
Pure. Simple. Solid.
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Nachhaltige Trink- und Abwasseraufbereitungslösung für Entwicklungsregionen und Entwicklung von Geschäftsmodellen

January 2023

Dr.-Ing. Philipp Otter, AUTARCON GmbH

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Philipp Otter, Dr.-Ing. Environmental Engineering

- Shareholder and Project Coordinator of AUTARCON GmbH
- Expert in adapted water technologies for rural regions
- Locally sustainable business generation
- Currently working in India, Nepal, Tanzania and Vietnam (rural !!)
- PhD TU Dresden

AUTARCON GmbH

- Founded 2010 as for-profit spin-off of Kassel University
- AUTARKIC – self sufficient drinking water treatment (10 – 250 m^3/d)
- Active in 12 countries worldwide with 60 installations in operation
- 10 years experience in on-site problem solving
- Winner of: SIEMENS Foundation empowering people Award 2019, and IWU - Award for Innovation in Climate and Environment 2013

Philipp Otter and AUTARCON GmbH

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Our target regions: Rural developing regions

- Example unimproved water source

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waterkiosk

Foto: by Georg Schaumberger

Water supply situation in rural developing areas

- Example improved water source (MDGs 2015)
- Water distribution in unsecured containers

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Foto: by Calvin Ndumwa

How good are improved water sources?

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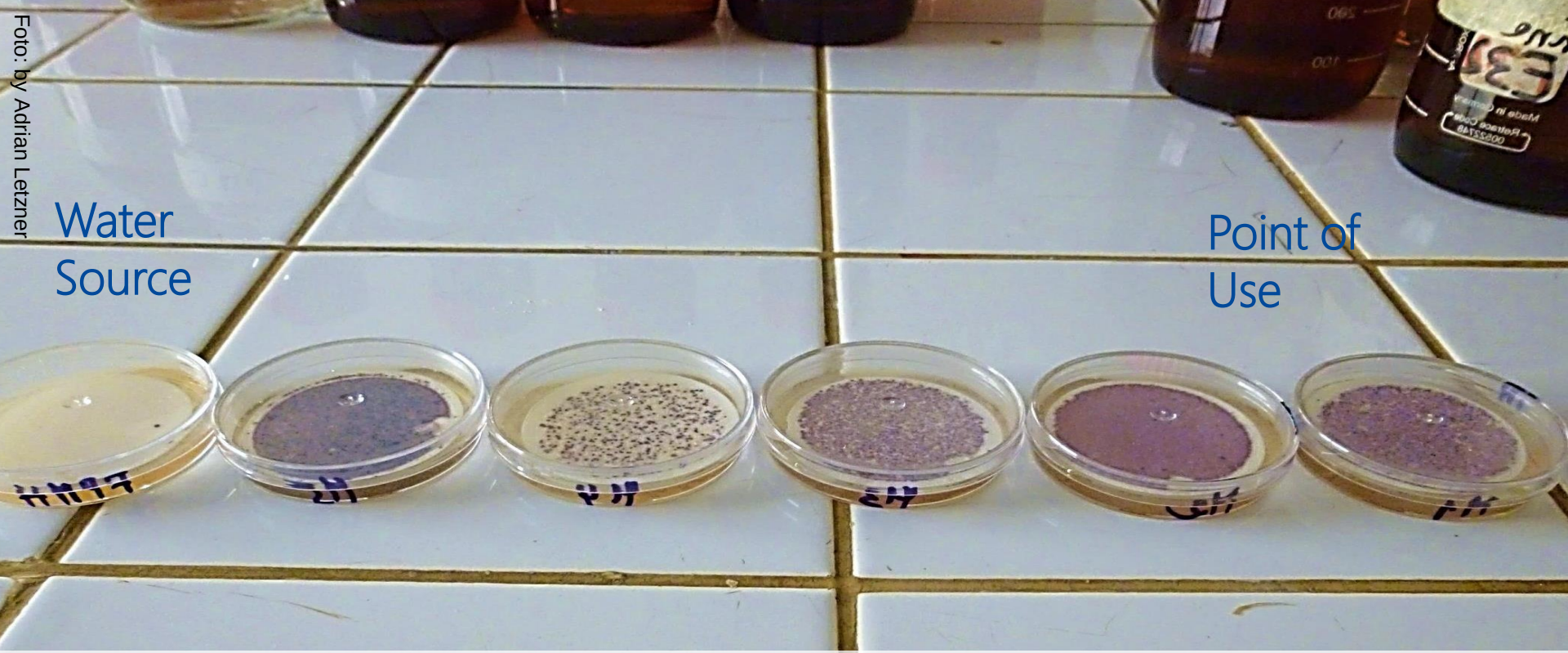

Foto: by Adrian Letzner

Water distribution in unsecured containers

- Recontamination after source / treatment
- UV, membranes, boiling, etc. are not sufficient !

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“Pathogen removal is of most important concern to assure safe drinking water conditions”

WHO 2017

Legal Limits	**0**	CFU/100 ml	E.Coli
	0	CFU/100 ml	Thermotol. coliform

Is a removal of 99.9 % for pathogens good?

Minimal infection dose			Colonies [CFU/100 ml]	Reduction [%]	Reduction [Log]	Technologies
			1.000.000	0%	0,0	
			500.000	50%	0,3	
			100.000	90%	1,0	Sandfilter
			50.000	95%	1,3	
			10.000	99%	2,0	Micro Filtration
Cholera	Thypus		1.000	99,9%	3,0	SoDis
E. coli O157:H7		Norovirus, Giardia	100	99,99%	4,0	UF/UV/Chlorination
Cryptosporidia		Lamblia, Shigella	10	99,999%	5,0	
			1	99,9999%	6,0	RO / Memdis
			0	99,99999%	~7,0	Boiling

Residual disinfectant requirements

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Parameter	WHO	Vietnam	Budapest	Malaysia	India	Tanzania
Residual Chlorine [mg/L]	≥ 0.5	min. 0.3 - 0.5	Inlet network 0.3!!!	≥ 1.0	0.2…1.0	0.2-0.4

Challenges of disinfection in rural areas

- Availability
- Transport
- Correct dosing

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Challenges of disinfection in rural areas

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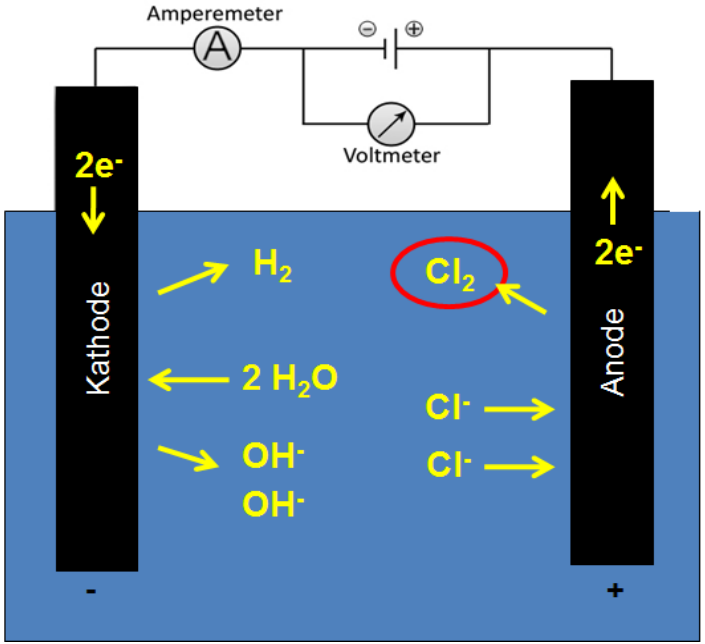

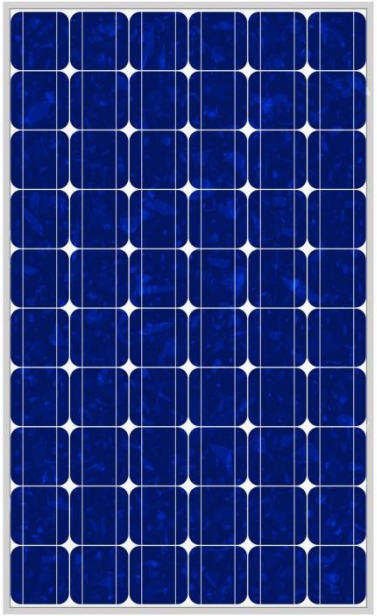

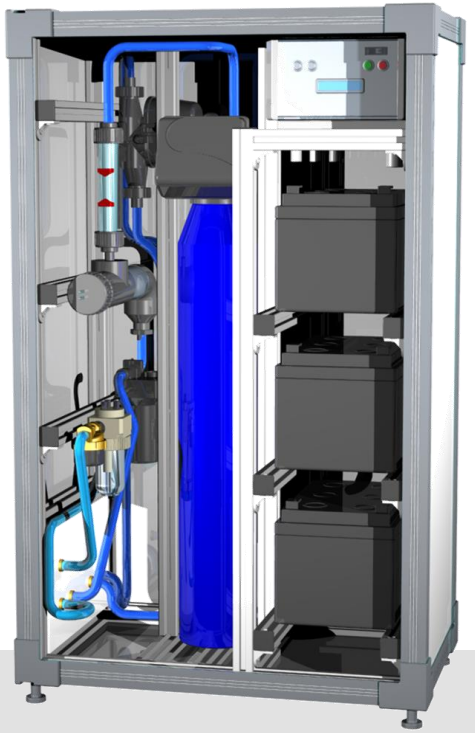

SuMeWa|SYSTEM

- Chemical free water treatment
- $Cl_2 + 2\ H_2O \leftrightarrow HOCl + H_3O^+ + Cl^-$

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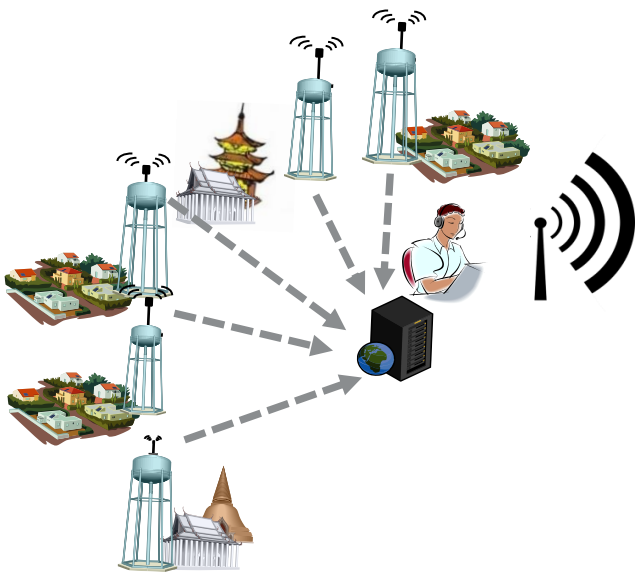

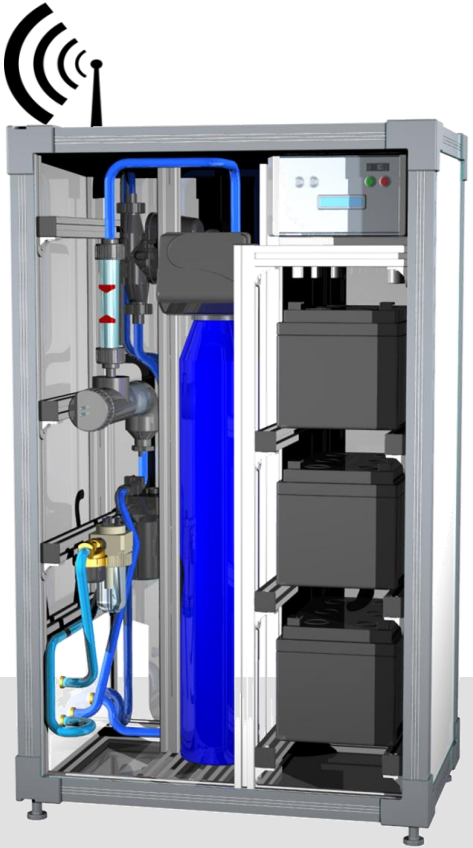

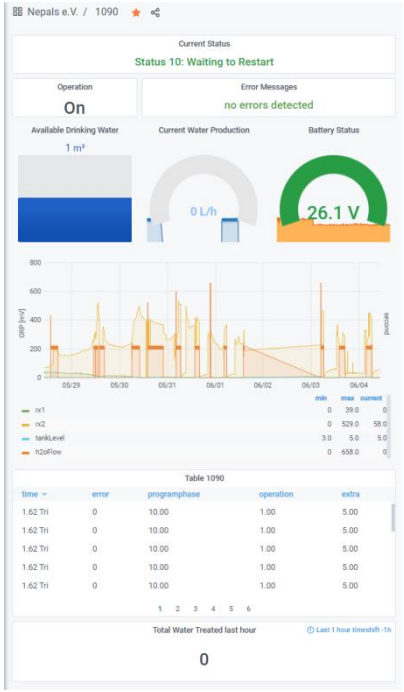

Online Data Monitoring

- System Performance
- Quality and quantity of water treated
- Very cost efficient
- Online, SIM Card management!!

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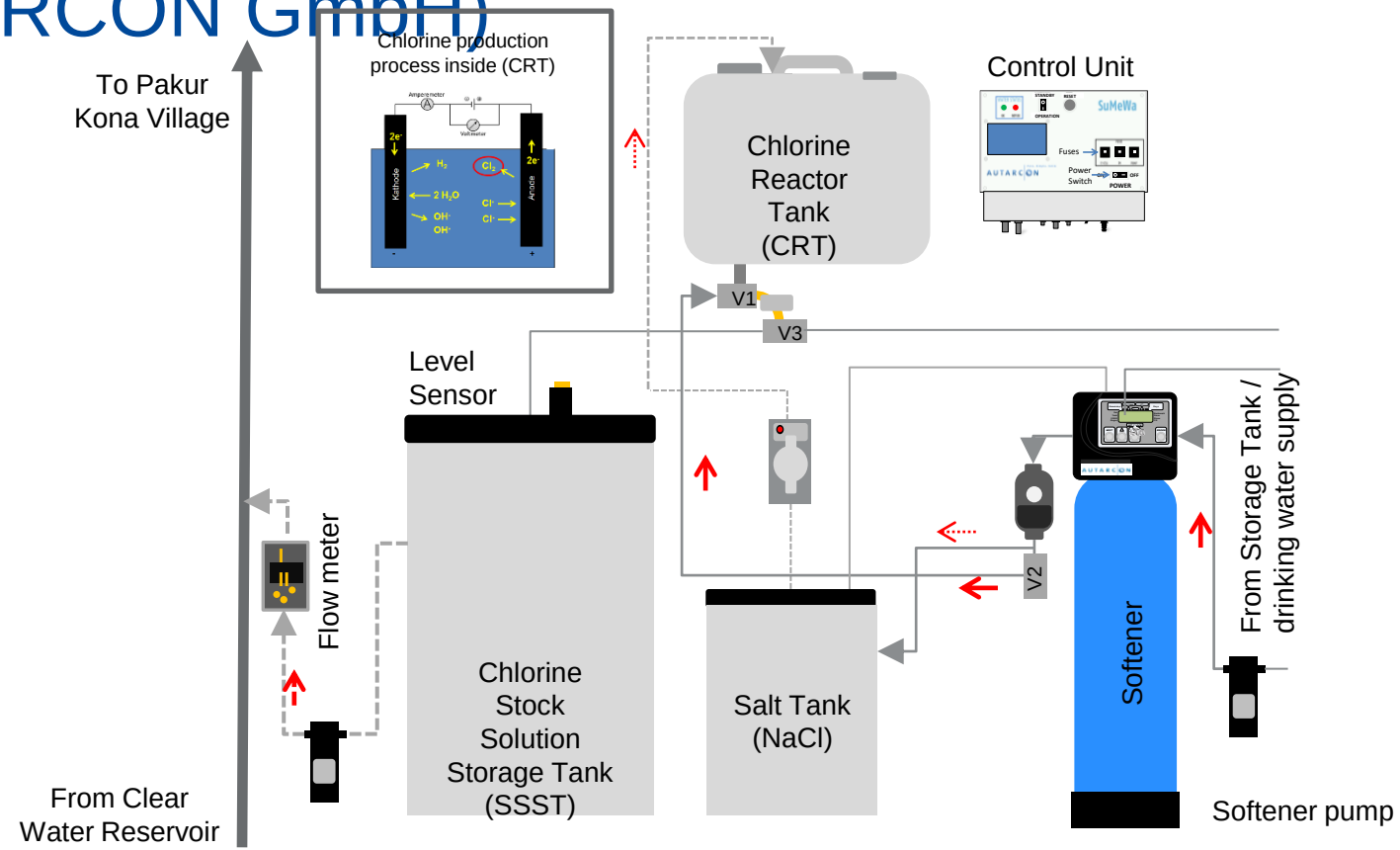
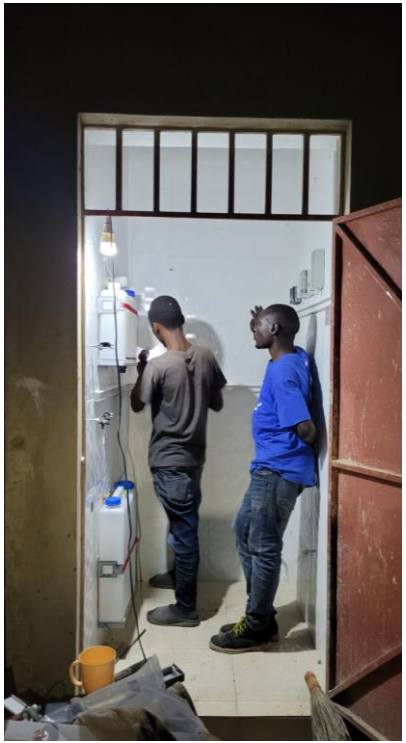
Pakur Kona Onsite Chlorine Generation Setting (by AUTARCON GmbH)



SuMeWA disinfection System



SuMeWa|SYSTEM

- 60 stations in operation
- 10 countries worldwide

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SuMeWa|SYSTEM in Egypt

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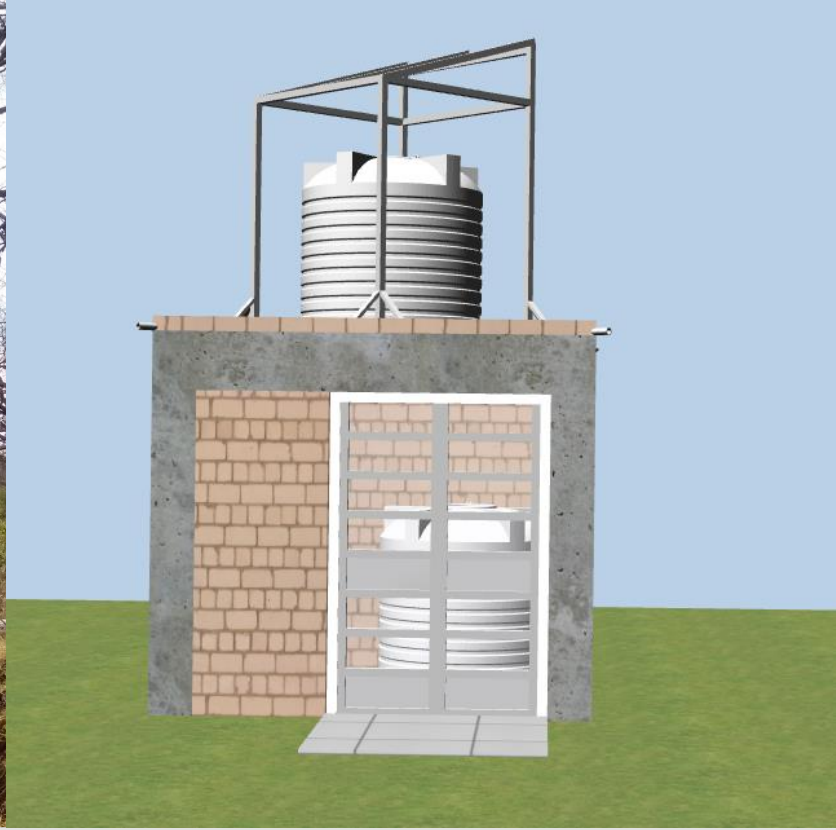

SuMeWa|SYSTEM

- Containerized vs. local made housing

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SuMeWa|SYSTEM

- Containerized vs. Local made housing
- AUTARCON is opposing containerized soluations

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SuMeWa|SYSTEM

- Locally made housing

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SuMeWa|SYSTEM

- Locally made housing

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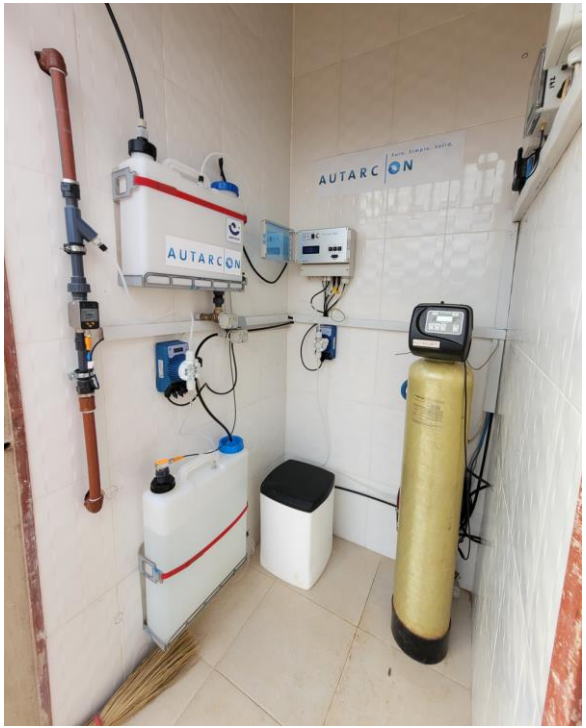

Ruvu Remit 20 m³/d

Pump operator Pakor Kuna Assam 60m³/d

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SuMeWa|SYSTEM in Egypt

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Why is the room so big?

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Purchased

Delivered

- Sourcing local components

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Source water condition – dry season

Example Tanzania

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Source water condition – rainy season

Example Tanzania

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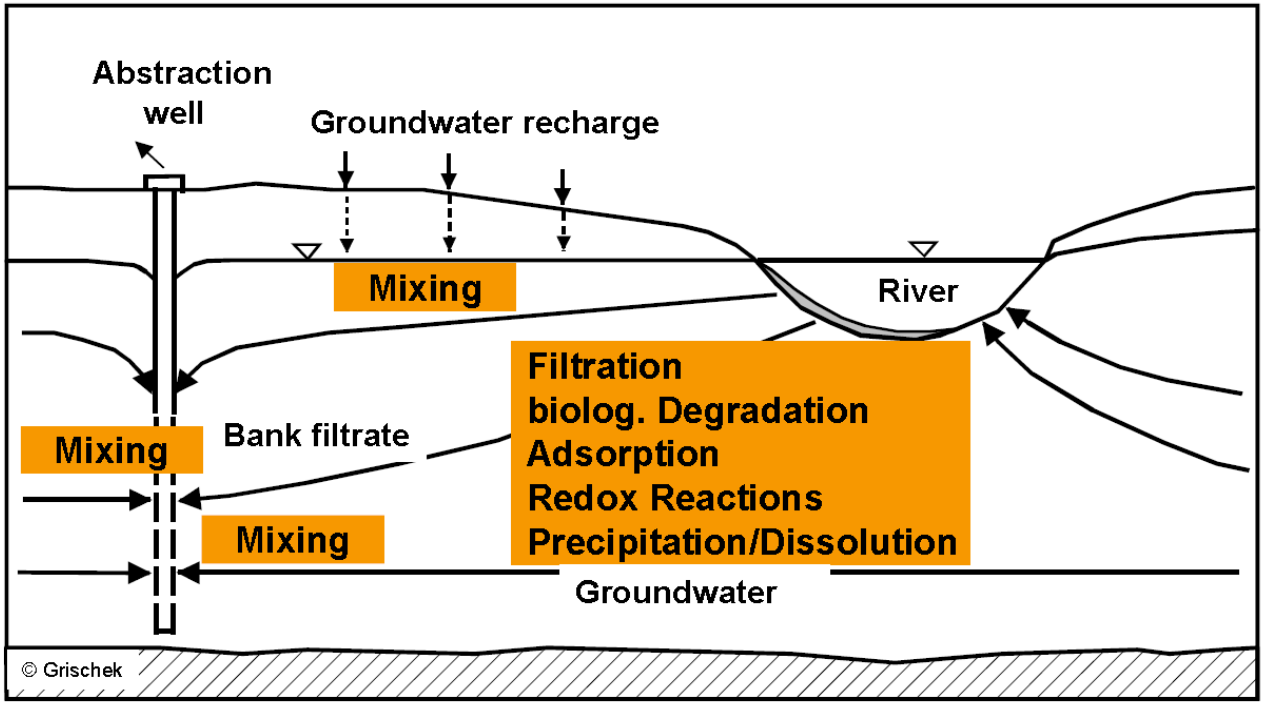

Riverbank Filtration (RBF)

- Natural pre-treatment
- Perfectly suited for SuMeWa|SYSTEM

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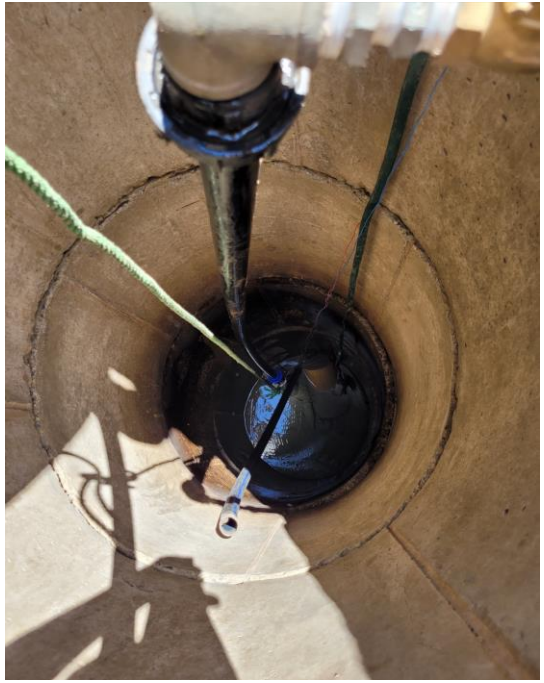

Riverbank Filtration (RBF)

- Natural pre-treatment
- Perfectly suited for SuMeWa|SYSTEM

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Ruvu Remit – Brunnenbau Uferfiltration

Foto: Julian Nitzsche, CC-BY-SA 3.0

Riverbank Filtration (RBF) System

Haridwar India

AquaNES

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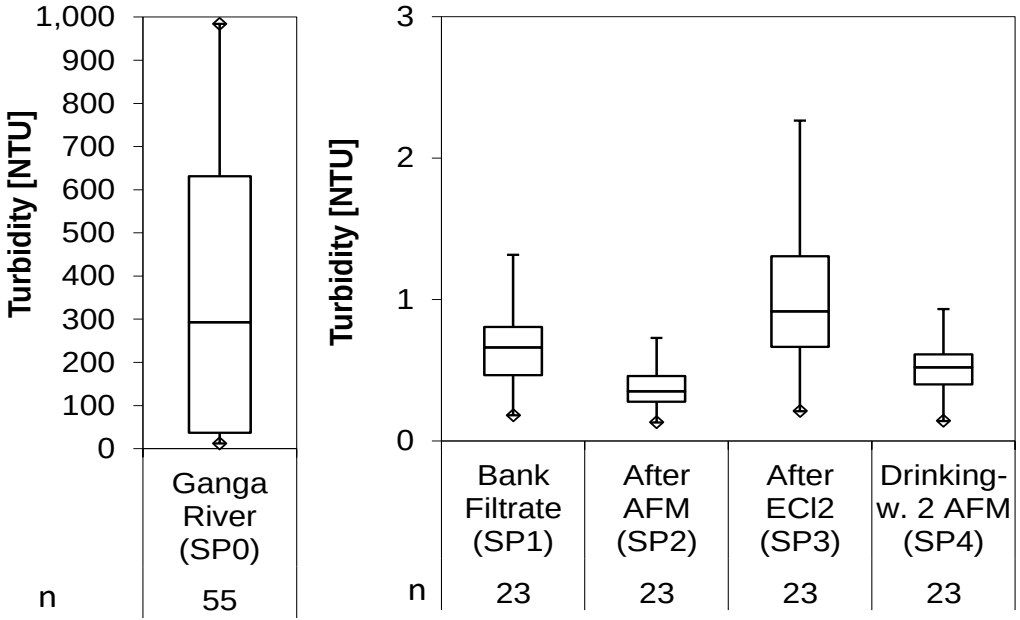
AquaNES Pilot Station in Haridwar

- Drinking water disinfection of riverbank filtrate
- 20.000 L/h safe drinking water supply

AquaNES

AUTARC ON



Turbidity removal

- RBF reduced turbidity from 293±272 to 0.6±1.6 NTU

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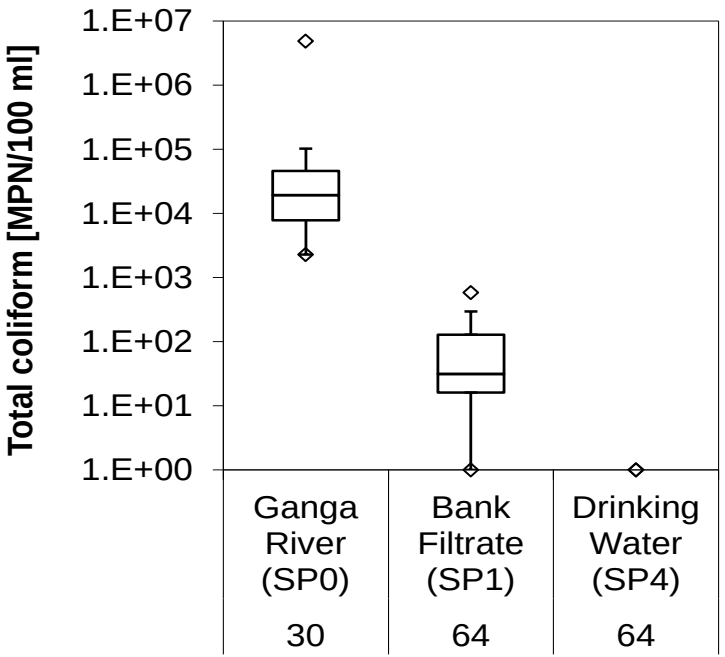

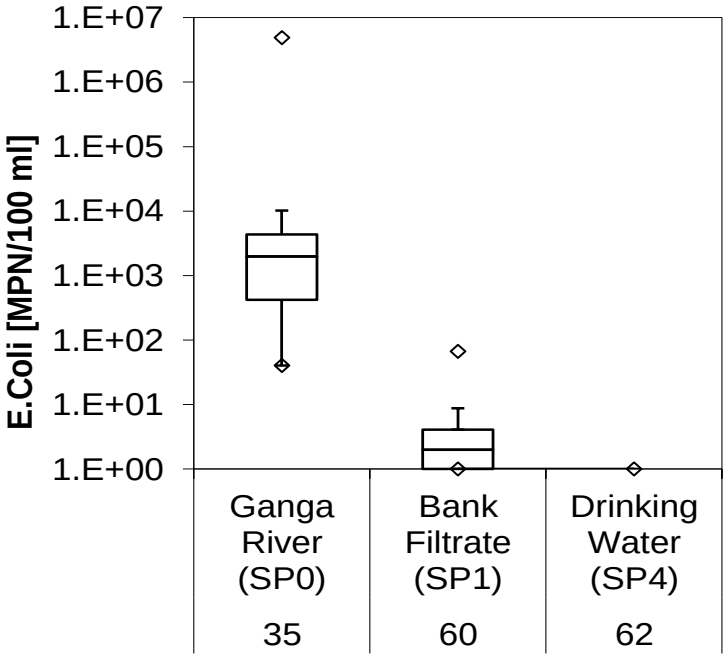

Disinfection Capacity

- Assurance of full disinfection
- RBF 3.9 log units, ECl2 > 2.8 log units (total > 6.7 log units)

AquaNES
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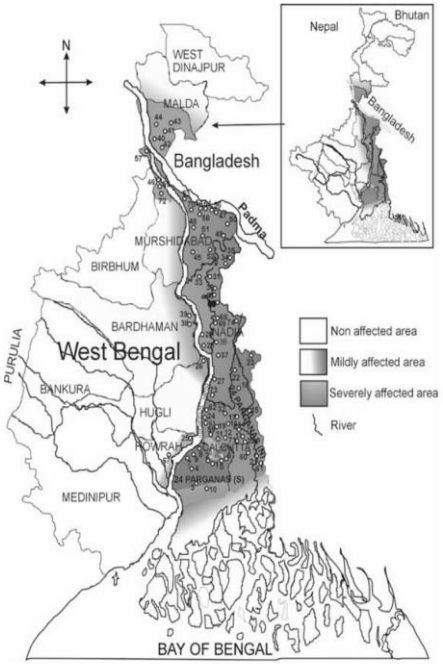

From Chakraborti *et al.* (2002)

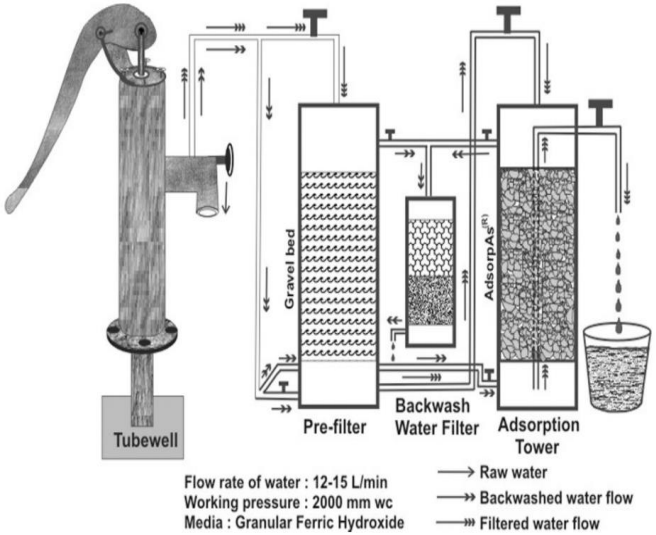

Fig. 1. Schematic diagram of a typical arsenic removal plant widely used in West Bengal, India.

Arsenic water contamination – Largest Mass Poisoning

- Study in West Bengal evaluated 570 Arsenic removal plants
- 475 not useful, 145 not in working conditions

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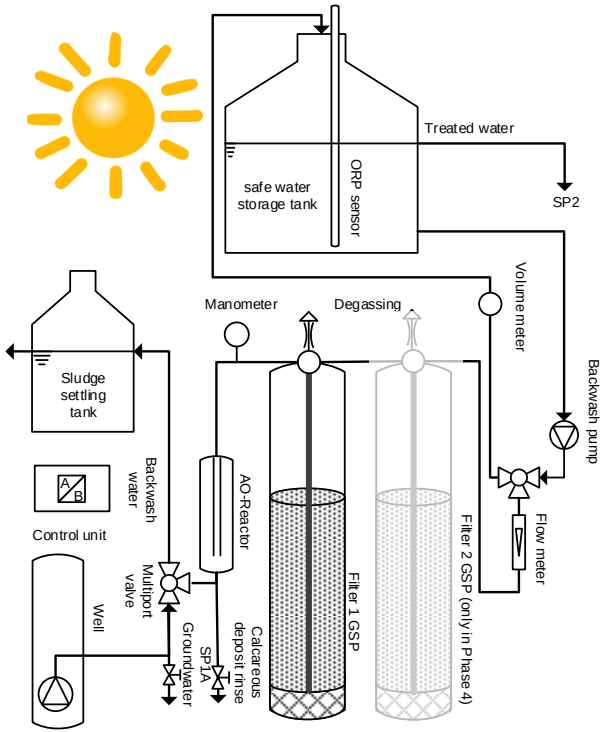

SolArEx Pilot System in West Bengal

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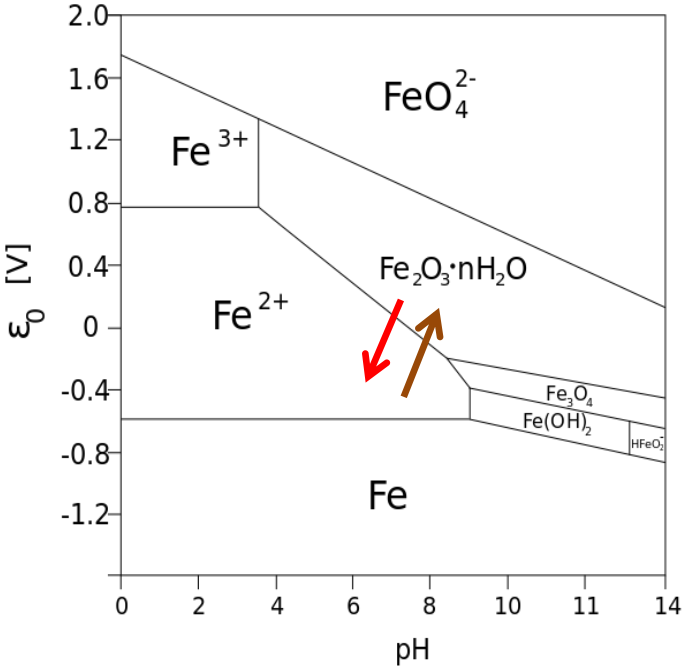

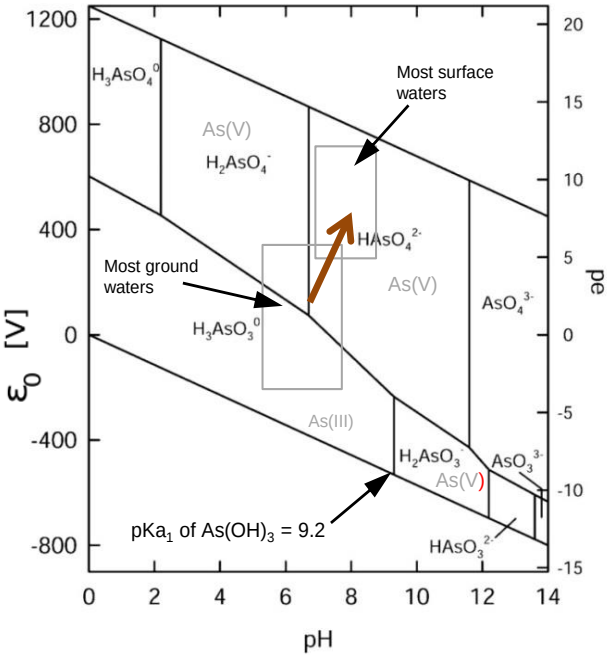

SolArEx - Approach:

In-situ iron sludge production and arsenic oxidation for enhanced co-precipitation

$$2\ Fe^{2+} + O_2 + 6\ H_2O \rightarrow FeO(OH)\downarrow + 8\ H^+$$

$$2\ Fe^{2+} + HOCl + 3\ H_2O \rightarrow FeO(OH)\downarrow + Cl^- + 5\ H^+$$

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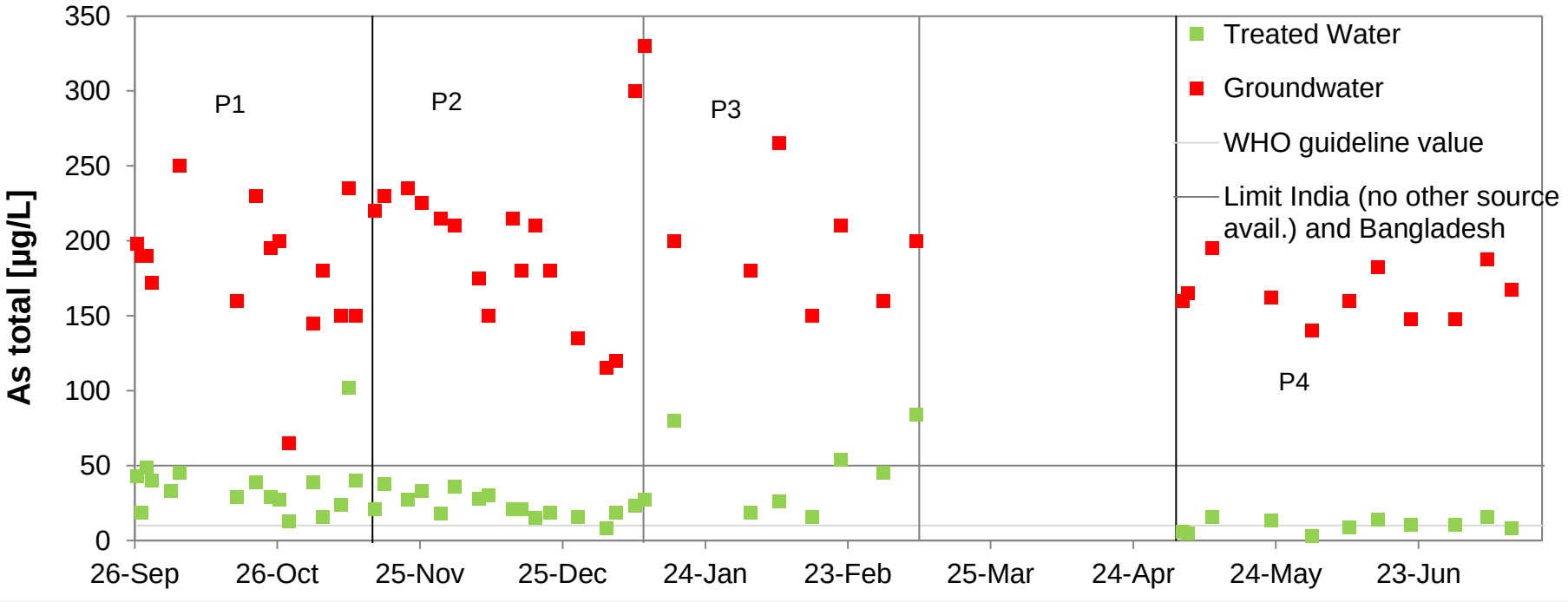

Achieved arsenic removal rates

- Reduction during P4 from 165 ± 17 µg/L to 10 ± 4 µg/L (~ 94%)
- Increased current density improves arsenic removal
- Potential for improvement

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Wastewater disinfection

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Solar driven mobile disinfection of treated wastewater (April 2018)

- Pilot size: 200 L/h
- Power Demand: ~ 50 W covered by solar PV

INCOVER
Innovative Eco-Technologies for Resource Recovery from Wastewater

Wetland in full operation

June 2018

INCOVER
Innovative Eco-Technologies for Resource Recovery from Wastewater

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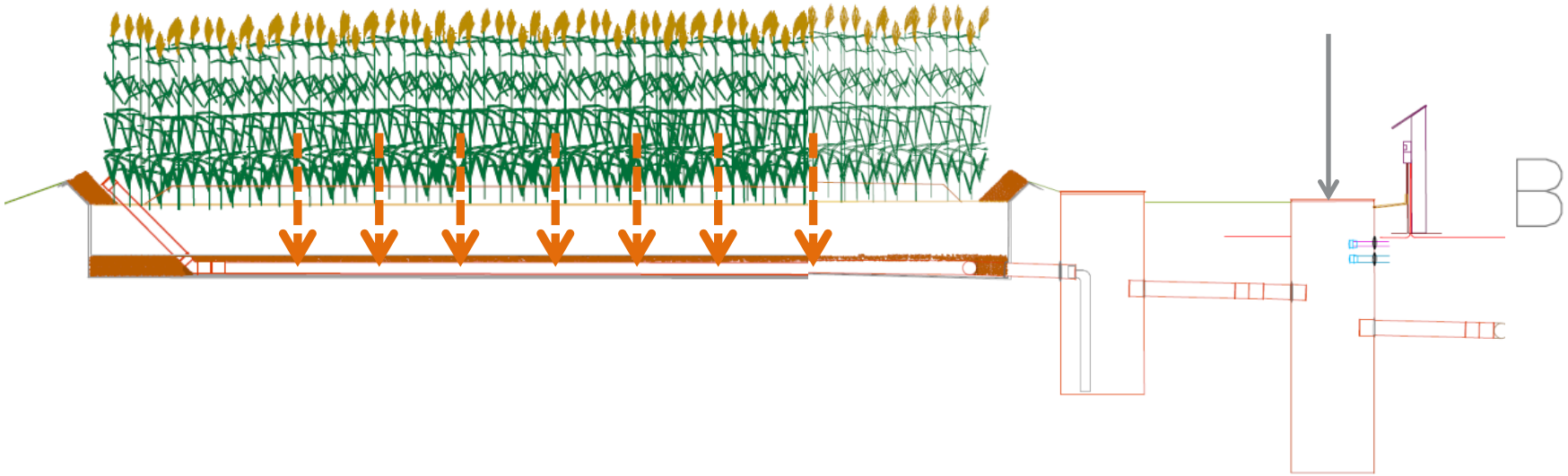

Treatment prior disinfection

- Vertical Flow Constructed Wetland (VFCW)
- 50 m² for 5.000 L/d, 6x per day pulse loaded

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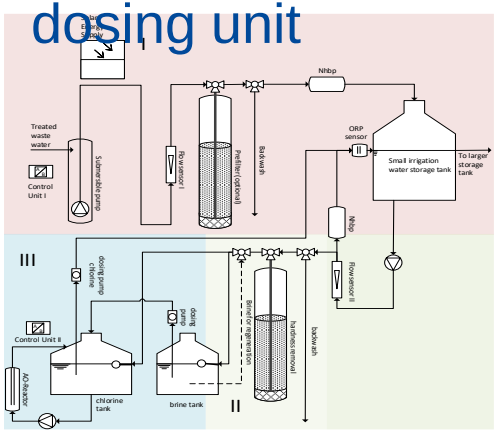
Innovative Eco-Technologies for Resource Recovery from Wastewater

1. Filtration Unit
2. Dehardening Unit
3. Chlorine production and dosing unit



INCOVER pilot station

- Pilot capacity of up to 5.000 L/d
- Follow up project 50.000 L/d

INCOVER
Innovative Eco-Technologies for Resource Recovery from Wastewater

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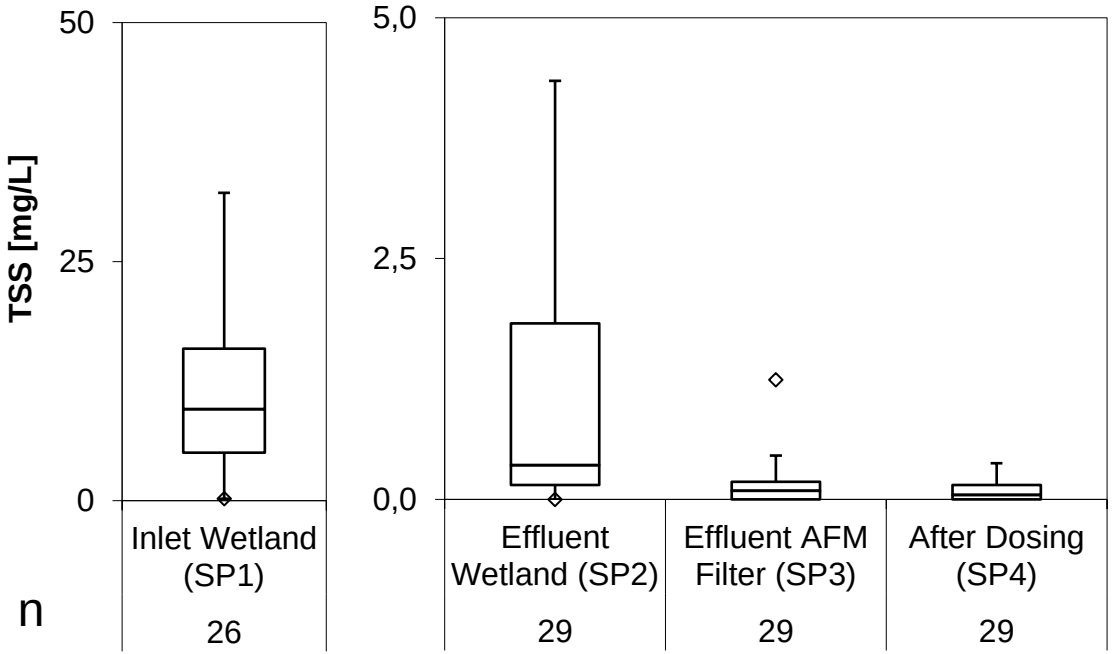
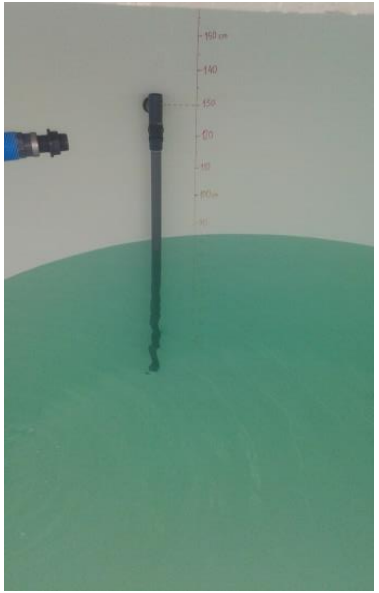




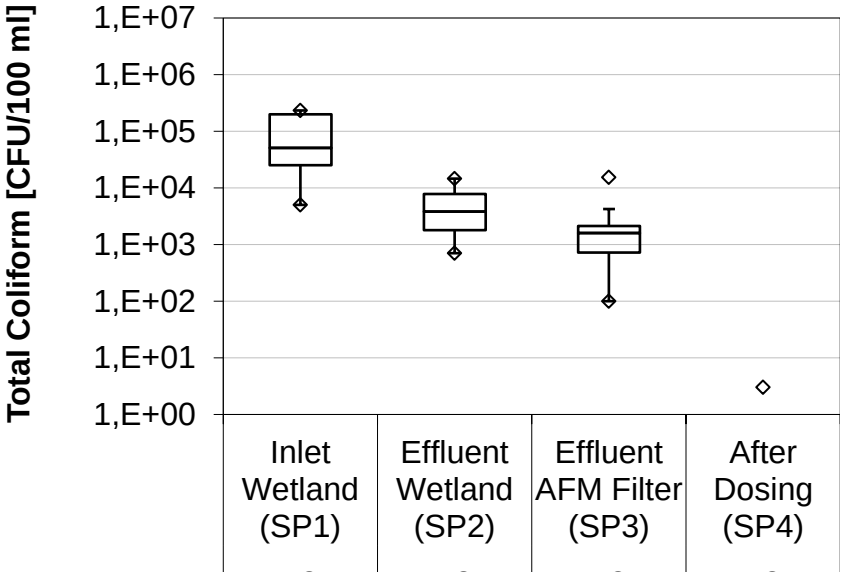
Total Suspended Solids (TSS)

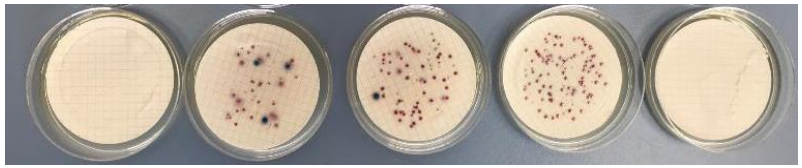
Reduction of 99,5%

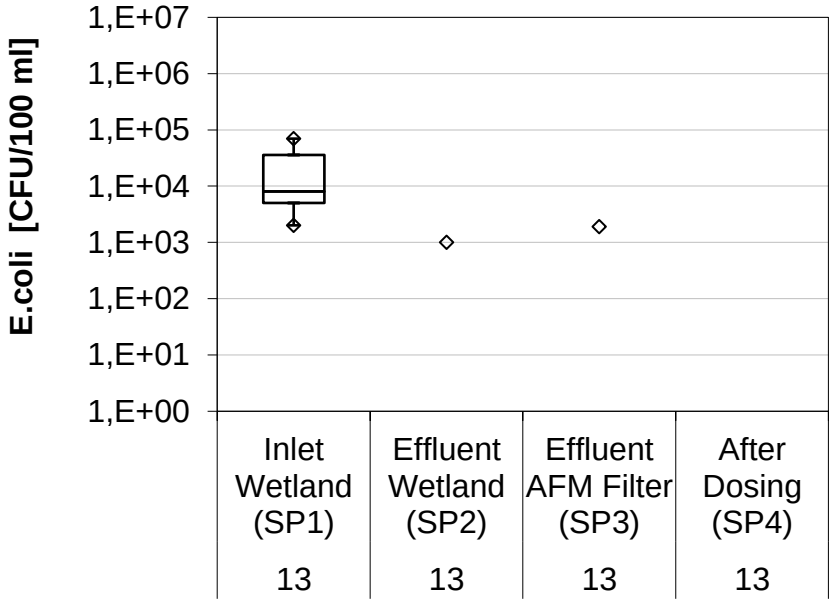
Wastewater treatment for reuse applications

- Incover project in Spain

INCOVER
Innovative Eco-Technologies for Resource Recovery from Wastewater
AUTARCON







Disinfection capacity of pilot plant

Country	Reuse	Pathogens (cfu/100ml)	BOD5 (mg/L)	TSS (mg/L)	Turbidity [NTU]	FAC [mg/L]
Greece	1. a) Urban uses: cemeteries, golf courses, public parks, freeway embankments, recreational facilities, fire protection, street cleaning and decorative fountains. b) Recharge aquifers by wells: not allowed for potable use c) Periurban green: including groves and forests	TC ≤2	≤ 10	≤ 2	≤2	
		TC ≤ 20				
Spain	Urban Reuse, Residential Garden, Sanitary applications	E.Coli = 0		≤10	≤2	
USA	IPR (Indirect Potable Reuse)	FC = 0	≤ 10	≤ 2	≤2	1
	Unrestricted Urban reuse	FC = 0	≤ 10	--	≤2	1

Wastewater reuse

Applications beyond irrigation

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Innovative Eco-Technologies for Resource Recovery from Wastewater

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Wetland in full operation

September 2018

INCOVER
Innovative Eco-Technologies for Resource Recovery from Wastewater

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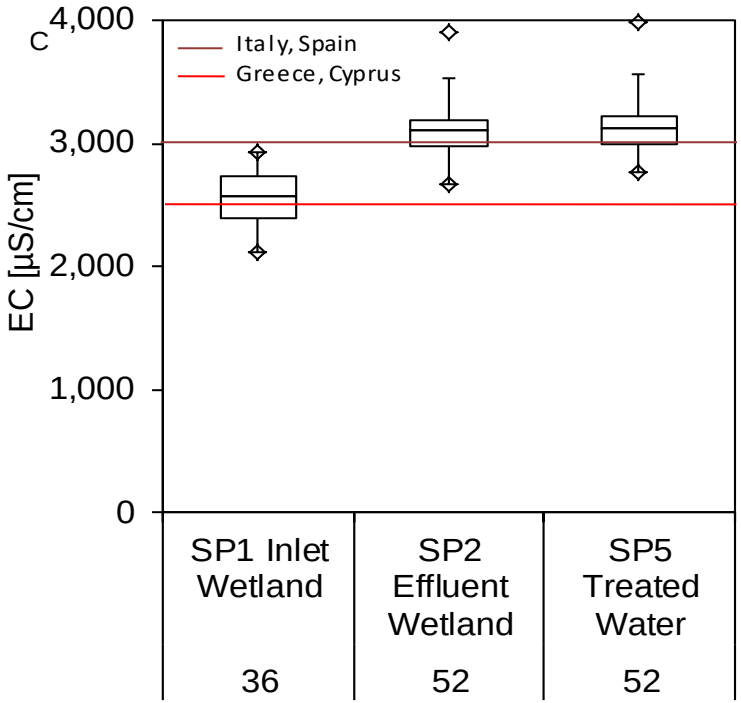
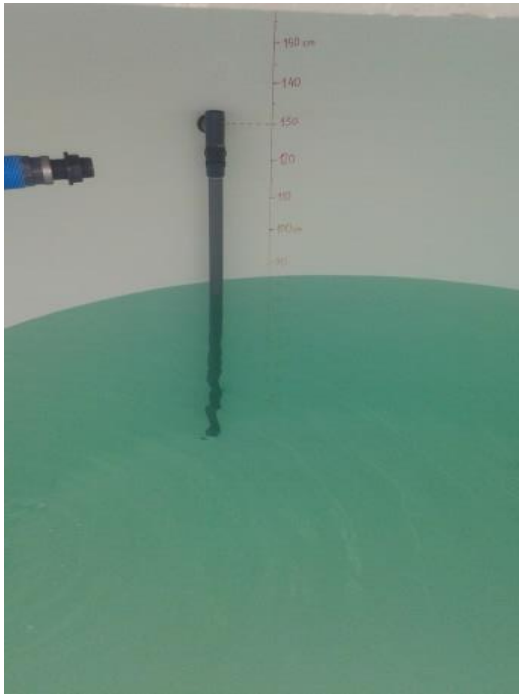
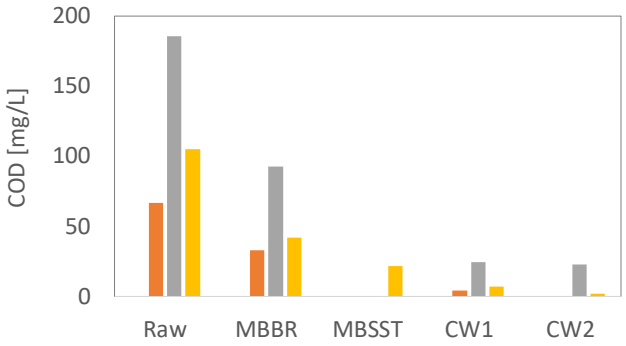


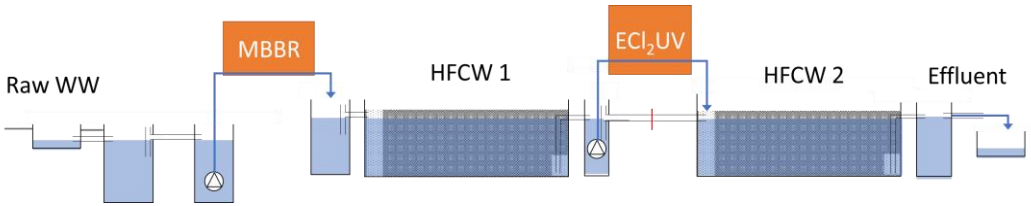


Total Suspended Solids (TSS)

Reduction of 99,5%

January 2023 – First aerated HFCW in India





March 2023

April 2023 – one of the first aerated HFCW in India

PAVITR

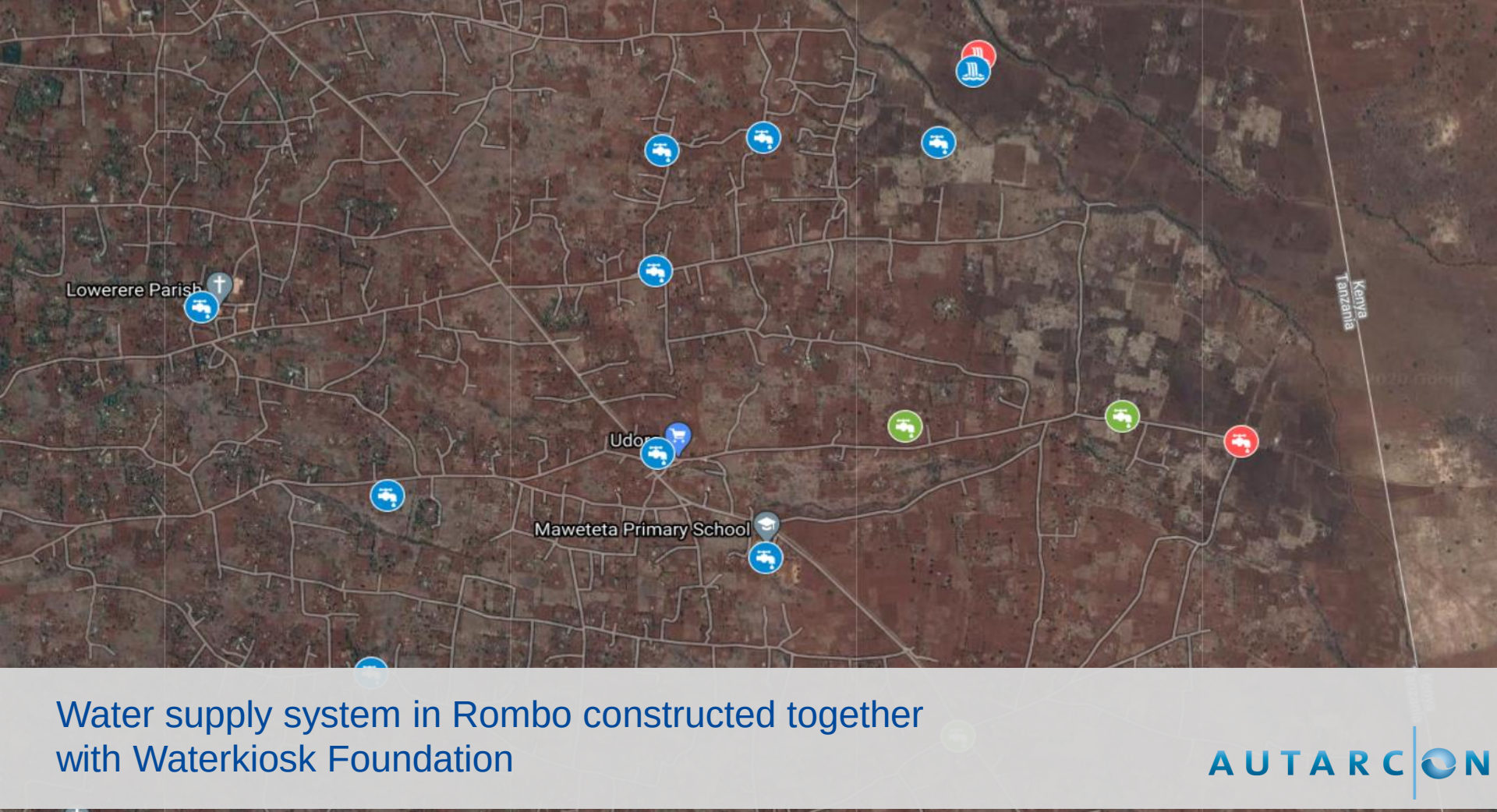
Operation of HFCW

Technology is only 20 % of the solution

Key question: How to generate income?

Can a station pay for itself?

Bottled water : 15 €cent/L (150 €/m³)
AUTARCON water: 0.150 €cent/L (3€cent/20L, 1.5 €/m³)



Water supply system in Rombo constructed together with Waterkiosk Foundation

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Prepaid water tapping at SuMeWa|SYSTEM

- Simple and fair distribution of water
- Long term operation of drinking water infrastructures
- Online monitoring of tapped water quantity

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- Prepaid Cards 3.000 - 6.000 TZS per card
- Consumers need to purchase at e.g. a rate of 5.000 TZS

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Constant flow of income

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Foto: by Calvin Ndumwa

Simple to use

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Accepted

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Creates trust and increases acceptance

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Main tapping station in Rombo

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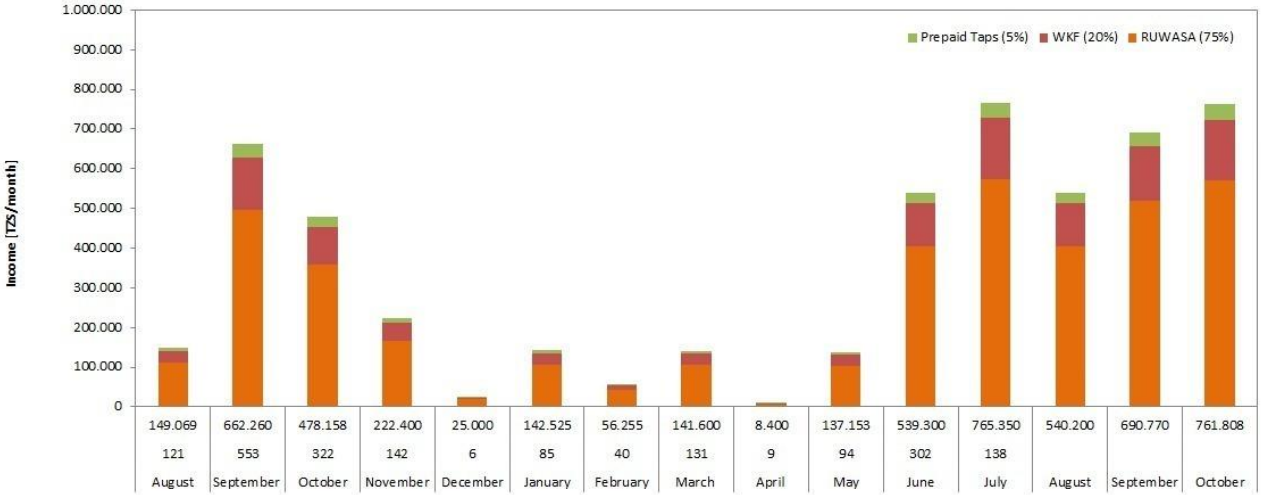
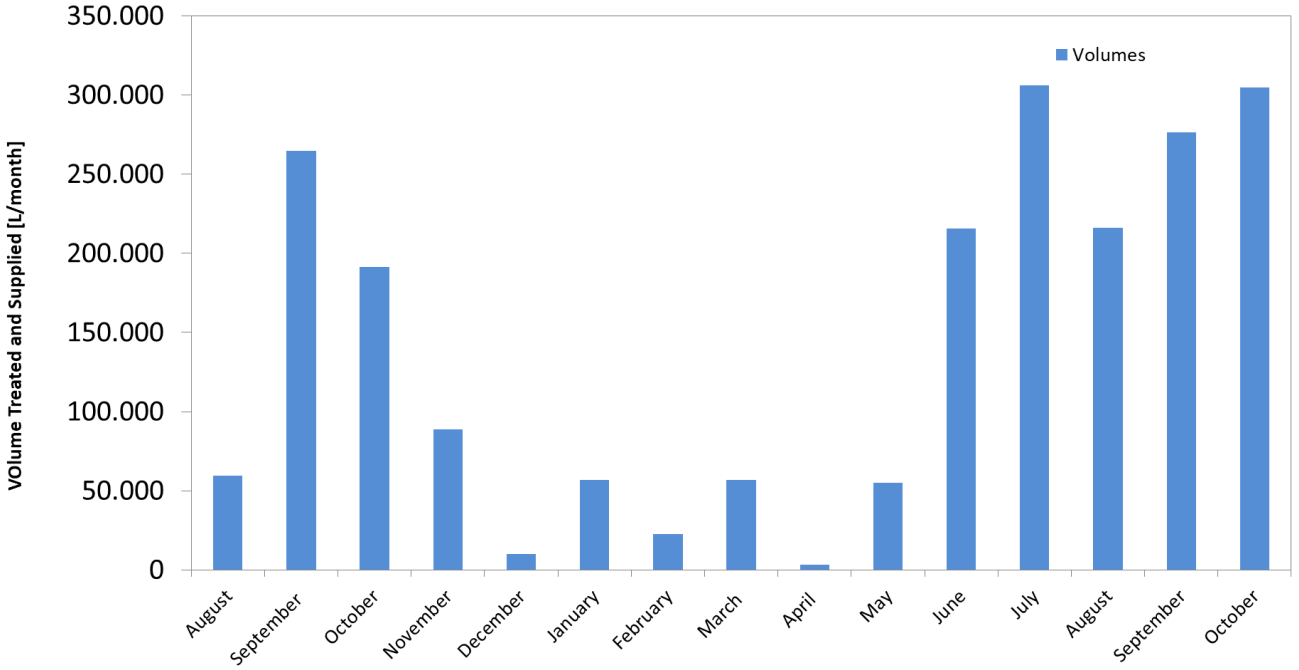
Generiertes Einkommen - November 2021 - Oktober 2022

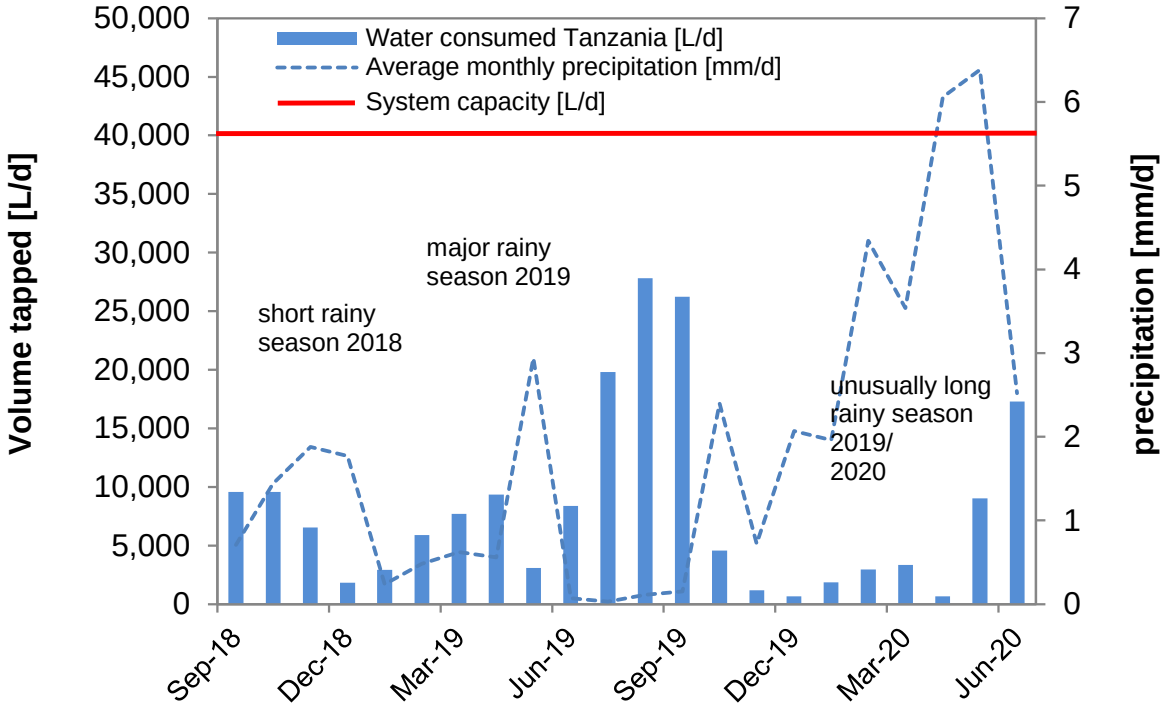


Income	TZS
No. of recharges	2.598
total income	5.320.248
RUWASA (75%)	3.990.186
WKF (20%)	1.064.050
Prepaid Taps (5%)	266.012
To be transferred to Peter	**1.330.062**

Wasserabgabe: November 2021 - Oktober 2022



1.600 m³/a → 4.4 m³/d → 110.000 TSZ/d → 22.000 TSZ/d for Peter (10 CHF/d)



Do not formulate your business model on the system capacity

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Business generation – safe water distribution

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In-Field water quality analysis

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Training of local technicians

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Business Generation

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Emplyment

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Business Generation

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Looking for a Masterthesis?

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- Economic evaluation of water supply systems operated with solar-driven electro-chlorination in rural regions https://doi.org/10.1016/j.watres.2020.116384
- Disinfection for decentralized wastewater reuse in rural areas https://doi.org/10.1016/j.scitotenv.2020.137595
- Combination of River Bank Filtration and Solar-driven Electro-Chlorination Assuring Safe Drinking Water Supply https://doi.org/10.3390/w11010122
- Arsenic Removal from Groundwater by Solar Driven Inline-Electrolytic Induced Co-Precipitation and Filtration—A Long Term Field Test Conducted in West Bengal https://doi.org/10.3390/ijerph14101167
- Oxidation of Selected Trace Organic Compounds through the Combination of Inline Electro-Chlorination with UV Radiation (UV/ECl2) as Alternative AOP for Decentralized Drinking Water Treatment https://doi.org/10.3390/w12113275
- …

Recent publications

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Thank you very much!