Challenges in groundwater management in humanitarian contexts: ‘from implementation to assessment’

Swiss Water Partnership event, September 2018

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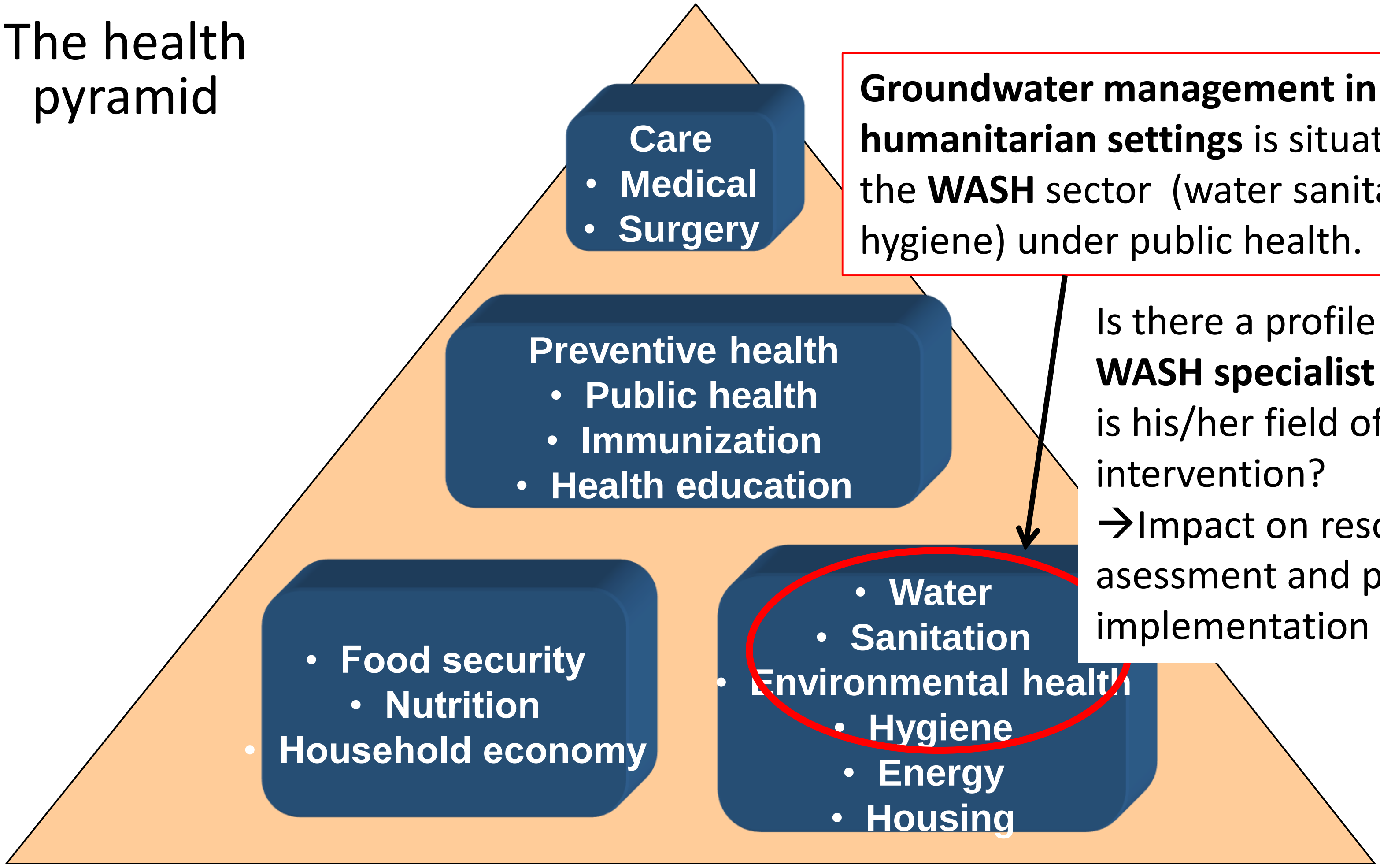
Where is groundwater management situated in humanitarian contexts: the public health sector **(WASH)**

The health pyramid



Groundwater management in humanitarian settings is situated within the **WASH** sector (water sanitation and hygiene) under public health.

Is there a profile of a **WASH specialist** and what is his/her field of intervention?
→Impact on resource asessment and project implementation

The framework of groundwater assessment and implementation in humanitarian crises

- Donations/funding mechanisms of humanitarian crises are highest during emergency phases
- Fast actions required to invest the funding and to get ‘quick wins’: e.g. geophysical campaigns often run in parallel with drilling campaigns
  - Quality of work is often poor during emergency phase, but wells are there to stay
  - Poorly constructed wells lead to high O&M costs and are not sustainable
- Legal frameworks and authorities are highly challenged in emergency situations
- Different actors with different mandates
- No or little accountability of the invested funds

Demographic challenges

Rural settings

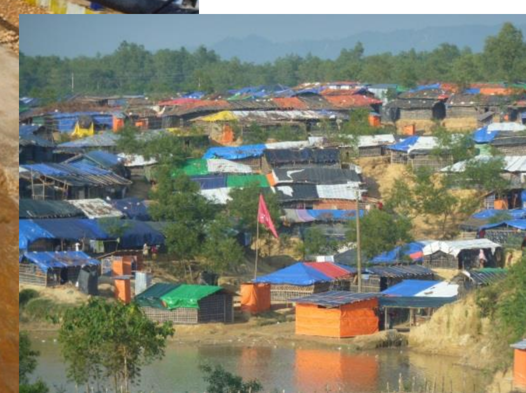
Camp settings for displaced populations, separated from host community

→ Humanitarian sector has a long experience in these settings

Urban settings (e.g. Syria/Bangladesh crises):

- Refugee population mixes in with the host community
- Sudden massive concentration of population

→ Humanitarian sector has little experience in such settings



The problem of groundwater assessment after implementation

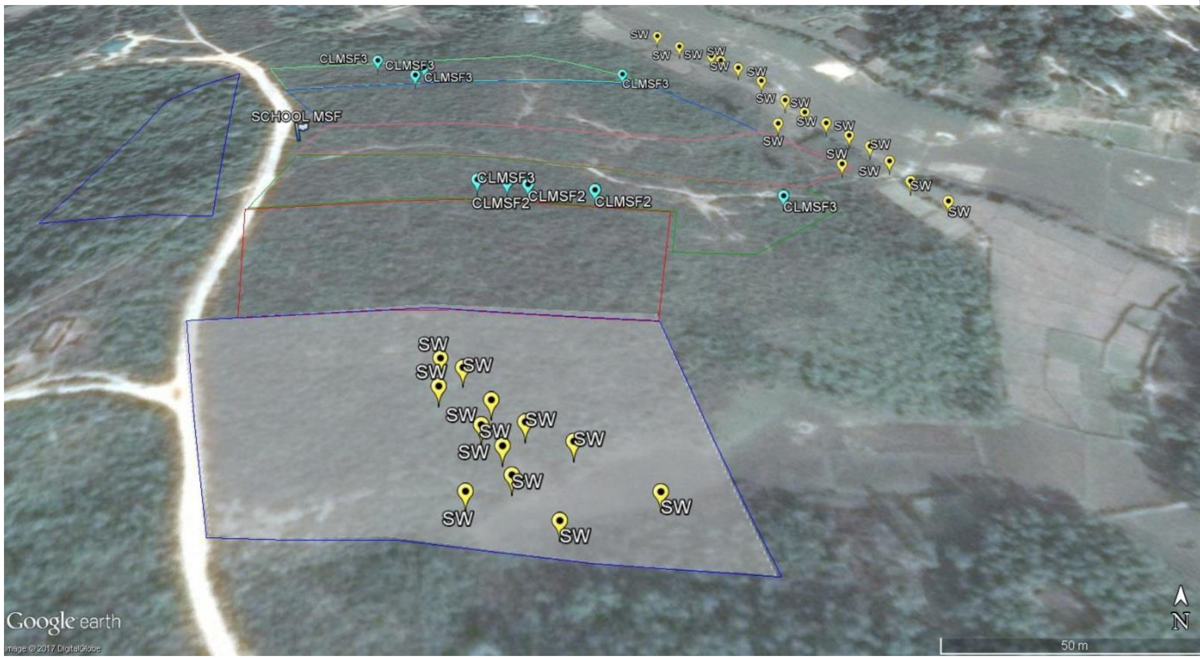
Transition from emergency towards mid-long-term groundwater management is often constrained by emergency phase implementation:

- Coincidental well distribution existing from emergency phase
- No coordinated vision on mid-longterm water water management

Example Bangladesh: 9830 wells drilled since October 2017 (within 20 km^2)

Example of emergency well implementation in the recent Rohyinga crises in Bangladesh

Example Bangladesh:
12 wells on plot of 8000m^2 (1 well every 25 meters)



- ➢ Wells are located just next to latrines: minimum standards often not met
- ➢ Well siting not coordinated and not based on resource assessments
- ➢ Well construction/documentation is generally poor

Bangladesh: example from a deep tube well

The challenge of quality control: example from a Swiss actor raising funds

Dank den neu errichteten Pumpen haben die Rohingya in den Flüchtlingslagern nun Zugang zu sauberem Wasser.

Feacal cross-contamination has been known for 150 years, but it still repeats itself in recent humanitarian crises!

→History has shown that **centralisation** allowing water treatment is the key to safe water supply in urban (high population density) settings

→Coordination of actors to agree on a common water supply strategy has taken 6 months

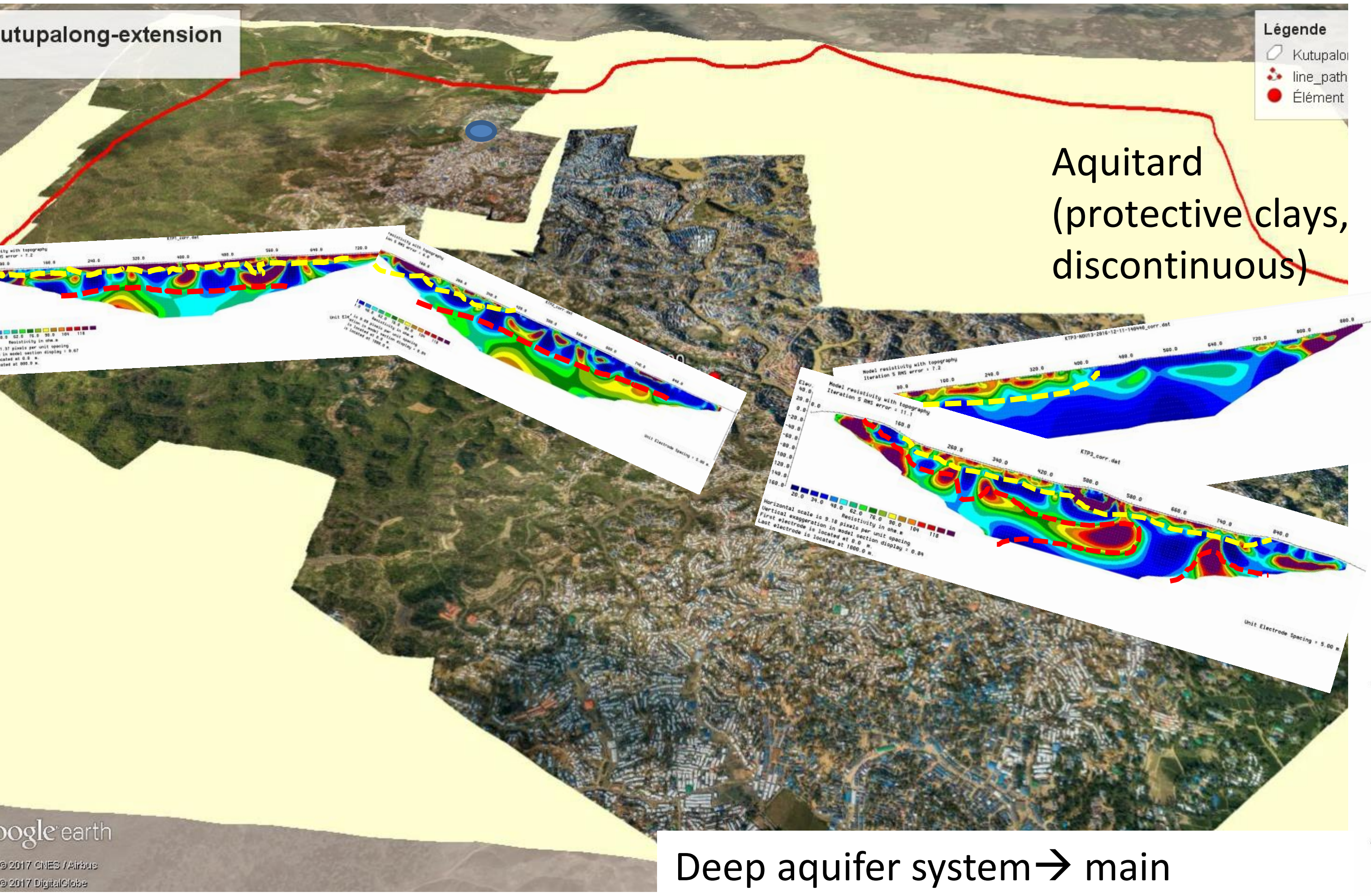
→ No apron/no sealing: surface-groundwater interaction!

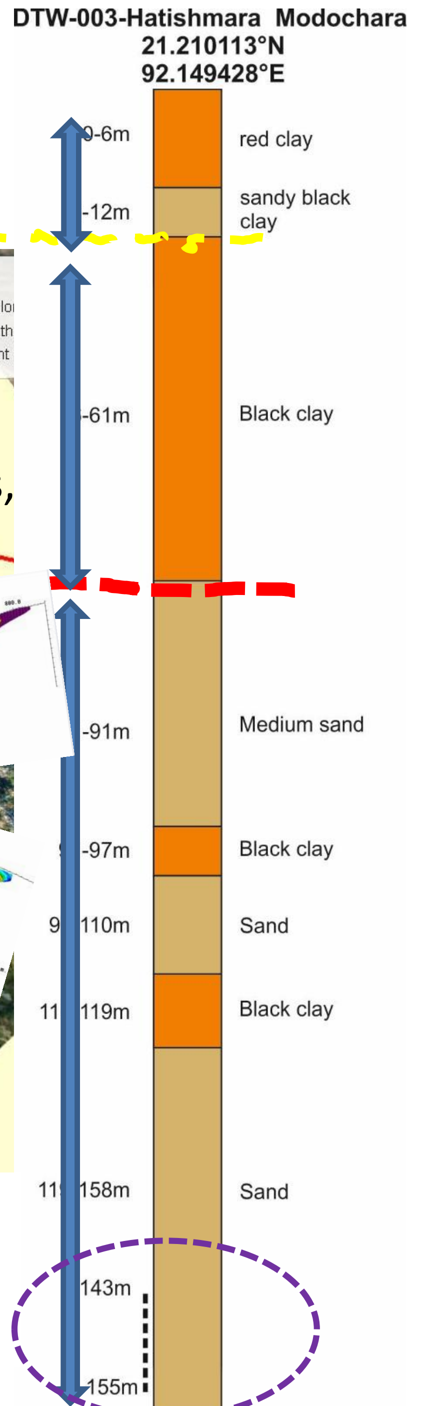
Groundwater assessment running in parallel with well implementation

Objective of geophysical assessment:

→Explore the geological conditions and map the aquifer(s) and continuity

Groundwater assessment running in parallel with well implementation





Shallow aquifer

Aquitard (protective clays, discontinuous)

Deep aquifer system→ main contamination path along well, due to poor well construction

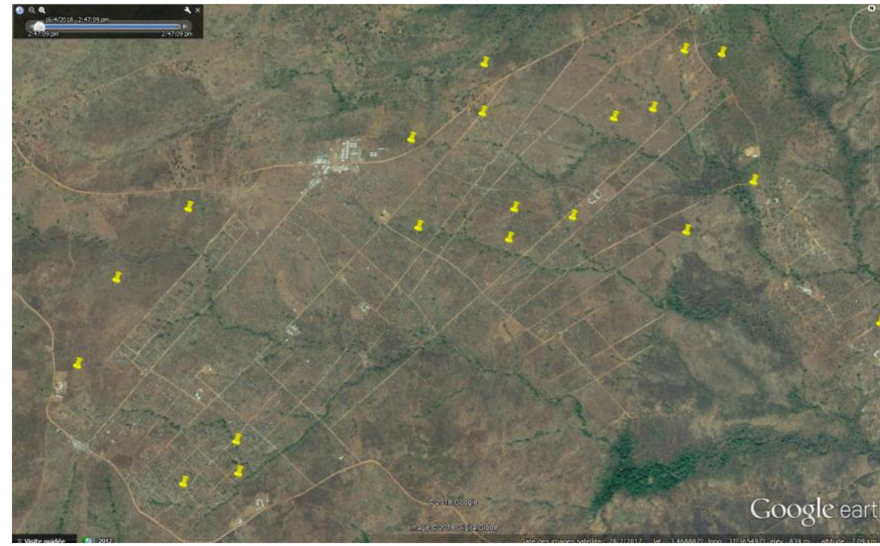
Implications of water resource management strategy on assessment approach:
Transition between emergency and long-term situation **requires consensus** on the fundamental question of supplying **'treated' or 'untreated' water**

- Although deep boreholes may be of better quality, contamination cannot be excluded and appropriate groundwater protection zones cannot be established

- Handpumps (untreated water) have often been a water supply option in humanitairain crises, but recent emergencies are confronted with increasing population density

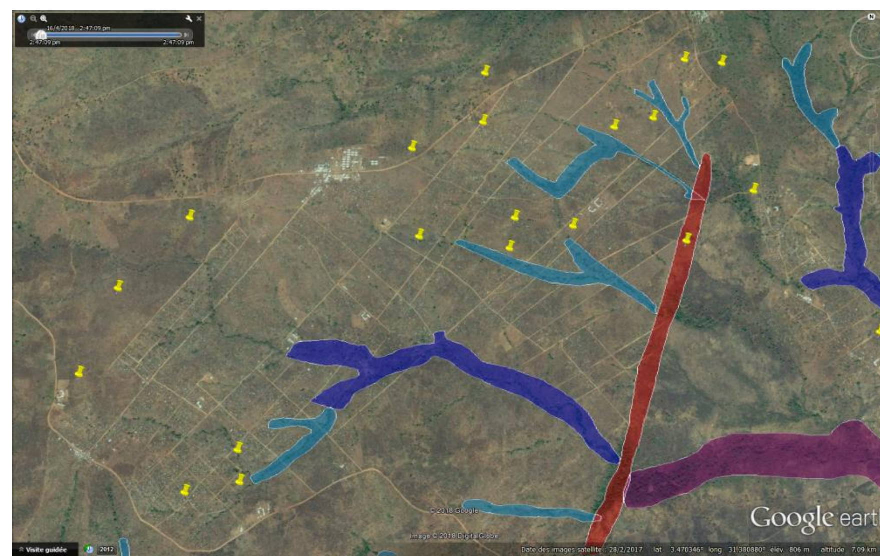
An attempt to place groundwater assessment before implementation : rapid groundwater potential mapping

Common emergency well siting approach: Get groundwater there where the people are or truck water (mostly from surface water).



Example Uganda: Water trucking costs (2016-2018): 2.5 million $/month

→ **Cost of water: 10-17 $/m³**



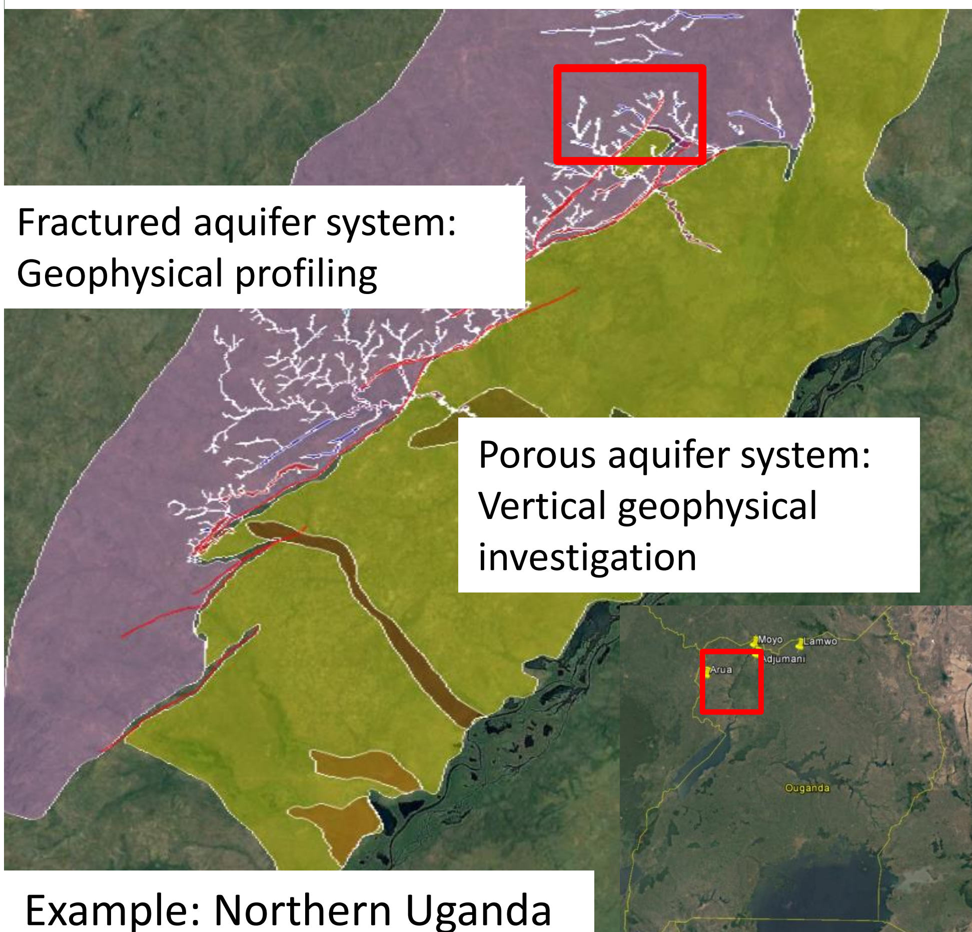
Alternative approach: Bring groundwater to the people from where the water is

→ Example of ongoing rapid groundwater potential mapping project (example Northern Uganda)

Rapid groundwater potential maps as tools for strategic well siting

The resolution of such maps is adapted to the spatial scale of local geophysical investigations : these are often just carried out to fullfill legal requirements (licencing)

→ Rational: Why not make use of this legal requirement and carry out the geophysics in a place with higher groundwater probability?



Fractured aquifer system: Geophysical profiling

Porous aquifer system: Vertical geophysical investigation

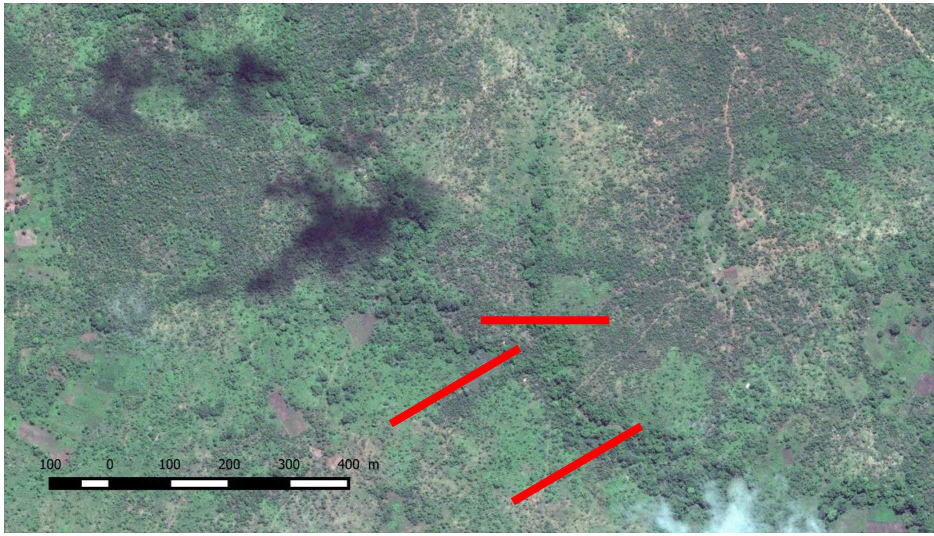
Example: Northern Uganda

Groundwater domain (exploration and drilling method)	Groundwater potential (expected permeability)	Geological/morphological identification (water availability)	Expected sustainable yield (m^3/hour)
Fractured — **Exploration method:** geoelecrical profiling combined with perpendicular VES or electrical resistivity tomography; **Drilling method:** DTH (down the hole hammer), open hole, full casing for pump house	High GW- potential (high permeability)	Discrete persistent **fault and fracture zones**/ clearly aligned vegetation **High water availability**: estimated recharge area **>** 1km²	10-30
	Medium GW- potential (high permeability)	Discrete persistent **fault and fracture zones**/ clearly aligned vegetation **Medium water availability**: estimated recharge area **<** 1km²	5-10
	Heterogeneous potential (high and low permeability: high exploration efforts)	**Regional-scale normal faults**/ often associated with swamps and/or high density vegetation **Locally high water availability** with **high spatial variability**	5-50
	Heterogeneous potential (high and low permeability: high exploration efforts)	**Regional-scale river beds:** locally alluvial,locally fractured/ meandering systems connected to groundwater, with high variability in permeability **High water availability in all areas**	5-50
Porous — **Exploration method:** perpendicular VES and or electrical resistivity tomography; **Drilling method:** Rotary with drilling fluid, casing and gravel pack	High GW- potential (high permeability)	**Lateral** potentially **coarse sedimentation lobes** within the mostly fine-grained Nile valley deposits, associated with decreasing size river beds (gw recharge) High water availability (locally low water quality)	10-30

Example of a groundwater potential map for groundwater prospection design

(example in northern Uganda)

By 'zooming' into the map, exploration can be optimised with respect to the distance to the 'water need'.



Rapid groundwater potential maps fill the intermediate scale gap, between regional scale information and local scale assessments (geophysics) and make use of the fact that geophysical assessments are in most countries a legal requirement.

Requirement of this mapping methodology:

→ **Rapid** (within days-weeks) in order to be used during the emergency

Groundwater resource assessments: groundwater monitoring in humanitarian contexts

Humanitarian crises often turn into protracted situations (average life-span of a refugee camp is 17 years) with sustainable groundwater management being a key issue.

Groundwater monitoring in is crucial for the following reasons:

- Assessment of the sustainability of the groundwater management schemes (longterm behaviour of resource)
- The need for an early warning system in case of water quality/quantity degradation
- Assessment and quantification of impact of refugee operation on other users (→ hard data used in conflict mitigation)
- Day to day operation and optimisation of O&M costs

Challenges of groundwater monitoring in humanitarian contexts

→No or little leverage on management to implement gw monitoring: ‘bottom of the priority list’

→Funding requests for O&M often neglected/not prioritised in budget cycle

→Process of systematic data collection/verification/compilation and sharing with management level not clearly defined

→No action plan associated with the groundwater monitoring system

→High turn-over of staff or change in implementing partners

→In some cases maintenance difficult due to security situation

Pilot groundwater monitoring projects in refugee camps: Dadaab and Kakuma refugee operations (Kenya)

Initial trigger for monitoring network implementation:

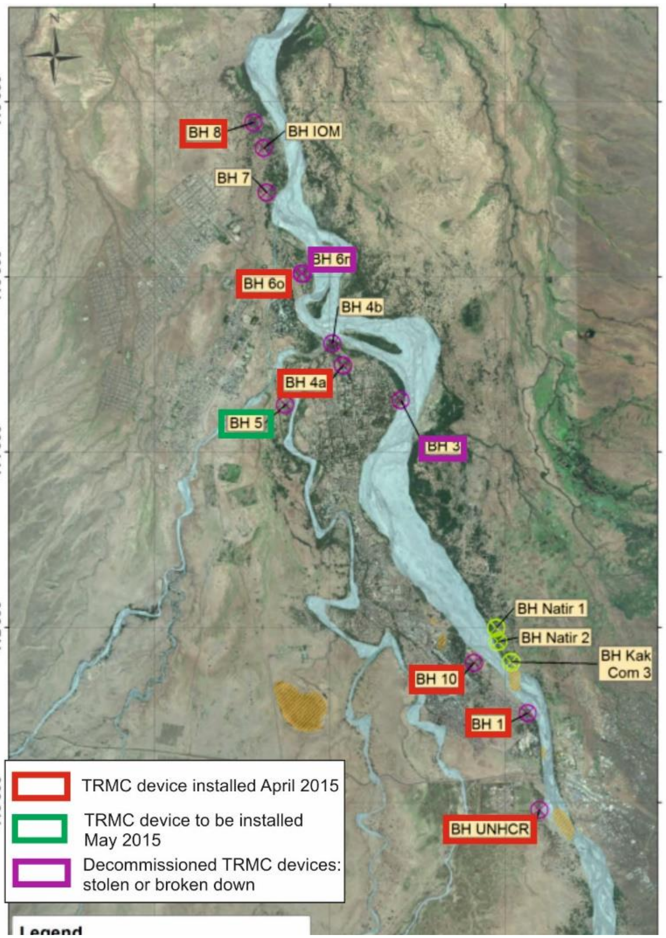
- ❖ Allegations were made by the host community that the Dadaab refugee operation was drying up the groundwater resources in the Merti aquifer

- ❖ No hard-data available to assess the validity of this allegation

→Implementation of two groundwater monitoring systems, measuring water levels and electrical conductivity in a total of 30 production and observation wells (with daily GPRS data transmission)

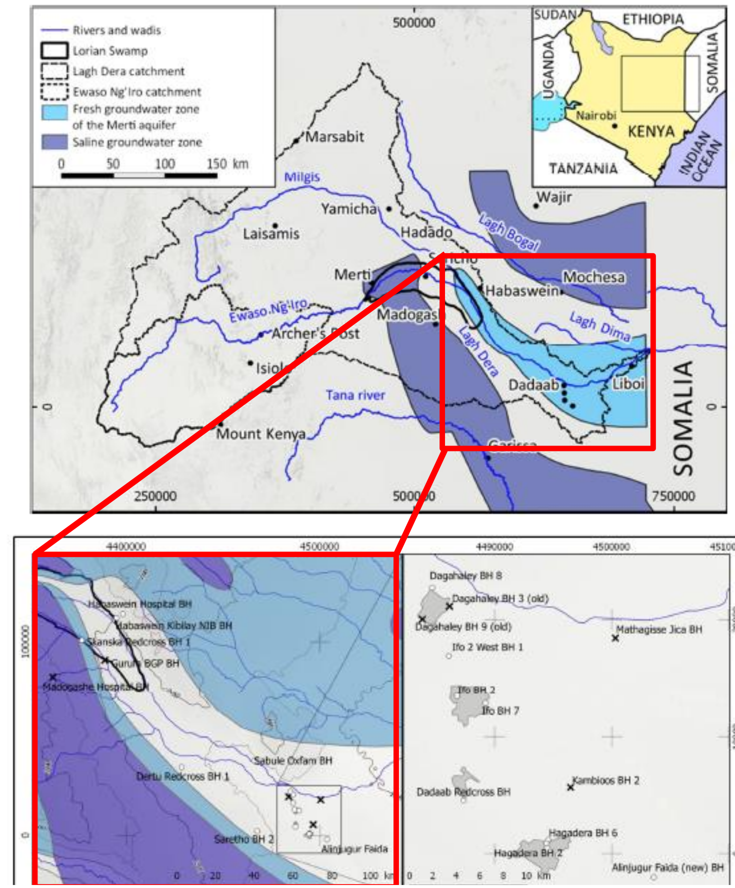
The Dadaab and Kakuma groundwater monitoring systems

Kakuma (100’000-180’000 refugees)



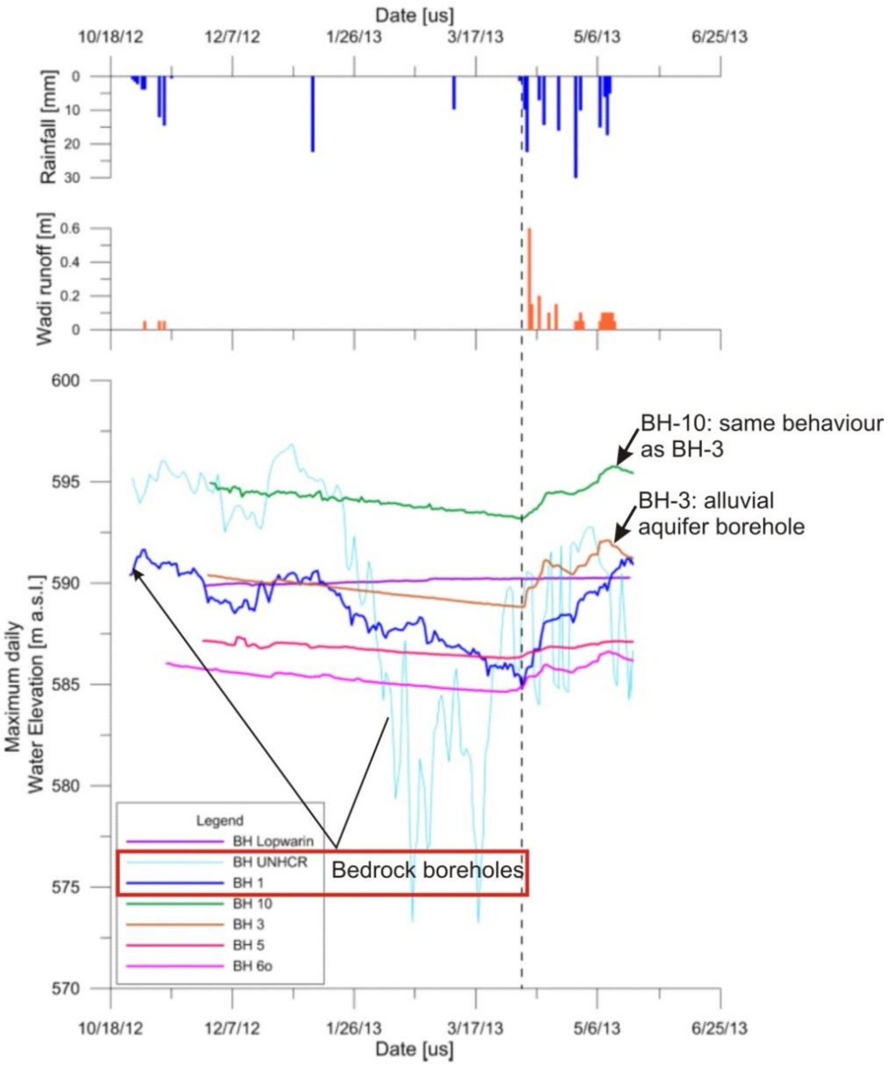
Monitoring within the area of the camp: 10 monitoring stations

Dadaab (300’000-450’000 refugees)



Monitoring within entire Mega aquifer system (beyond camp boundaries): 20 monitoring stations

The Kakuma groundwater monitoring systems: some results

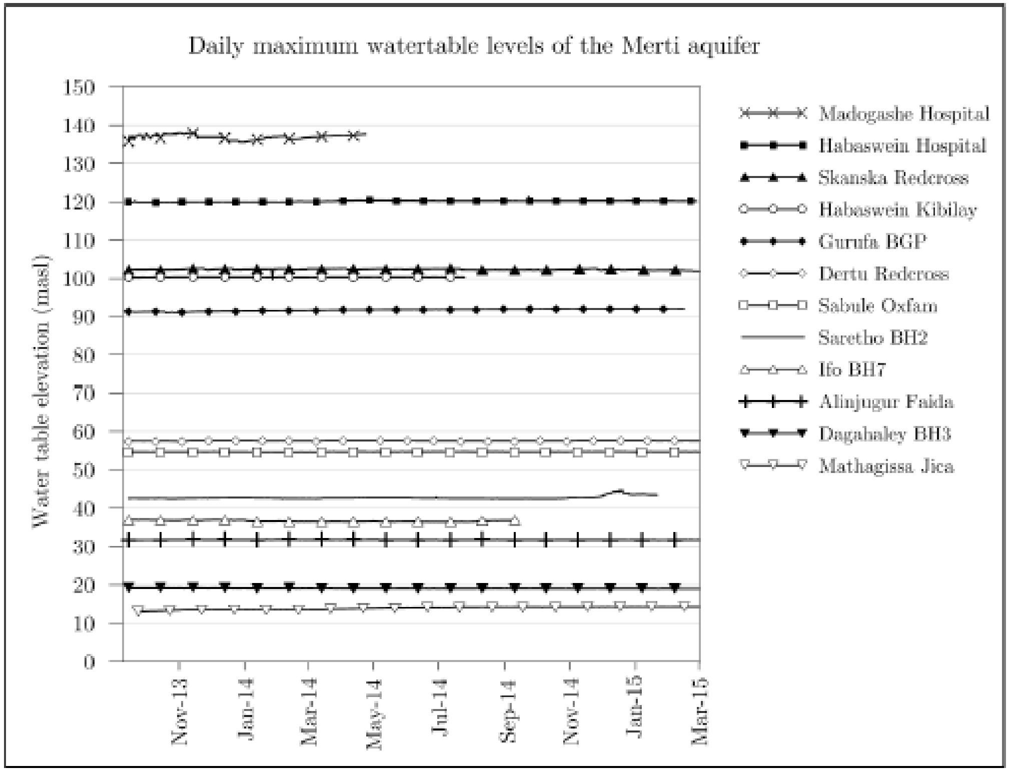


→Data revealed interaction between two aquifer systems (alluvial and fractured aquifer)

→ Recharge processes could be quantified and are tightly correlated with river run-off events

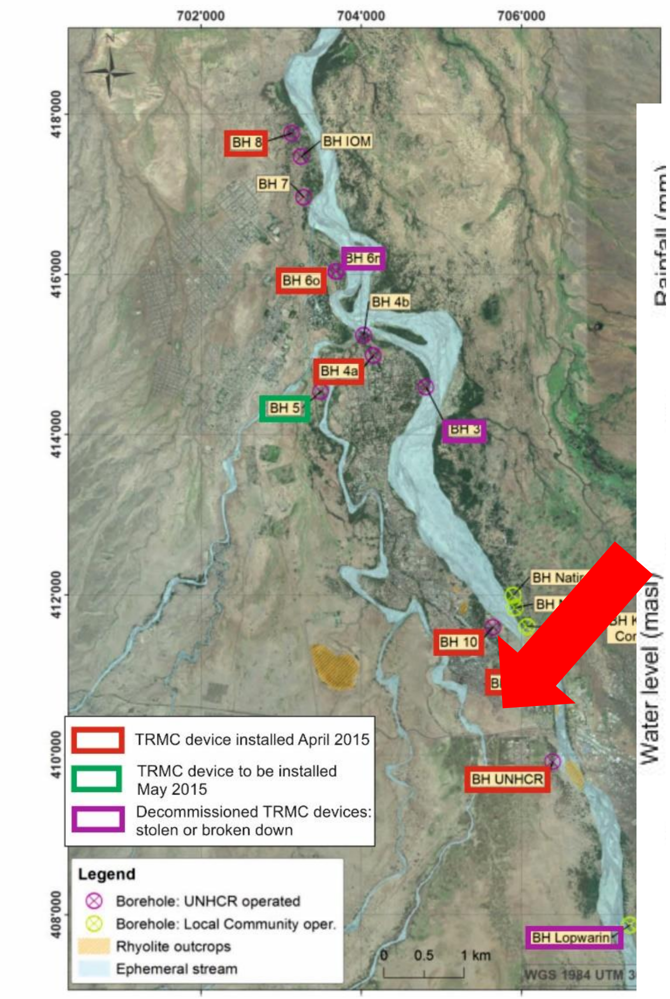
→ Correlation between monitoring data and energy consumption has allowed to identify that fractured aquifer wells produce water that is 3-5 times more expensive than alluvial aquifer wells

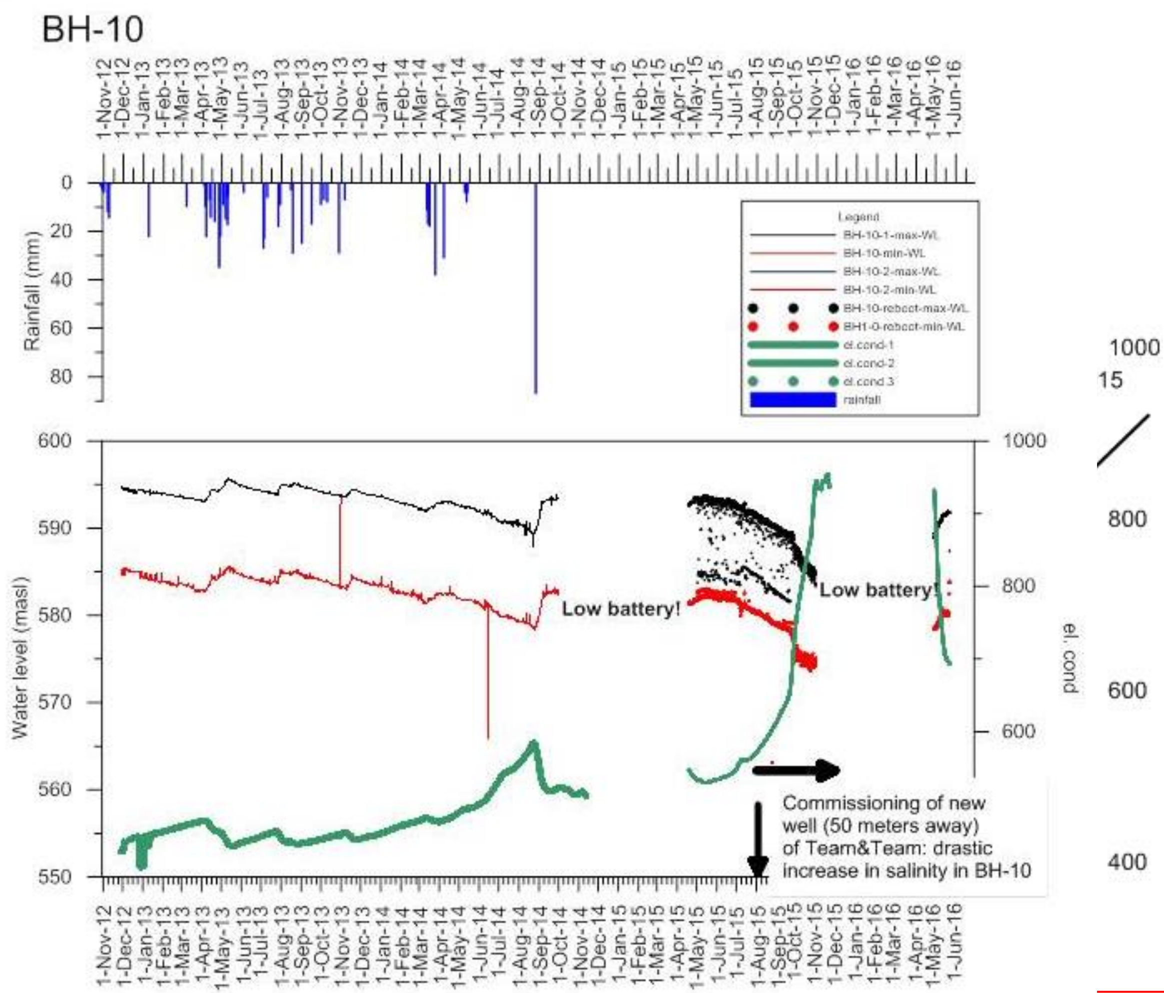
The Dadaab groundwater monitoring systems: some results



→Data revealed a high inertia of the system
→Data from monitoring network was used in the framework of a SDC funded thesis (Blandenier, 2015)
→System is now abandoned

Groundwater monitoring as early-warning system





→Groundwater monitoring has to be bound into an overall strategic action plan in order to perform and to be useful.

Open questions upstream of groundwater-surface water assessments in humanitarian contexts

- How can groundwater assessment in humanitarian settings be efficiently embeded within the emergency phase in order to act upon the mid-longterm situation?
- Can sustainable groundwater management-assessment be implemented as long as it is situated in a subsector under public health?

Example
Surface water transport processes- Uganda- Blue Nile

Thank you