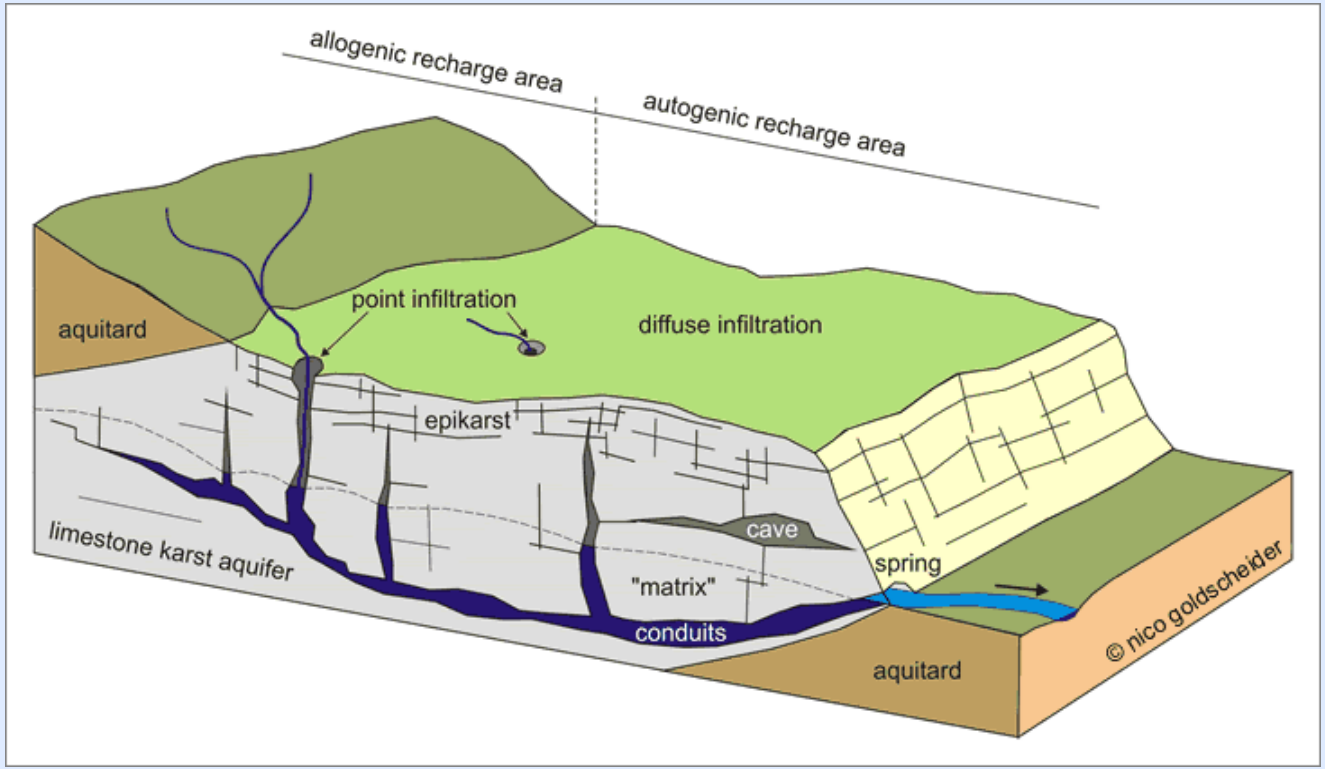


Windhoek Water Security: Dam storage

https://de.wikipedia.org/wiki/Neckartal-Damm

- Three-dam scheme 60 - 170 km away
- Supplies 60% of city water
- Extremely high evaporation rates
- 2016 record drought stopped inflow - forced innovation

Windhoek Water Security: Managed Aquifer Recharge



- MAR technique will provide water buffer of 3 yrs. through drought
- Recharged with treated urban water/ catchment
- Provides 20% of city's water supply

https://www.alamy.com/avis-dam-windhoek-namibia-image223922305.html

https://www.bgr.bund.de/whymap/EN/Maps_Data/Wokam/wokam_fig3_g.html?nn=9930710

Windhoek Water Security: Wastewater Reuse

- Pioneered practice since 1967
- One of three plants like it in the world
- Provides 20% of city's water supply

https://www.afrik21.africa/en/windhoek-how-to-treat-wastewater-to-make-it-drinkable/

Transfer : Bolstering Windhoek

https://africa.cgtn.com/2016/08/18/windhoek-the-city-of-many-faces/

Chapter 4 of IPCC Report

Section 4.8

Enabling Conditions for Achieving Water Security, Sustainable and Climate Resilient Development through System Transformations

- Appropriate Technologies
- Adequate and Appropriate Financing
- Gender, Equity and Social Justice
- Inclusion of Indigenous Knowledge and Local Knowledge
- Participative, Cooperative and Bottom-up Engagement
- Polycentric Water Governance
- Strong Political Support

Worsening drought & precipitation changes

&

Rural to urban migration + natural growth patterns

Water deficit of 40 million m³ by 2050

https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_Chapter04.pdf (IPCC, 2023)

Water Governance

Challenges Faced

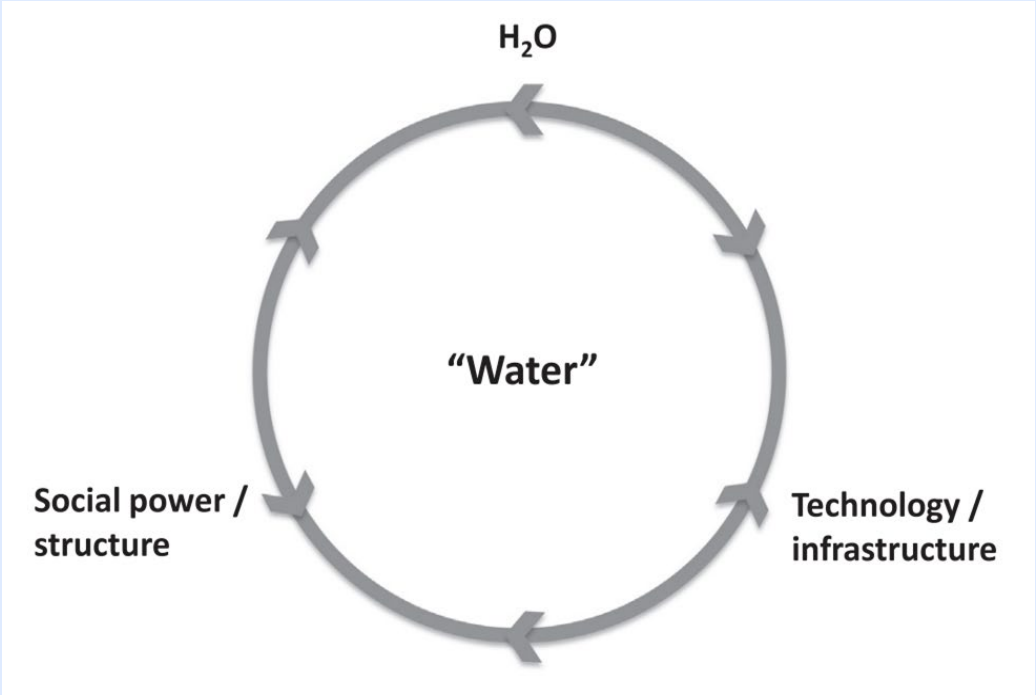
- Centralised and eurocentric setting
- Lack of expertise
- Poor communication
- Poor implementation
- Voluntary based local actors

Changes Needed

- Polycentric governance
  - Stakeholder and role mapping
- “Sell” and liaise with key (political) stakeholders
- On-going capacity building
  - Innovative technology
  - Support and empower local actors
- From pilot to long-term

Our Role as an NGO

- Building political will
- Building social power
- Bridging public and private stakeholders and actors
- Reducing inequality
- Introducing innovative technical solutions
- Non-profit



The Hydrosocial Cycle

(Linton, J., & Budds, J.,2014)

Seize Existing Opportunities, Build Collective willingness

SANITATION AND WATER FOR ALL

International Association of Hydrogeologists
the World-wide Groundwater Organisation

NAMWATER
Namibia Water Corporation Ltd

Global Water Partnership Southern Africa
Namibia Water Partnership

BMZ Federal Ministry for Economic Cooperation and Development

KFW
Bank aus Verantwortung

University of Zambia

Hochschule für nachhaltige Entwicklung Eberswalde

Sub-themes

- Groundwater as a catalyst for attaining SDGs;
- Groundwater and ecosystem services;
- Groundwater and livelihoods; and
- **Resilient groundwater infrastructure innovations for socio-economic development and rural and urban water security**

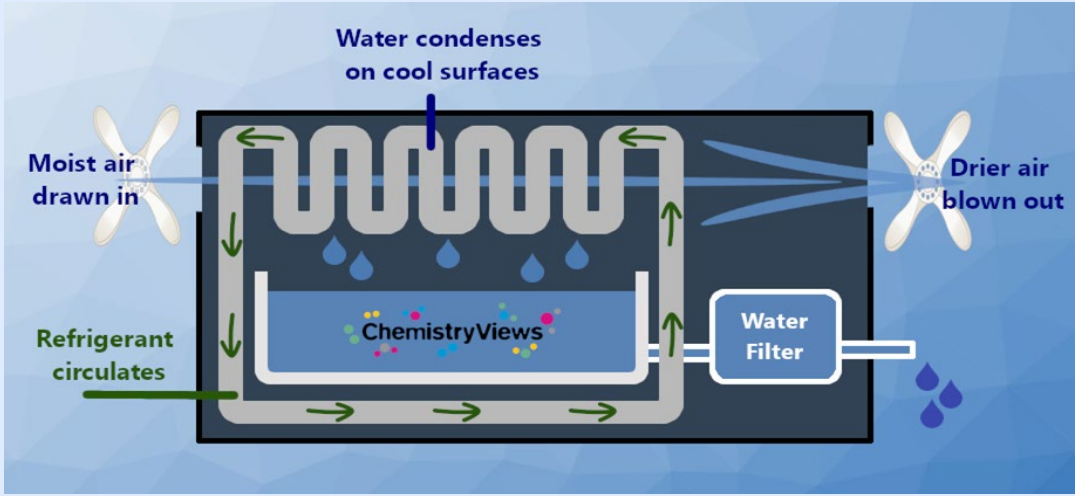
Photovoltaic Evaporation Covers & Hydroelectric Installation

Atmospheric water generators (AWG)

- Extracts clean, drinkable water from the air
- Till 8.400 l/day

Pros:
- Immediate, continuous usage
- Transportaple, decentral
- Wastefree
- Transforms greenhouse gases
- Wide spectrum of usage (15°C and 20%)

Cons:
- Very energy intense
- 5 litre per 1 kWh



→ Combination with renewable energy sources (e.g. water turbines or solar panels)

- Could undermine permanent water infrastructure

Case Study Windhoek

Relative humidity in %

Never under 20 % humidity

Precipitation in mm/day

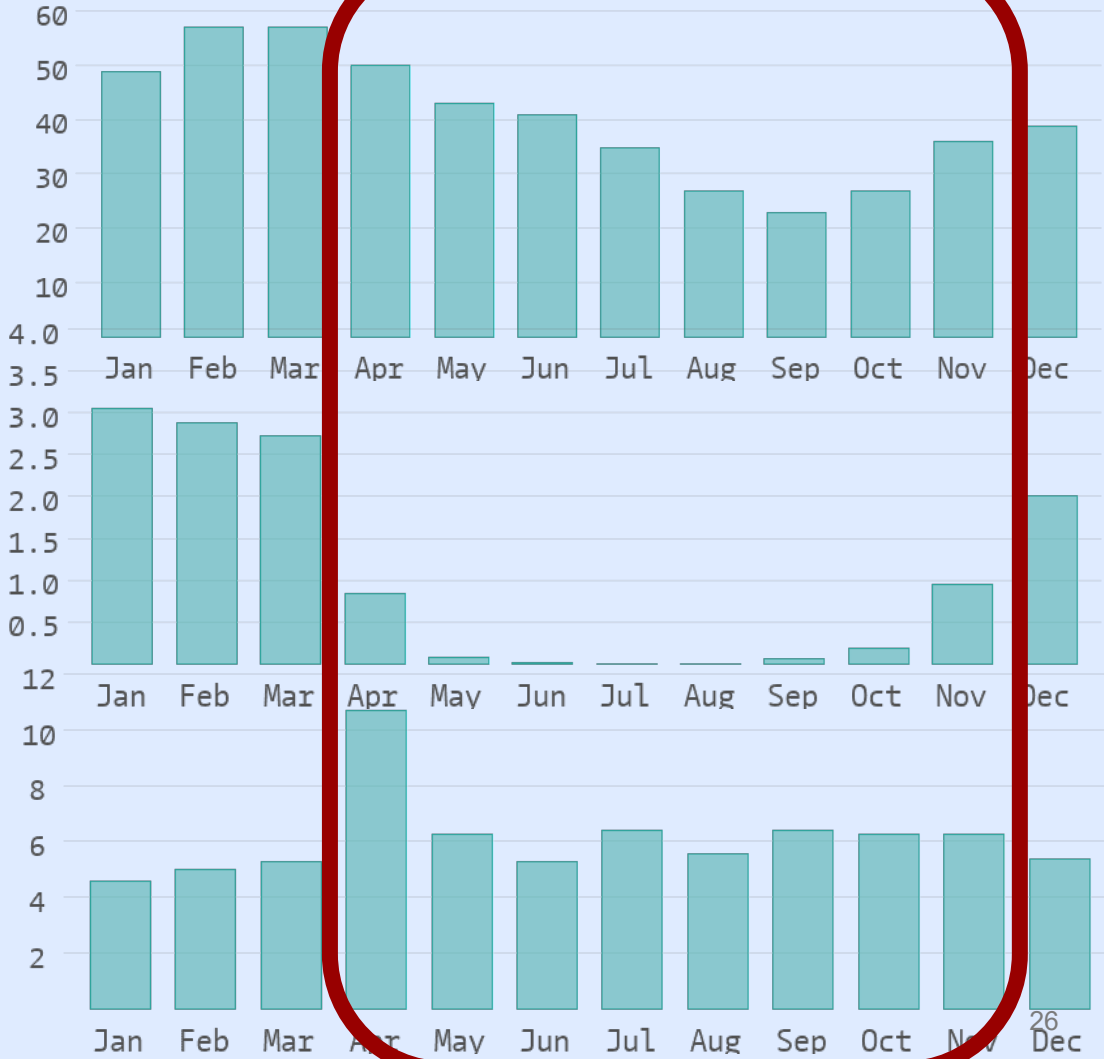
April to November scarce precipitation

Sunhours/day

Enough sun hours all year long

Dynamic seasonable use possible (~2000 l/day/AWG possible)

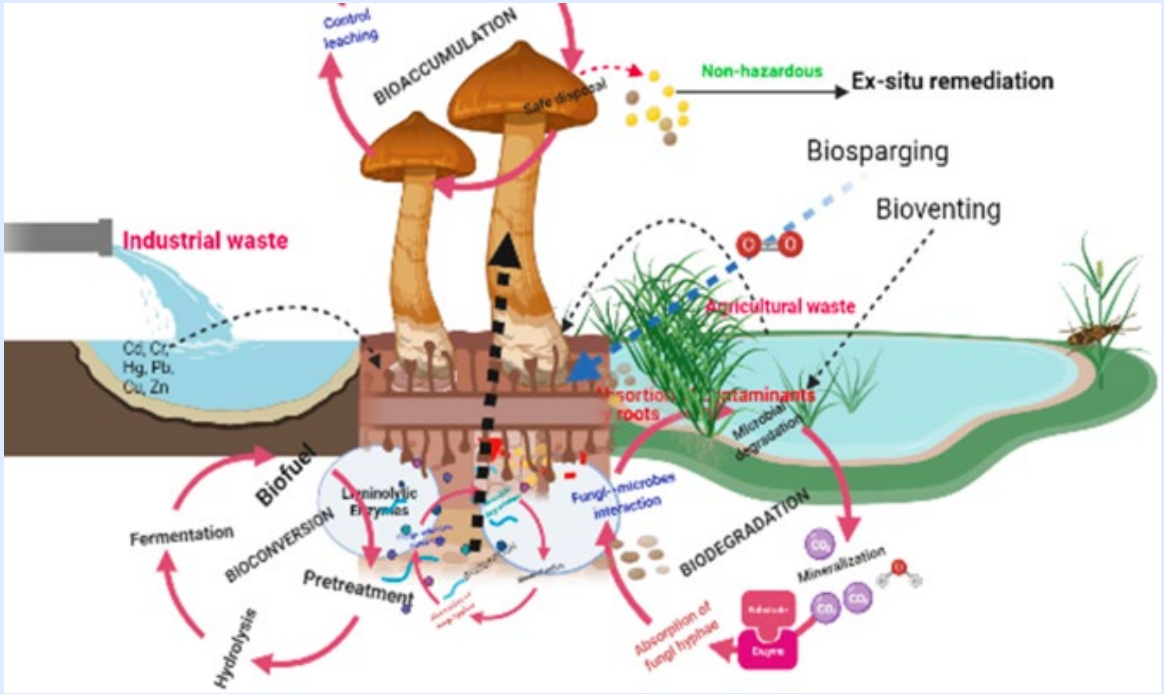
https://www.laenderdaten.info/Afrika/Namibia/Klima.php



Green engineering - Mycofiltration/ mycoremediation

Advantages

- Less expensive
- Less harmful to the environment
- Better than bacteria in degrading complex carbohydrates (starch) & coping with adverse circumstances
- Does not require a secondary treatment



(Gurudatt M. Hegde, Sanghmitra Aditya, Dechen Wangdi & Bimal Kumar Chetri, 2022)

Rough Budget

			Phase 1 (Introducing)	Phase 2 (Implemetating)	Phase 3 (Optimzing)	Total Sum
Catergory	**Number**	**Description**	**€**	**€**	**€**	**€**
Research and Developement		Assessement and stakeholders mapping before introducing new proejcts, further caluclation of water volumetrics lost via evaporation	10000	15000	15000	40000
Communication		Networking, organizing	8000	6000	6000	20000
Manpower		For project managers, local actors, etc.	12000	70000	70000	152000
Hardware		Installation	50000	26000	78000	104000
		Mycoremediation			45000	45000
	P2: 30/ P3: 100	Atmospheric Water Generators (3500 €)		105000	350000	455000
	P2: 30/ P3: 100	Floating Solar Panels (3000 €/ kW/h)		90000	300000	390000
	100	Hydroeletric Turbines (2000 €/kWh)			200000	200000
Maintenance				20000	200000	220000
Data collection and monitoring			10000	10000	10000	30000
Project Managment		Evaluation		9000	12000	21000
			Sub-total			1677000
Project Managment		Contingency (10% of the total budget)	**Grand-total**			1844700

Env., Social, & Economic Consequences - Discussion

- High cost for long term implementation + maintenance
- Concern of longevity once pilot ends → how to establish a lasting pilot?
- Strong environmental impact of dam + hydroelectric
- New sciences and technologies with understudied impacts

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