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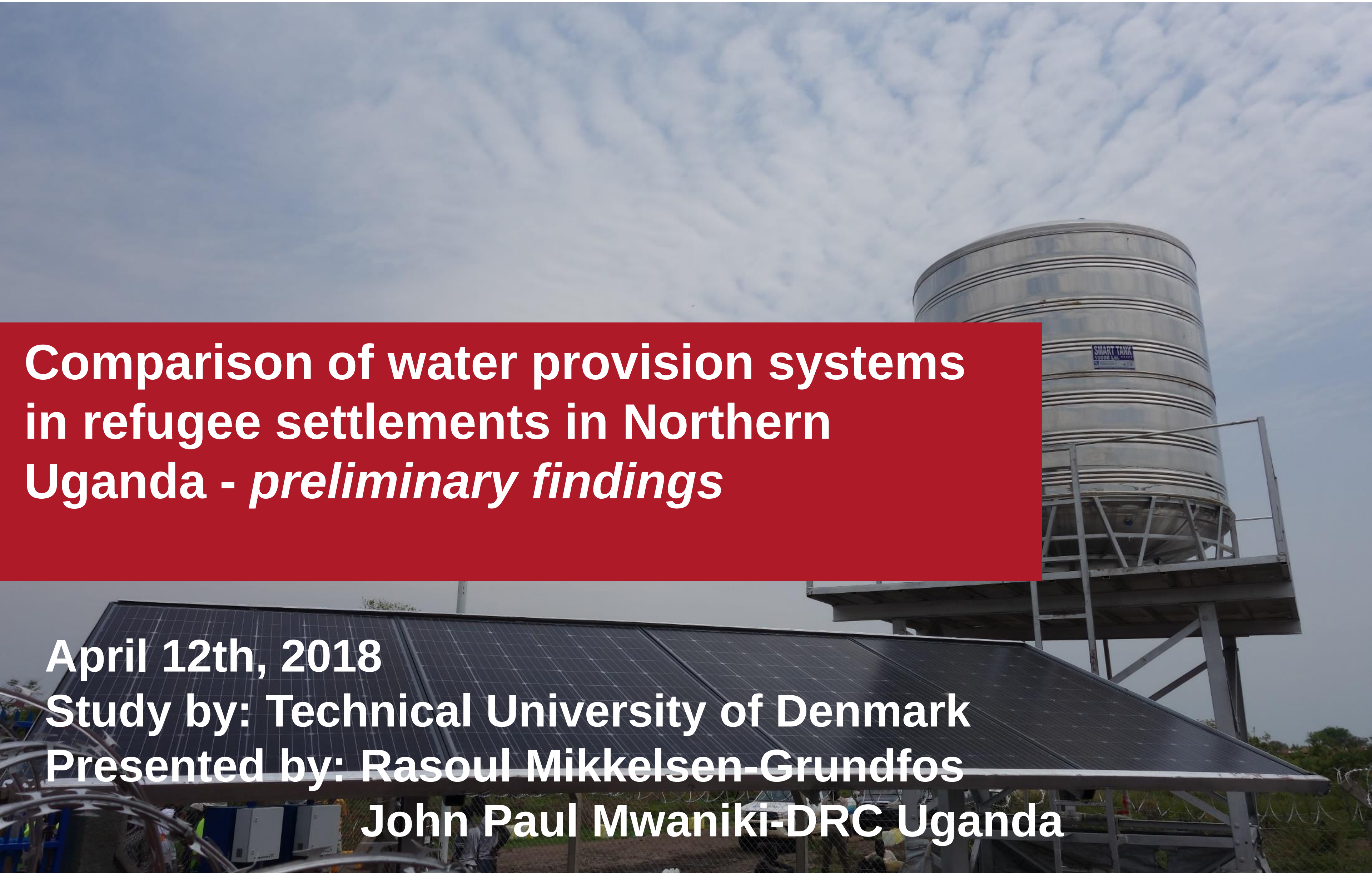

Comparison of water provision systems in refugee settlements in Northern Uganda - *preliminary findings*

April 12th, 2018

Study by: Technical University of Denmark
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The Humanitarian Partnership Lab

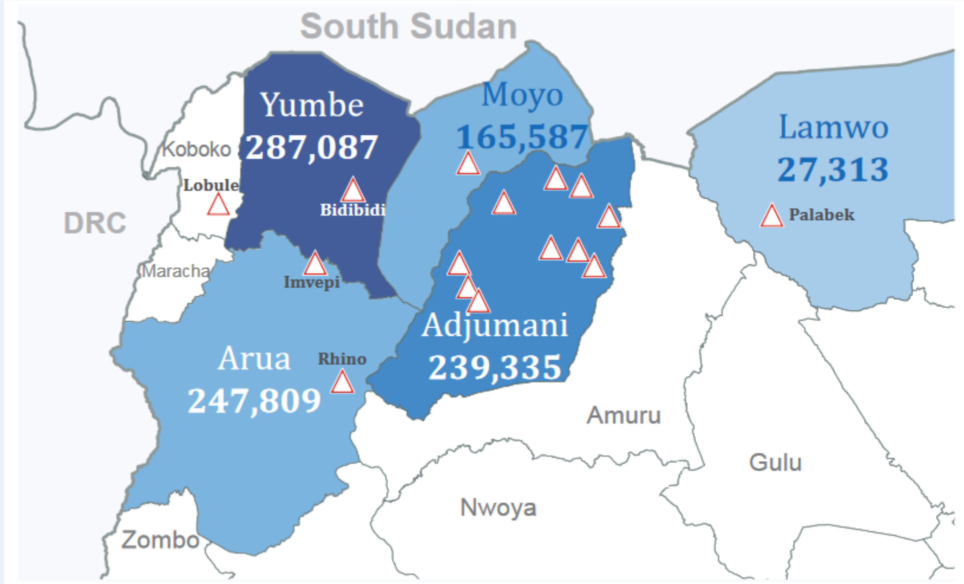
- Is strategic partnership between DRC, Grundfos and DTU

- Objective is to pilot-test, co-develop and advocate for new innovative solutions and business models to global humanitarian challenges related to water- and opportunities in camp and non-camp settings .

- Field visits to Adjumani and Bidibidi in 2016 motivated to conduct an in-depth study on various water provision in Northern Uganda. DTU chosen as an independent research partner.

Study context

- 1,395,146 refugees and asylum-seekers (end 2017)
- 1,037,898 refugees and asylum-seekers from South Sudan (end 2017).
- 61% of population < 18
- 82% women and children (<18 years)



https://reliefweb.int/sites/reliefweb.int/files/resources/Weekly%20SSD%20Info-Graph%2019-01-18.pdf

Settlement	District	Refugees	Water supply (end of 2017)			
			[l/person/day]	Hand pumps	Motorized systems	Water trucks
Bidibidi	Yumbe	285,969	17.6	30%	43%	27%
Rhino camp	Arua	116,453	15.5	23%	26%	51%
Imvepi camp	Aura	126,636	11.6	20%	3%	77%

Study objectives

1. Defining and analyzing comparable alternatives for water provision.
2. Analysis of lifecycle costing (LCC) and assessment of carbon footprint and freshwater impacts
3. Assessment of water safety issues through a Hazard Analysis Critical Control Point (HACCP) approach
4. Socio-technical assessment

In a lifecycle perspective, is deployment of advanced solar-driven water pumps a more sustainable solution in emergencies than hand-driven water pumps or water trucks?

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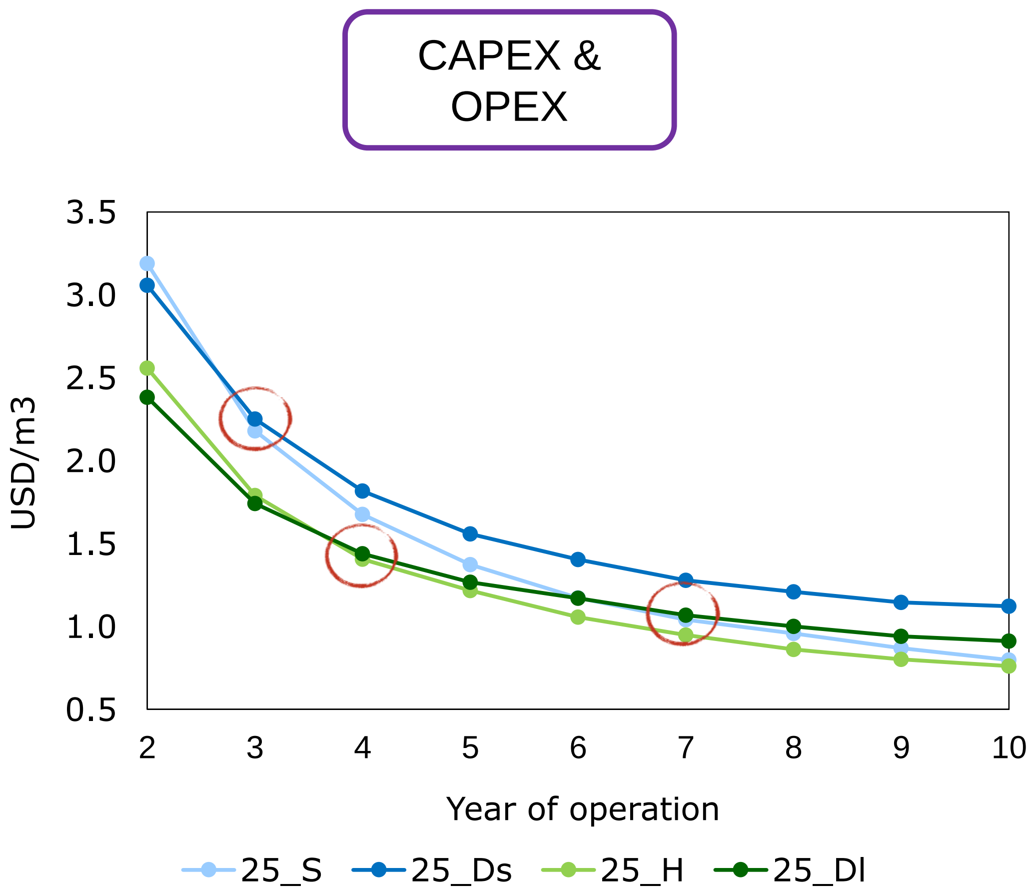
Methodology

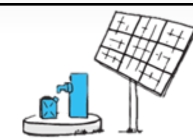
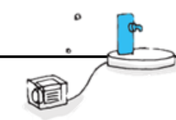
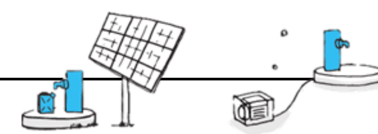
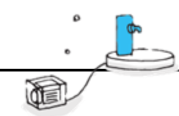
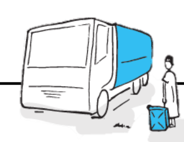
	End users' survey	LCC	Carbon footprint	Freshwater availability	HACCP
Unit	N/A	USD / m^3	kg CO_2 eq / m^3	N/A	N/A
What do we compare?	400 households	26 scenarios	26 scenarios	- Shallow borehole - Deep borehole - Surface water	- Hand pump - Motorised pumps - Water trucking
Outputs	Questionnaire	- Unitary NPV (incl. CAPEX) - Unitary NPV (excl. CAPEX)	CO_2 emissions	Hydrogeological analysis	Critical Points

Key findings: Cost comparison of alternatives

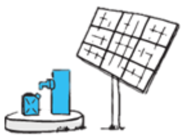
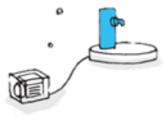
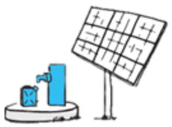
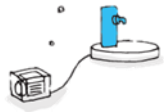


Alternative comparison	Breakeven year
2_S & 2_Ds	1st
2_S & 2_Dl	2rd
5_S & 5_Ds	3rd
5_H & 5_Dl	5th
5_S & 5_Dl	10th
10_H & 10_Dl	3th
10_H & 10_Dl	6th
10_S & 10_Dl	-
25_H & 25_Dl	**3th**
25_H & 25_Dl	**4th**
25_S & 25_Dl	**7th**
50_S & 50_Ds	4th
50_H & 50_Dl	6th
50_S & 50_Dl	8th
50_S2 & 50_Ds2	5th
50_H2 & 50_Dl2	6th
50_S2 & 50_Dl2	8th

Water trucking vs. motorized systems 10m3/hr

4,667 people/day for 2 years	Solar system for 7 hours at 10m3/hr	988,055,403 UGX (3rd year solar becomes cheaper than 10Ds)	
	Diesel system for 7 hours at 10m3/hr	940,404,912 UGX	
	Hybrid system for 12 hours at 10m3/hr	1,345,438,870 UGX	
	Diesel system for 12 hours at 10m3/hr	1,236,800,189 UGX	
	Water Trucking	1,439,067,600 UGX	

Water trucking vs. motorized systems 25m3/hr

20,000 people/day for 10 years	Solar system for 7 hours at 25m3/hr	1,835,040,915 UGX	
	Diesel system for 7 hours at 25m3/hr	2,578,532,246 UGX	
	Hybrid system for 12 hours at 25m3/hr	2,997,019,104 UGX	 
	Diesel system for 12 hours at 25m3/hr	3,591,613,641 UGX	
	Water Trucking	29,153,566,800 UGX	

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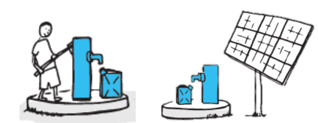
Water trucking vs. motorized systems

Imvepi camp, 126,636 people

Years of operation	Water [m³]	OPTION A	OPTION B	OPTION C
		100% water trucking 	1st year 100% trucks, from the 2nd year 20% hand pump, 40% trucks and 40% solar 	1st year 100% trucks, from the 2nd year 20% hand pump, 80% solar 
1 year	693,332	20,896,675,200 UGX	20,896,675,200 UGX	20,896,675,200 UGX
3 years	2,079,996	57,029,868,000 UGX	41,759,118,600 UGX	34,805,538 UGX
10 years	6,933,321	184,594,557,600 UGX	95,278,971,600 UGX	39,072,844,800 UGX

End user (Communities/Stakeholders) Feedback regarding Prepaid Metering System

Photo: AQ Tap Installation in Bidi Bidi, Yumbe

1. **Willingness to pay**
   - Equality in access to water, shorter queues and ease of drawing water and service for O&M a key motivation for communities to pay water user fees
   - Communities suggested 1,000-3,000 UGX/month (1,000ltrs) through water user committees
   - Refugees were willing to pay but complained of other refugees not paying in the same camp
   - Cattle keepers, they pay for extra tokens of water for their cattle
2. **Affordable**
   - lower cost because of higher efficiency in tariff collection and dispensing of water (metered/real time data collection)
   - O&M costs can likely be covered with a water tariff (the study looks at a rage of 0.124 USD/3,000 UGX m3
   - Availability 24/7

- **97% verified through ATM card distribution**

End user (Communities/Stakeholders) Feedback regarding Prepaid Metering System…(2)

Photo: A scenario before commissioning of the system

3. Social Impact

- Reduced security risks associated with carrying hard cash for women/children to access water.
- Increased time for social, economic and development activities due to increased time as a result of 24-7 availability of water
- Reduced tension between host communities and refugees over water point access. The host and refugee have ownership of ATM cards which harmonizes the issue of access to water from common points.
- The system is adjustable to various scenarios, e.g. it is possible to set limits for which if the tokens are exhausted payment must be made.

4. Environmental Impact

- The water contribution leads to decrease of aquafer exploitation since only the water drawn is accessed for use.
- As the systems are motorized, they reduce multiple borehole drilling which is subject to over exploitation

Conclusions

- Water trucking is the most expensive and least environmental friendly solution
- Costs are highly affected by the timeframe considered. Short financing timeframes isn't likely to be cost-efficient.
- The larger the system, the cheaper the water.
- The "break-even" year between solar versus diesel (7 hours) is between 3 and 5 years
- O&M costs: solar (for hours) is the cheapest followed by hybrid systems, and diesel powered systems. O&M costs can likely be covered with a water tariff (the study looks at a rage of 0.124 USD/3,000 UGX m3)

Conclusions

- Carbon footprint, solar energy has zero carbon footprint on the environment as of time of operation (10-25 yrs).
- LCC for handpumps proves in 10 years a handpump cost unit per 1,000 ltrs of water is equal to a solar system of 50m3/hr the difference is 100 UGX in favour of handpumps.
- The rate of non-functioning hand pumps also needs to be factored properly in (see other studies by NGOs).

Proposed Way Forward

> Focus on disruptive Business Models and innovative technologies
> Increase private sector engagement (R&D, Innovation, Business Models, investment
> Increase cross sector partnerships and alignment (designs, green procurement rules and regulations-LCC, Supply Chain for O&M, Energy efficiencies)
> Use of new and innovative business models, BOT, Leasing, small water service providers, social entrepreneurs etc.
> New ways of funding and role for development donors, Guarantees, Micro-loans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Thank You!