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Non-potable water reuse in Namibia using modified waste stabilization ponds using different pretreatment technologies (EPoNa)

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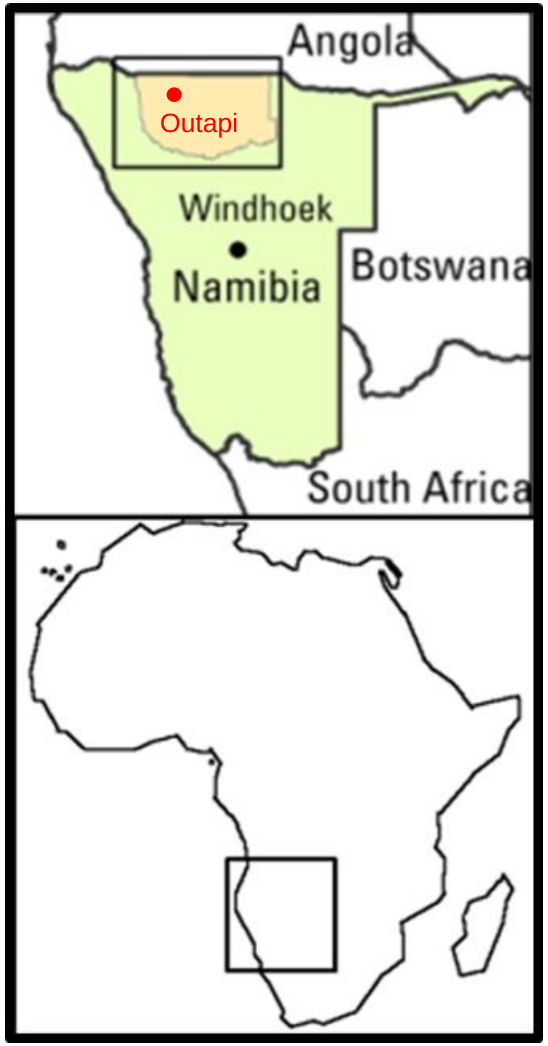
Outapi



(Google Earth 2016 (Version 7.1.8.3036), Price and Hegnauer 2017, modified)

Pond system

- Design in 2004:
  - Constructed for 2,000 – 2,500 inhabitants
  - Two parallel lines with 4 ponds each, 1 facultative and 3 maturation ponds (41,000 m²)
  - Effluent to be evaporated – no discharge into environment
  - First extension by one evaporation pond (41,000 m²)
- Status quo 2016:
  - More than 5,000 people connected (today about 7,000 out of 12,000)
  - Evaporation pond too small – overflow to the Oshana
  - Low efficiency due to overload and missing maintenance (sludge removal)
  - Vandalism (fence and embankment)

Some basic calculations

- Net evaporation in north Namibia: 2,000 mm/year; → **2 m³/(m² * y) pond area**
- **Rule of the thump: 20 m² / person connected for evaporation**

Example Outapi:

Total Pond area = 81,000 m² → **444 m³/d mean evaporation**

But: daily inflow **600 – 1,000 m³** wastewater (dry weather)
(up to 2,000 m³ during rainy season)

→ **160 – 560 m³/d** are overflowing in Oshanas

- Health risk for humans and animals
- Flood water contamination during rainy season

Solutions ?

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- Two solutions without discharging in environment:
  - larger ponds → water is lost by evaporation
  - **water reuse for irrigation** → water generates business opportunities
- **Water reuse requires improved quality of treated water**
- **Steps for improvement**

1. Desludging of existing ponds to gain treatment volume
2. Pre-treatment to remove solids
3. Optimizing flow in ponds
4. Filtration of effluent

1. Sludge removal from ponds

first step: Dewatering for solar drying

1. Sludge removal from ponds

second step: removal of dried sludge

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2. Pretreatment for solids removal –
two options investigated

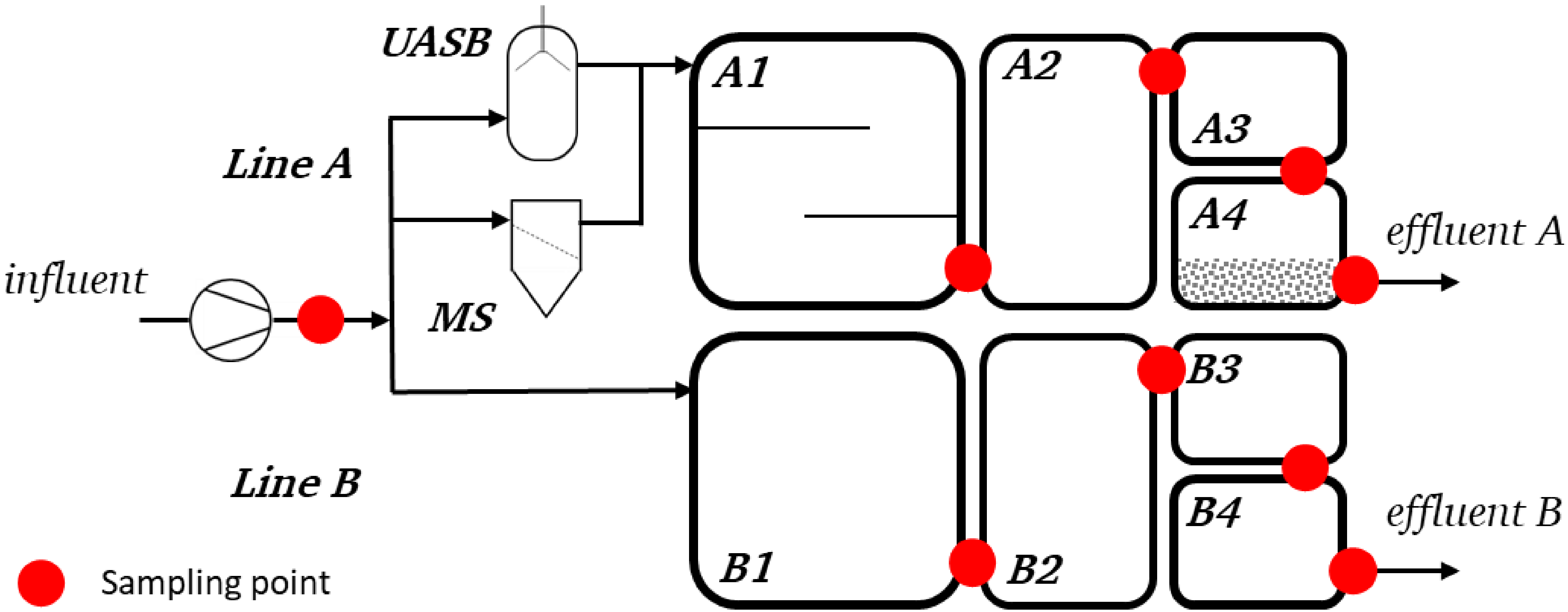
- **UASB**
  solid removal by sedimentation and digestion

- **Microscreen (MS)**
  solid removal by screens (250 µm)

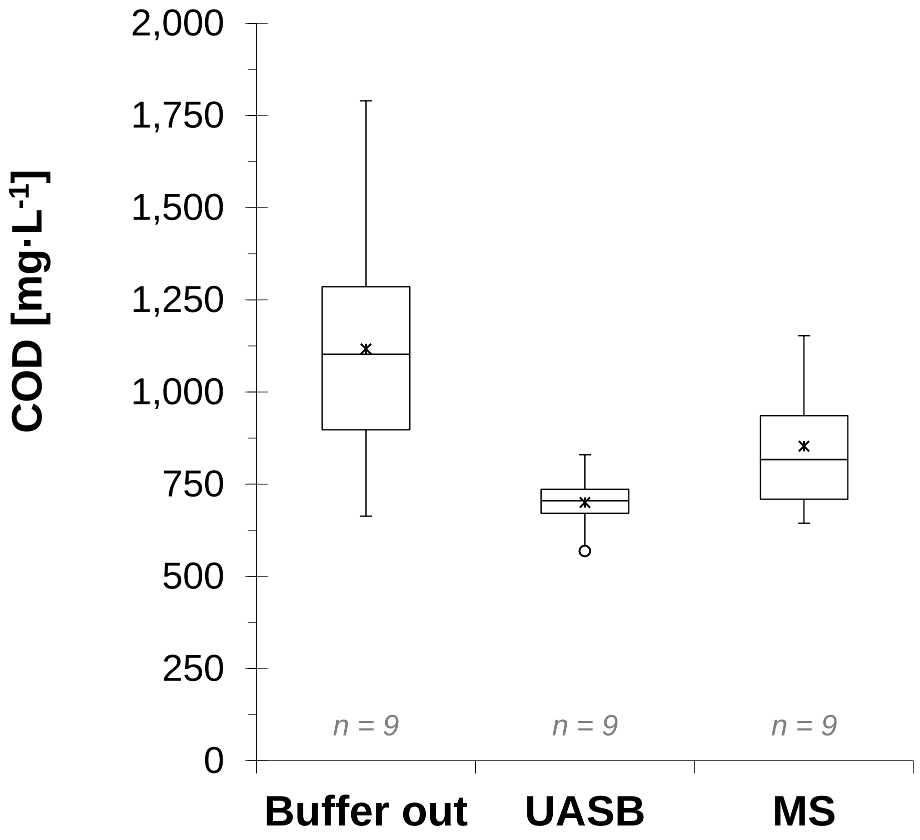
3. Flow optimization

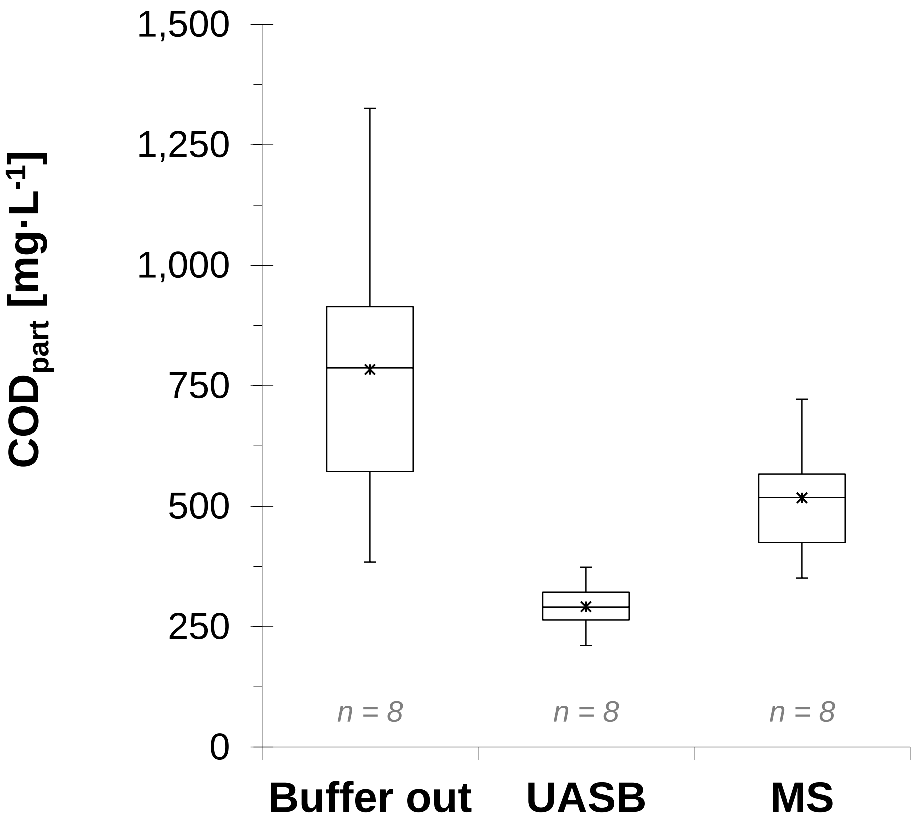
4. Effluent filtration – algae removal

Layout of the enhanced pond



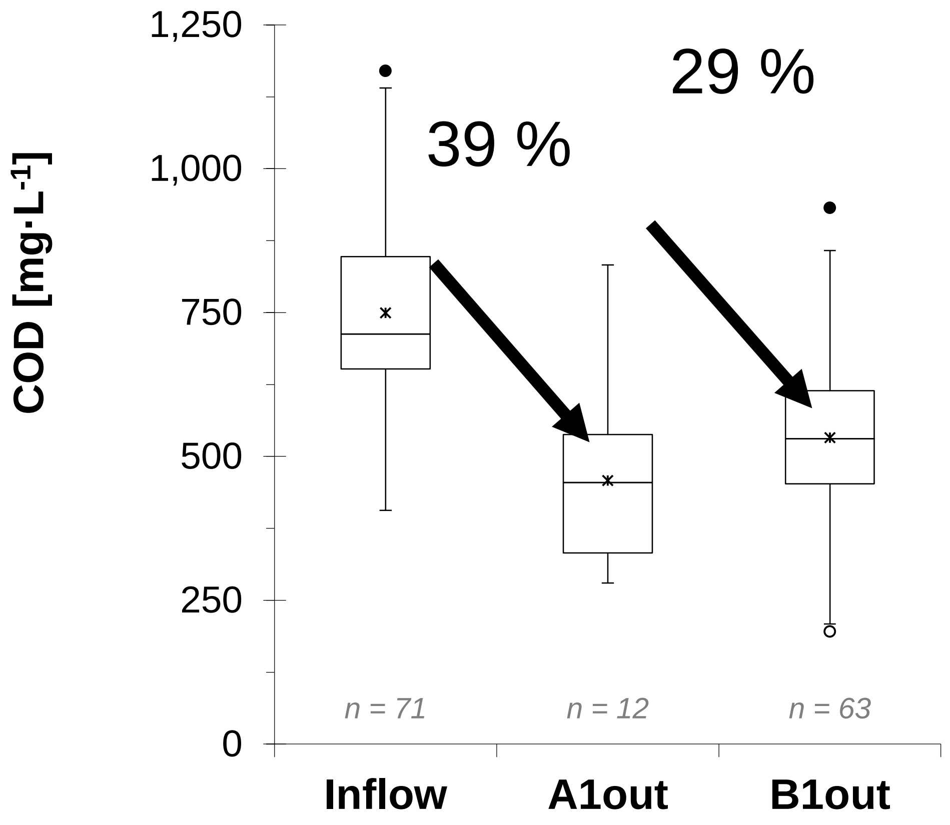
1. Comparison: UASB – Micro-screen
COD total and particular in mg/l





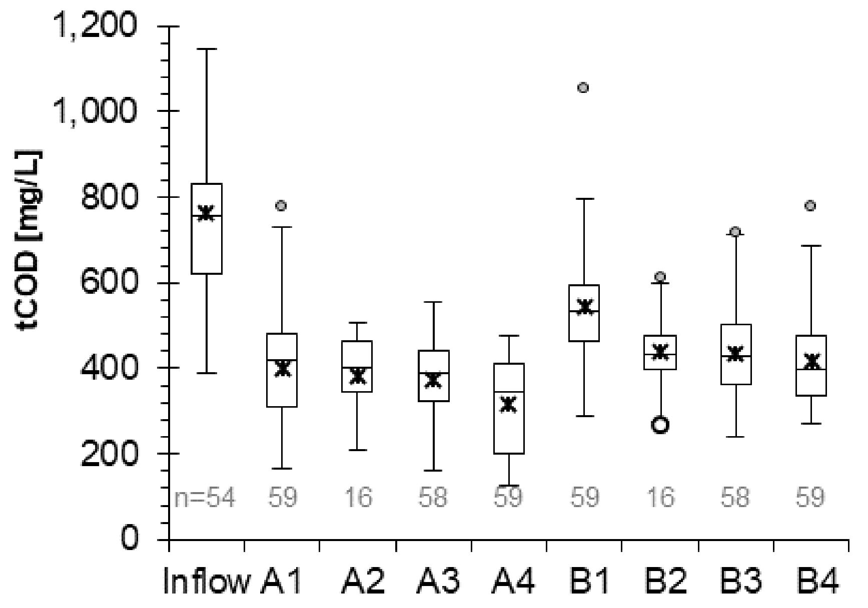
Sinn, J. and Lackner, S. 2020. Enhancement of overloaded waste stabilization ponds using different pretreatment technologies: a comparative study from Namibia. Journal of Water Reuse and Desalination 10(4), 500–512.

Comparison: Lines A and B – facultative ponds



Sinn, J. and Lackner, S. 2020. Enhancement of overloaded waste stabilization ponds using different pretreatment technologies: a comparative study from Namibia. Journal of Water Reuse and Desalination 10(4), 500–512.

Comparison: Line A and Line B: total COD

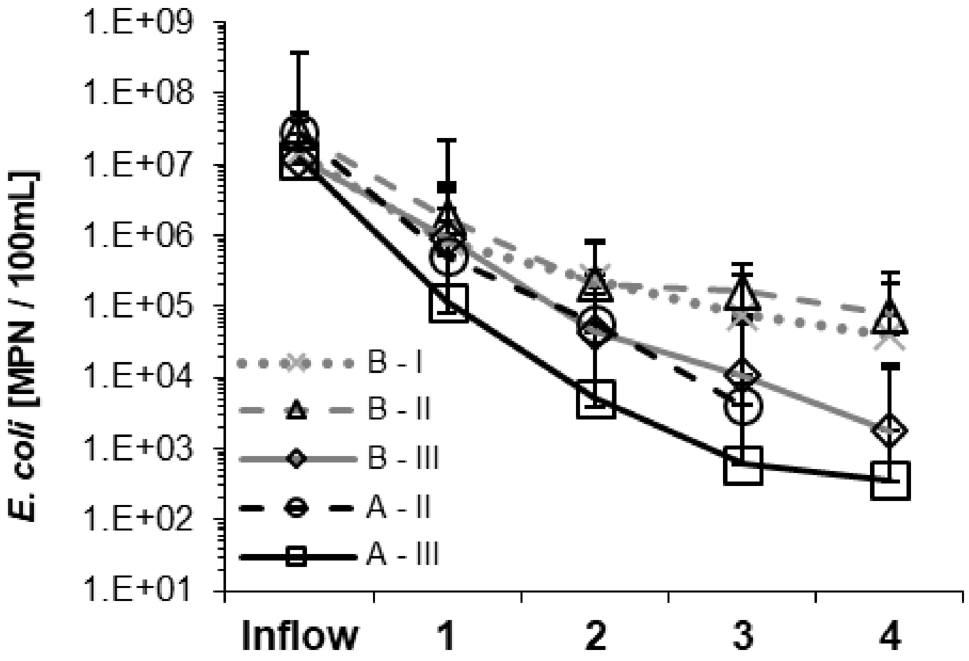


biggest reduction from inflow to outflow A1 / B1

only slight changes in tCOD concentrations form A1 to A4

less reduction of the tCOD in Line B compared to Line A

Comparison: Line A and Line B: Pathogens



Phase	Operation	Starting day
I	Total inflow in Line B – no PreT and PostT	1
II	Total inflow in Line B – only PreT	676
III	Inflow shared between Line A and B (PreT and PostT)	1012

Irrigation Site – Approach

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Test fields

Wastewater Treatment Plant Partnership in Northern Namibia

- 13 municipalities from Northern Namibia and 5 Regional Councils participate in the partnership
- Core towns: Outapi, Okahao, Oshikuku

Advantages of the wastewater partnership:

- Exchange of knowledge, experiences (e.g. improved pond management) and information
- Identification of options for sharing financial, personal or technical resources
- Better communication between regional councils and local authorities
- Creating a stronger bargaining power vis-à-vis negotiation partners, e.g. consultants, suppliers, authorities, international organisations

Conclusions

- Pre-treatment reduces CODpart and TSS, the UASB furthermore dissolved COD, pathogens and nutrients
- Effluent quality of upgraded line is significantly better
- Reuse of water and nutrients for irrigation of fodder plants is possible
- Further improvement needed, depending on application and regulations
- Farrow-, drip- and drain-irrigation tested (farrow cheapest, drain best yield)
- Sorghum and Alfalfa compared (better yield with Sorghum)
- Wastewater Treatment Plant Partnership to connect the local operators

More information about EPoNa

- www.epona-africa.com
- www.zdf.de/wissen/nano/
  190829-sendung-102.html
  (von Minute 3:37 bis 10:40)

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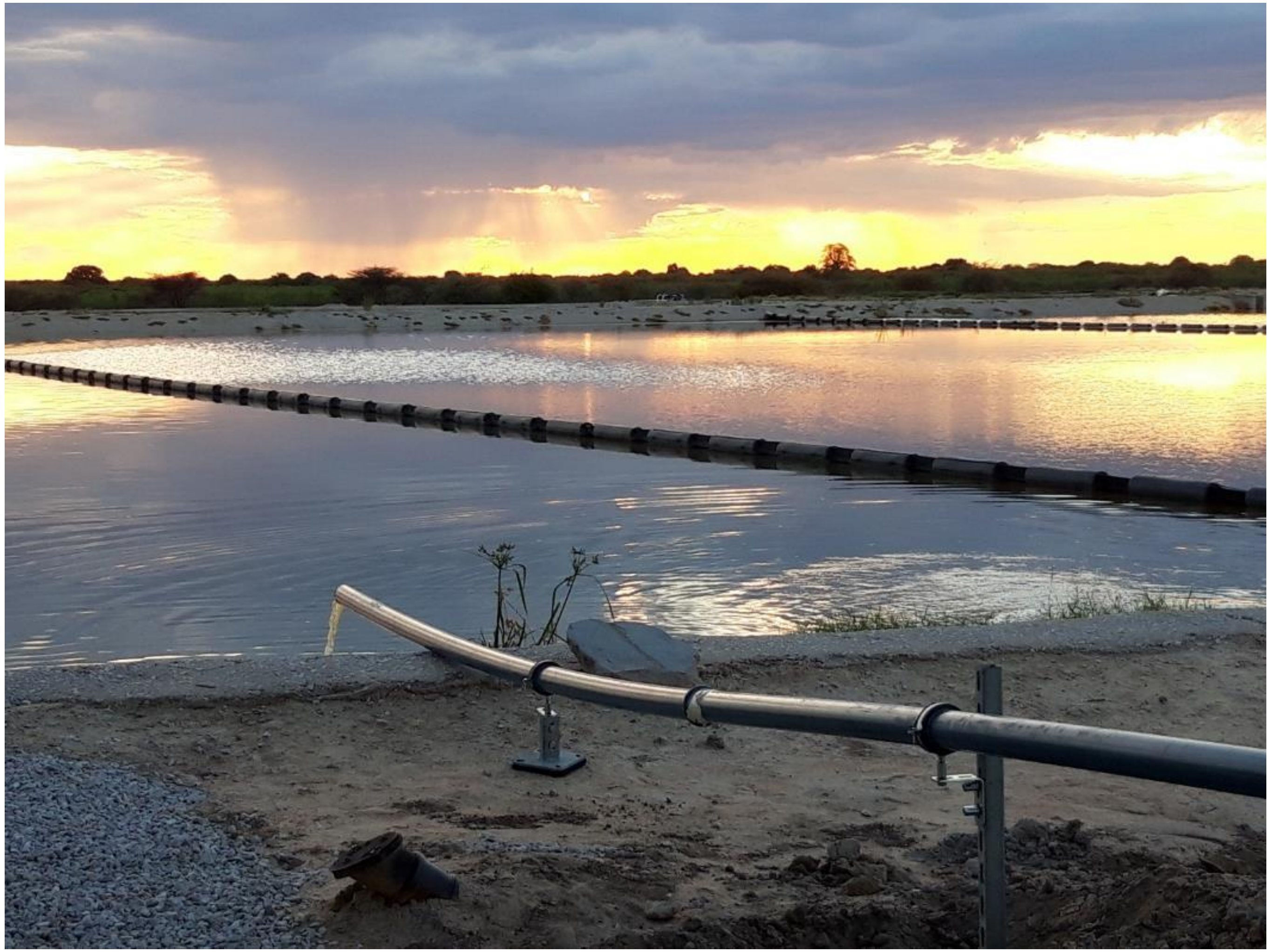

References

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Price, P. and Hegnauer, O. 2017: Staatswappen Afrika, Umriss/Länder. http://www.swissfot.ch/htm_public_d/wappen/world/Af/Africa_Umriss_Laender.htm, (accessed 9 July 2017)

Sinn, J. and Lackner, S. (2020) Enhancement of overloaded waste stabilization ponds using different pretreatment technologies – a comparative study from Namibia; Journal of Water Reuse and Desalination JWRD 10(4), 500–512.

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