A socio-material analysis of rural water supply performance in Africa

RWSN webinar

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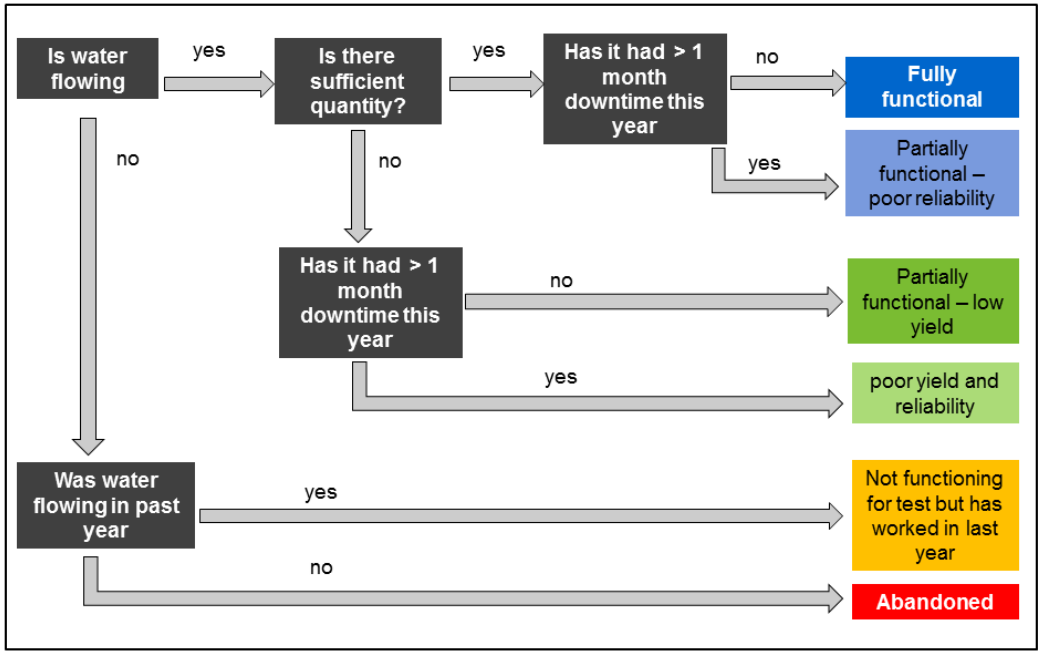
Hidden Crisis: unravelling failures for future success

- Handpumps (HP) are widespread, c.200 million people use c.0.5 to 1.5 million HPs in SSA.
  (MacArthur, 2015, Foster et al., 2019, Danert, 2022).
- Millions will continue to rely on HPs in future.
- HPs can be a resilient form of water supply.
- 15 – 40% of rural water supplies are non-functional at any time.
- Interdisciplinary research in Ethiopia, Malawi, Uganda to better understand:
  - HP functionality status.
  - ***Relationship between underlying socio-material factors and HP performance.***

Handpump borehole functionality – example from Ethiopia



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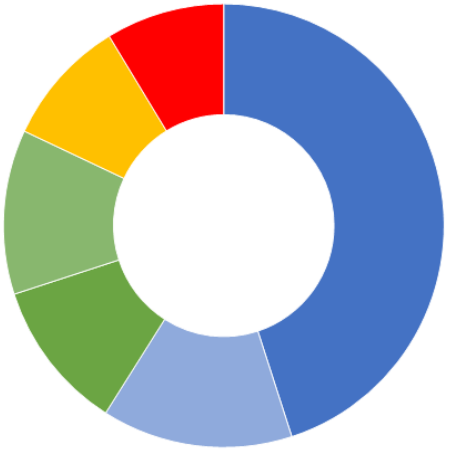
82%, functional / non-functional

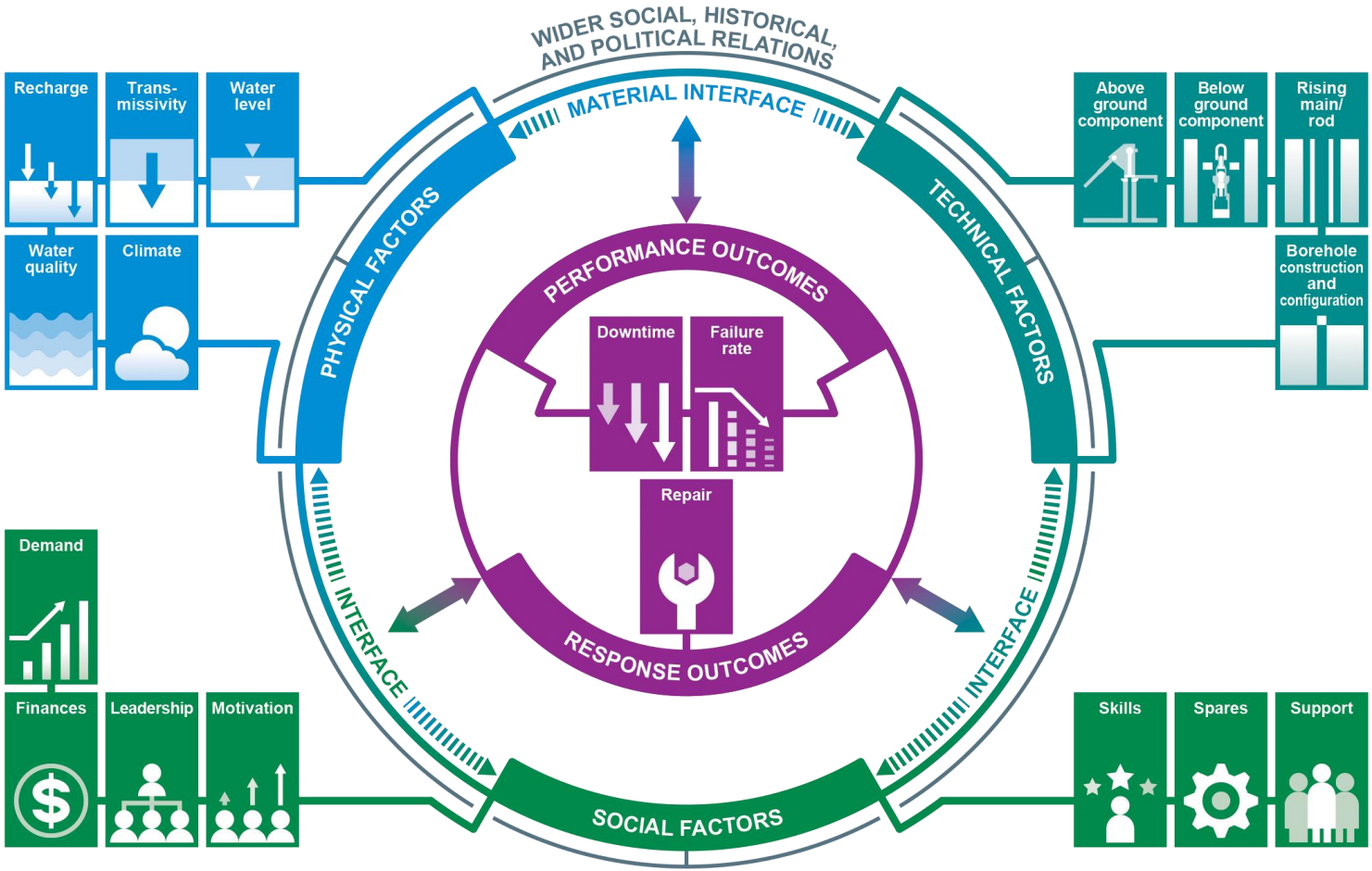


45%, good yield and reliable

Bonsor, H., et al. (2018). "The need for a standard approach to assessing the functionality of rural community water supplies." Hydrogeology Journal **26**(2): 367-370.

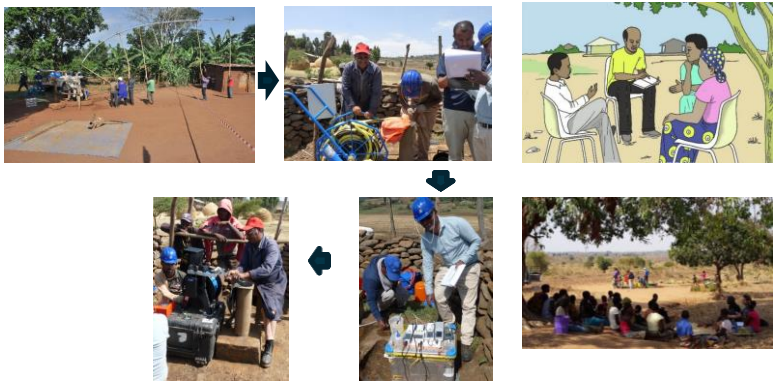
Kebede, S., et al. (2017). "UPGro Hidden Crisis Research Consortium. Survey 1 Country Report, Ethiopia."
http://nora.nerc.ac.uk/id/eprint/516998/

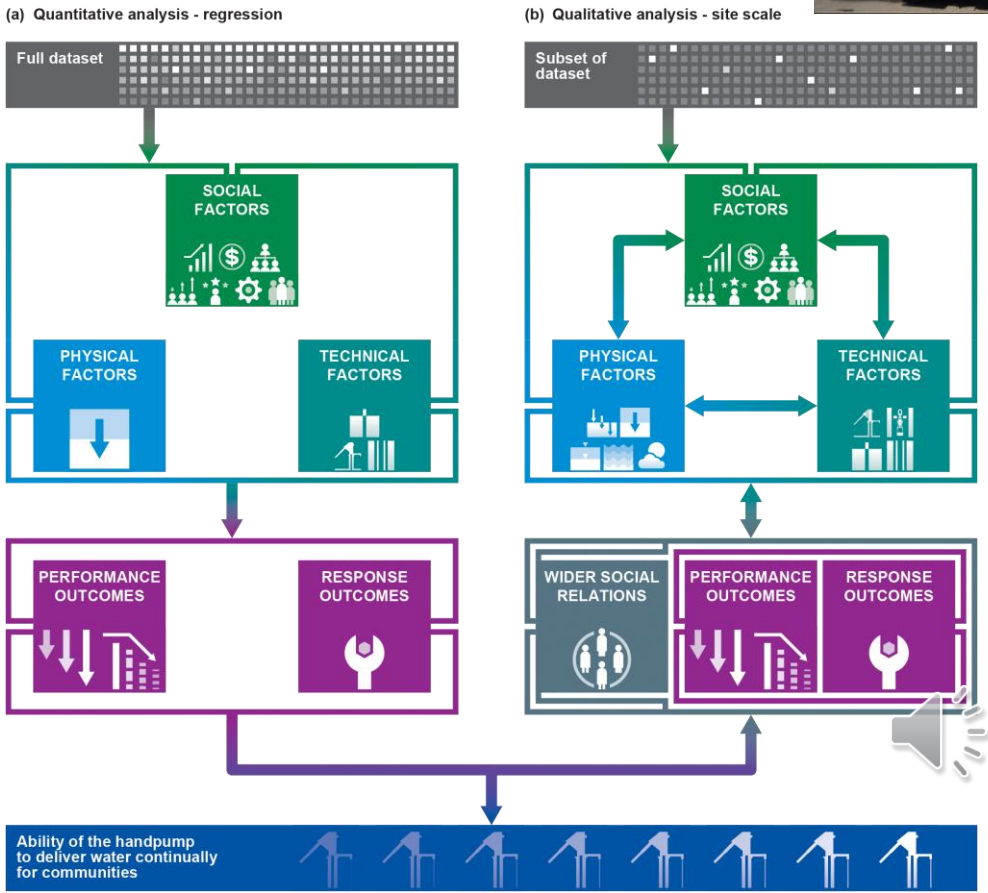
The socio-material interface



Investigating the socio-material interface

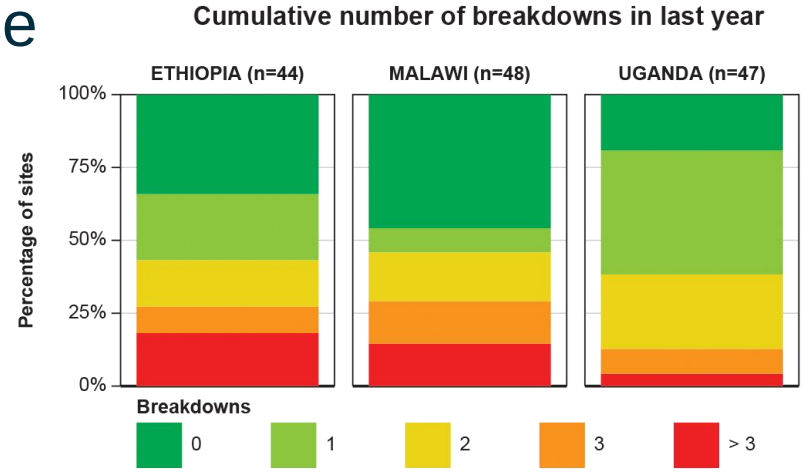
- Interdisciplinary fieldwork at 150 HPs in Ethiopia, Uganda and Malawi.
- Quantitative: Logistic, ordinal, and multinomial regression.
- Qualitative: Small sub-set of sites selected for in-depth qualitative analysis.

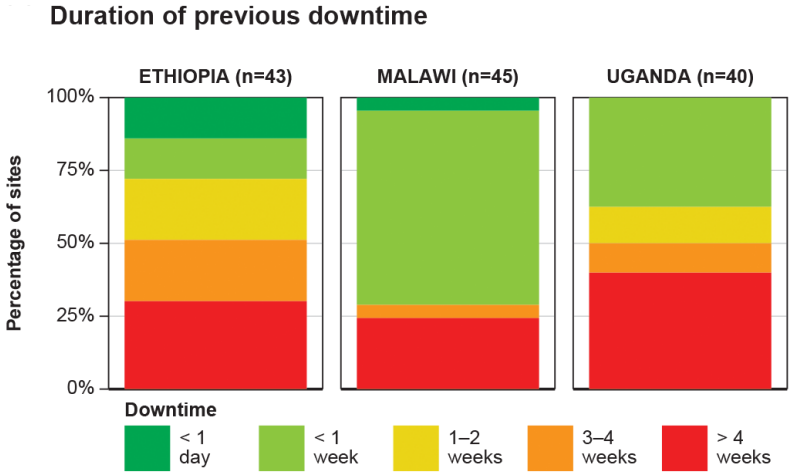


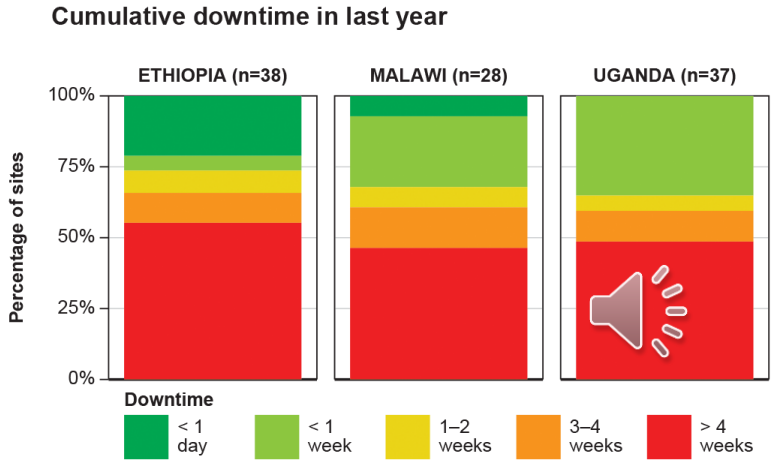


Handpump borehole performance

- Up to two breakdowns per year is most common, more is rare.
- Highest proportion of HPs with > 3 breakdowns and > 3 weeks previous and cumulative downtime in Ethiopia.
- Highest proportion of HPs with previous and cumulative downtimes < 1 week in Malawi.

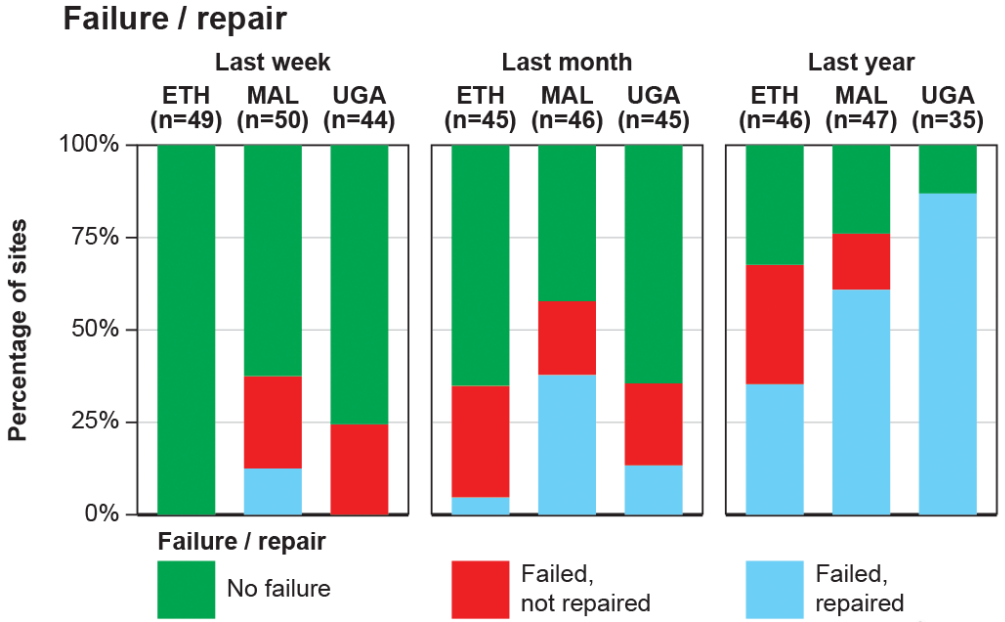




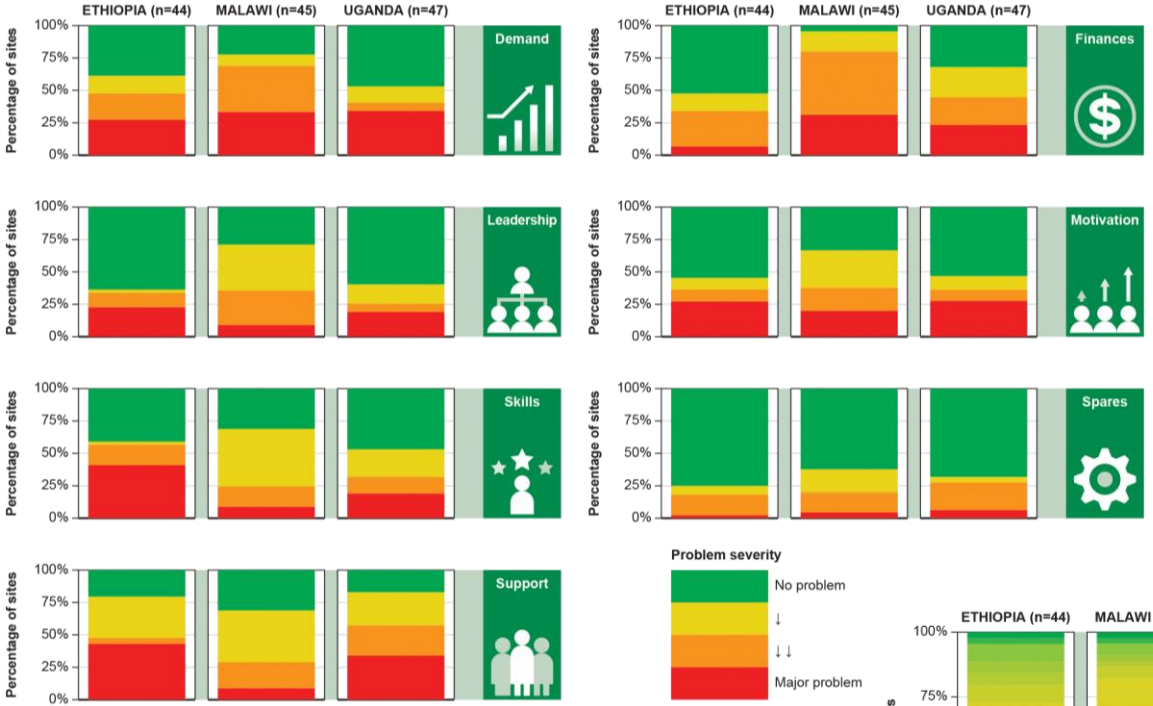


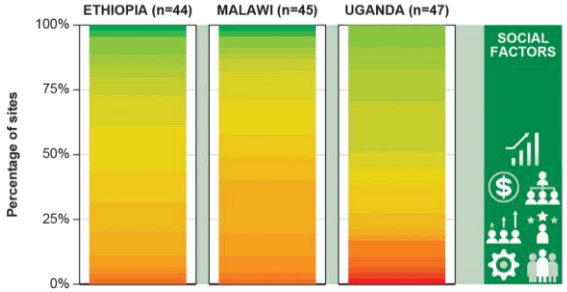
Repair of handpump boreholes

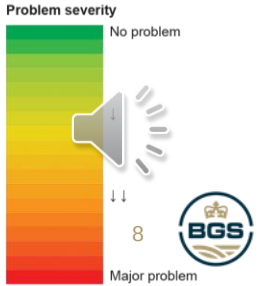
- Malawi experienced quickest repair times (12% in one week, 38% within a month).
- Repairs least likely within a year in Ethiopia (35% needed repair only 51% repaired).
- In Uganda 87% of HPs that needed repair were repaired within a year.



Social factor state

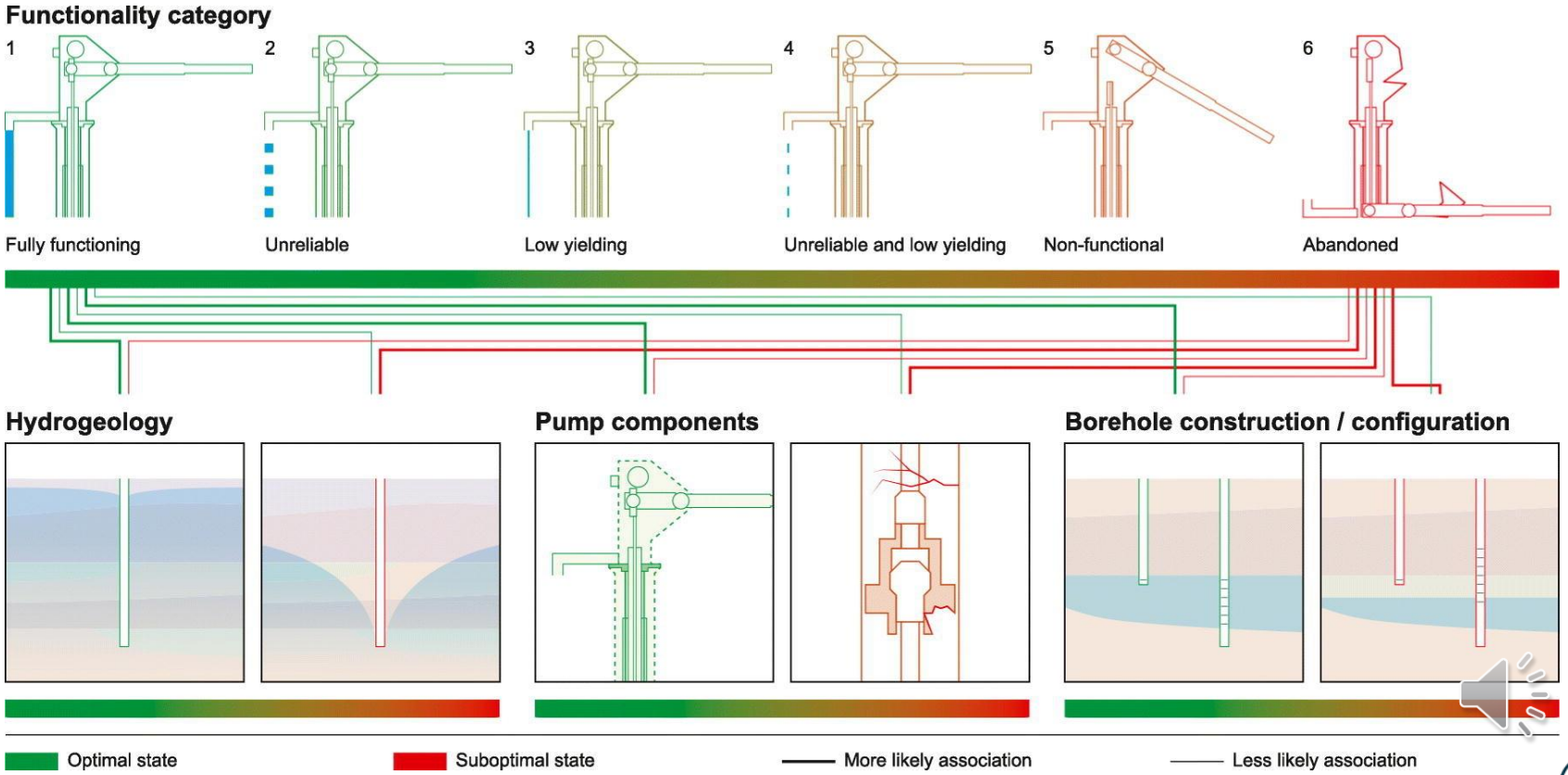






- Malawi has weakest social context.
- Least problems across factors in Ethiopia.
- Access to spares is the least problematic issue.
- Access to external support, finance are the most problematic issues.

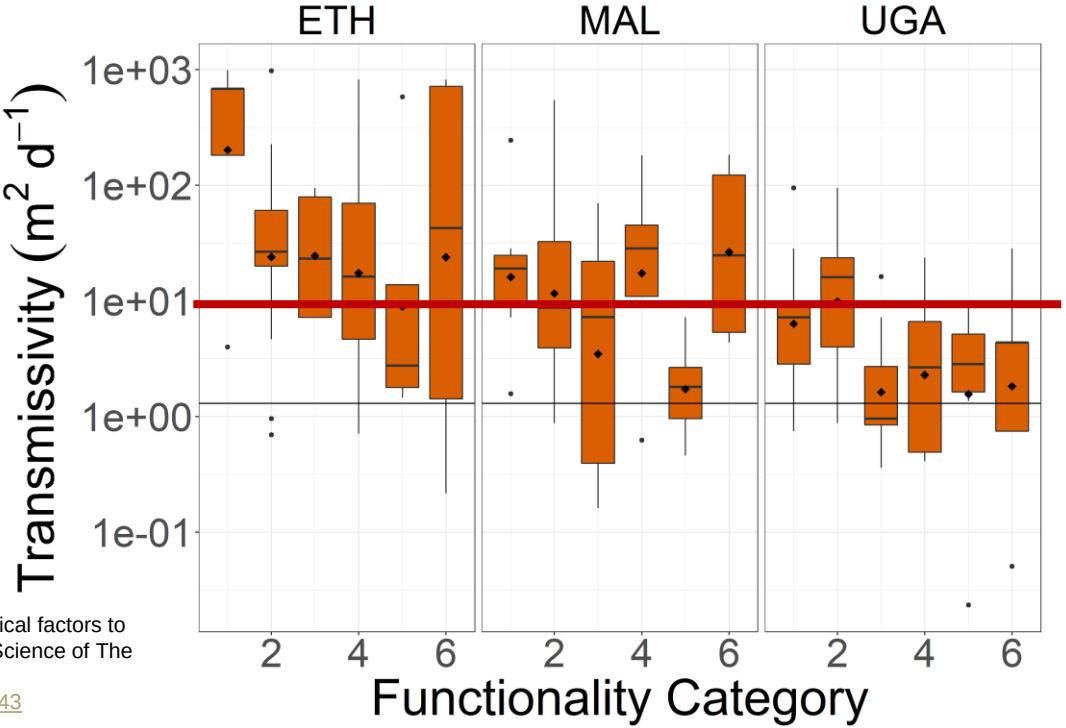
Influence of physical and technical factors on functionality



MacAllister, D. J., et al. "Contribution of physical factors to handpump borehole functionality in Africa." Science of The Total Environment 851 (2022): 158343.
https://doi.org/10.1016/j.scitotenv.2022.158343

Hydrogeology – aquifer pumping test

- Transmissivity (a measure of the ability of water to move through the aquifer) particularly problematic in Uganda.
- Transmissivity results have implications for larger reticulated systems (e.g. solar pumps).



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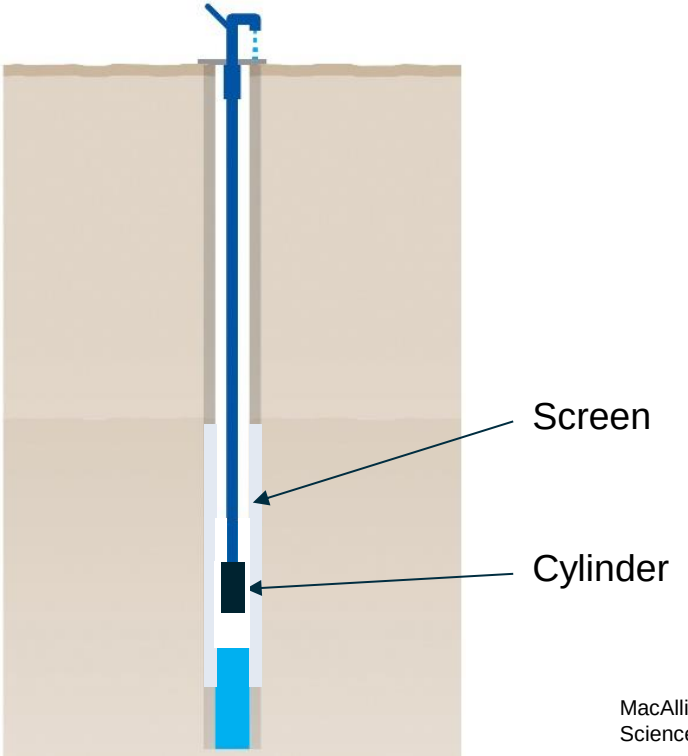
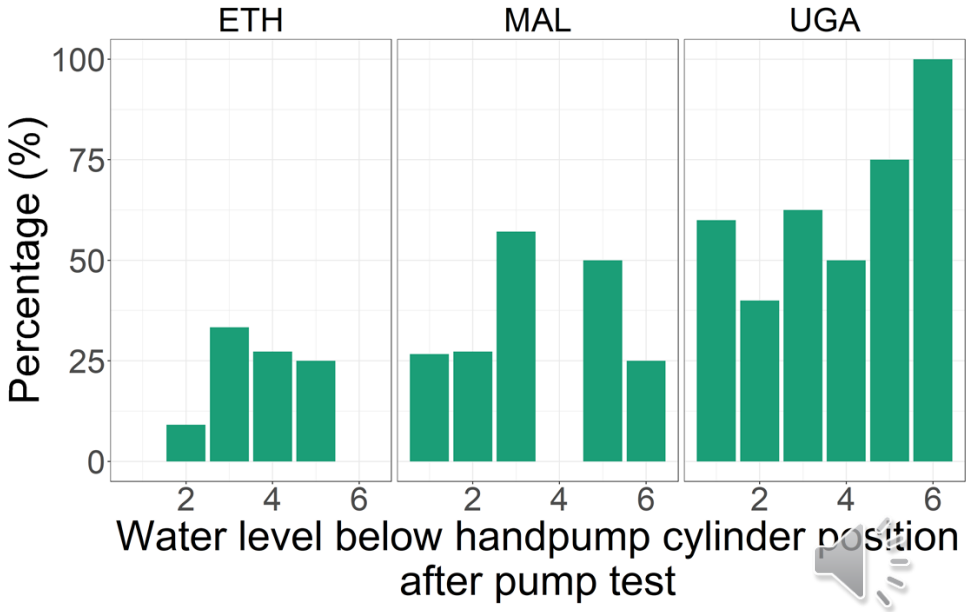
Borehole construction and configuration – CCTV survey

- Due to design or maintenance flaws, risk of water dropping below cylinder at many sites.
- In dry season this means handpump cannot extract water.





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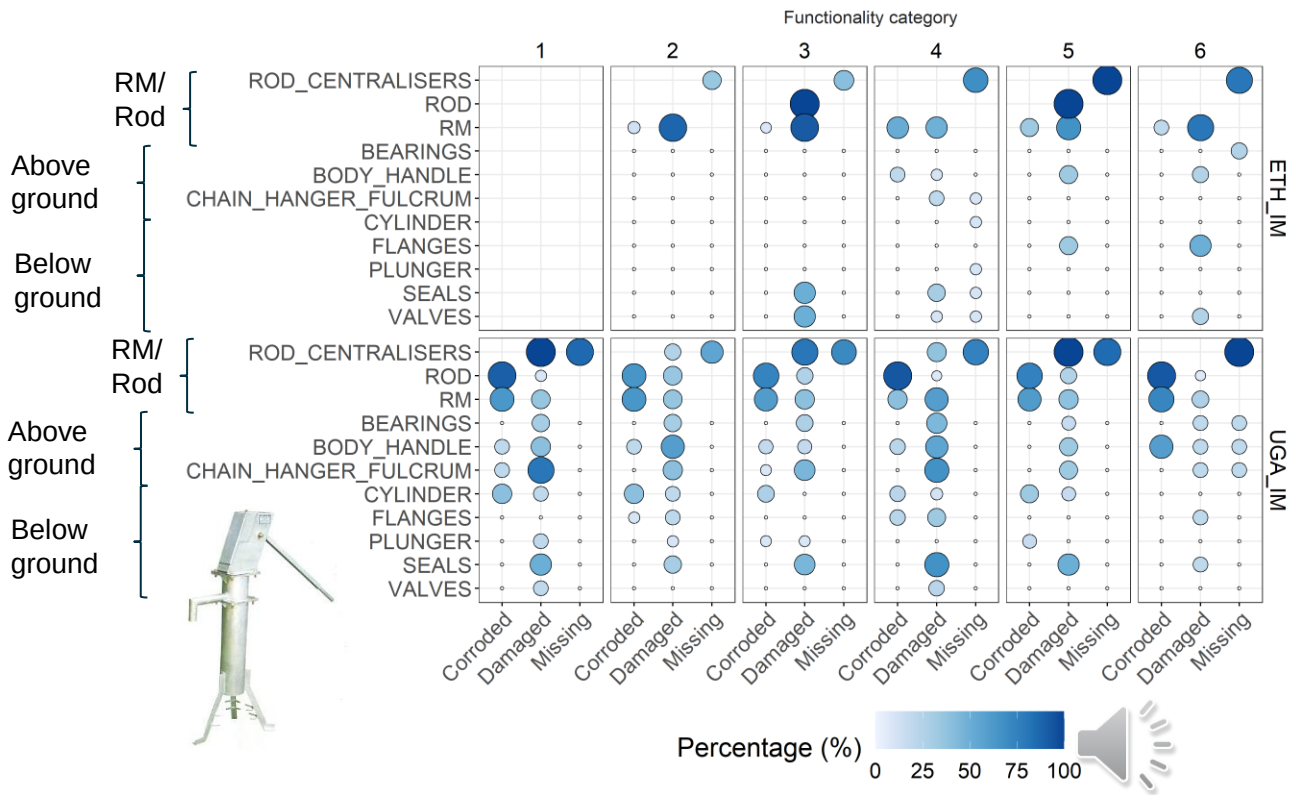
Handpump component condition – India Mark II



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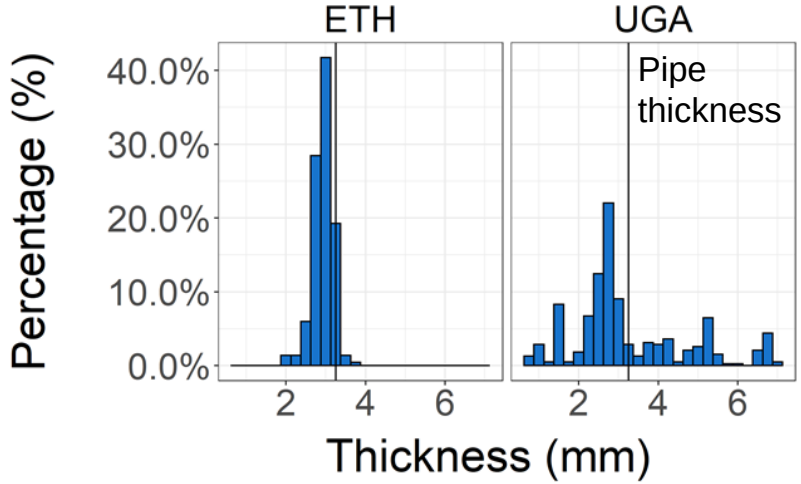
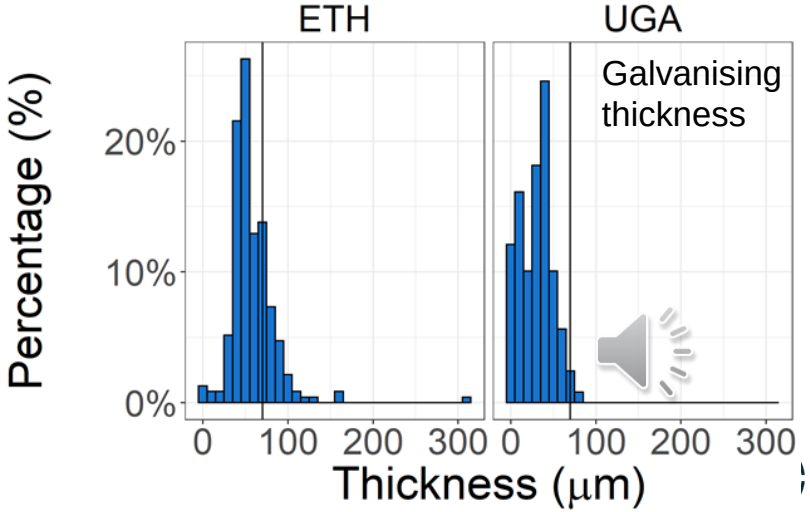
Handpump component condition

- Corrosion of IM2 rising main (RM) in Uganda:
  - 65% thickness below spec. (3.25 mm ±0.2 mm)
  - 90% galvanising thickness below spec. (70- 80 µm)
  - > 80% of RMs corroded.



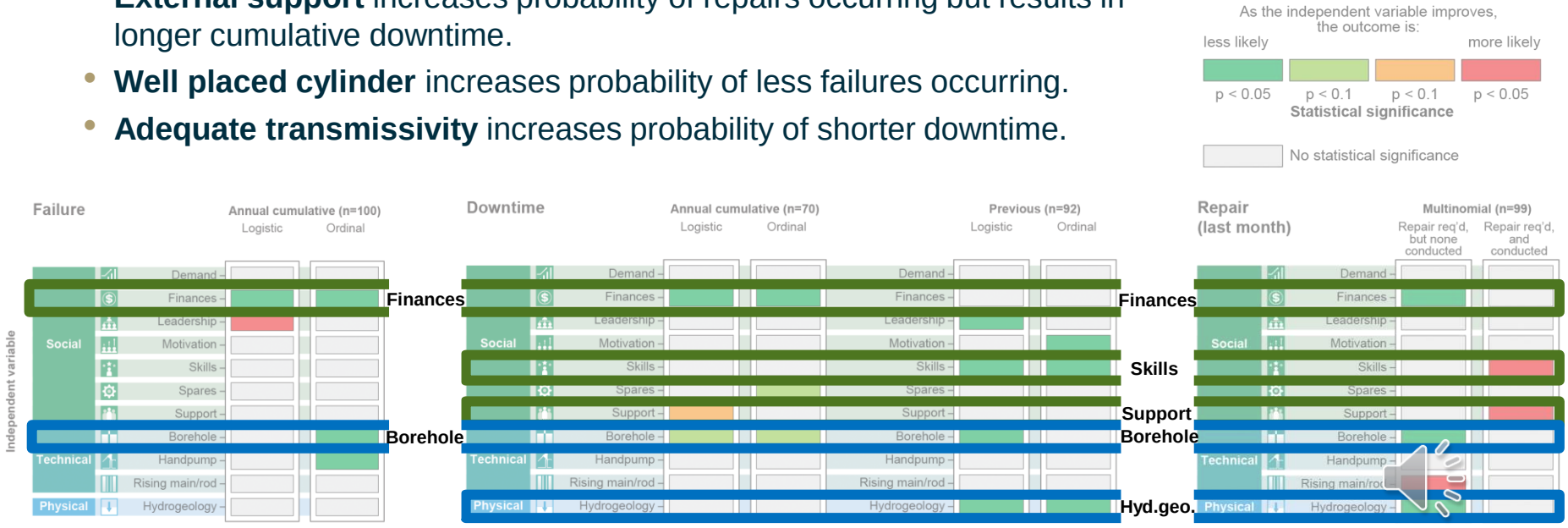


Kebede, S., et al. (2019). "Physical factors contributing to rural water supply functionality performance in Ethiopia."

Owor, M., et al. (2019). "Physical factors contributing to rural water supply functionality performance in Uganda."

Socio-material factors influence on performance

- **Finances** are important across all performance and response outcomes.
- **Skills in the community** increase probability of repair occurring and shorter downtimes.
- **External support** increases probability of repairs occurring but results in longer cumulative downtime.
- **Well placed cylinder** increases probability of less failures occurring.
- **Adequate transmissivity** increases probability of shorter downtime.



Logistic = < 1 breakdown / > 1 breakdown

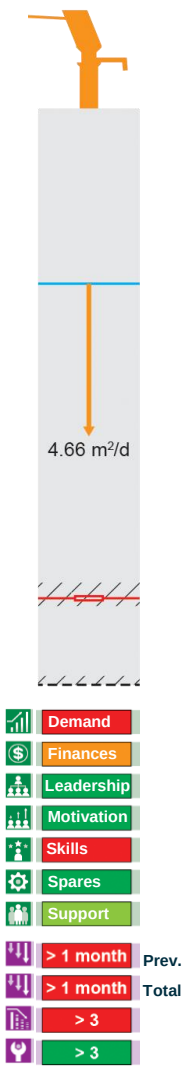
Ordinal = none / 1 / 2 / 3 / >3

Logistic = < 1 week / > 1 week

Ordinal = < 1 day / < 1 week / 2 – 4 weeks / > 4 weeks)

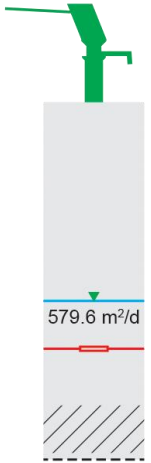
Abeshge, Ethiopia (EAE01)

- Until recently technical ***support*** for the HP was provided by an NGO with equipment to remove pipes during repair. The community were happy.
- The NGO left and handed technical support over to the Woreda water office. They don't have the right equipment and must remove pipes by hand.
- As a result, Woreda staff are reluctant or unable to perform some repairs.
- Often repairs are followed quickly by breakdowns. In the previous instance, only two jerry cans were filled before the HP stopped working.
- This has created tension between the community and the Woreda, the community feel that their support is not being carried out in good faith.



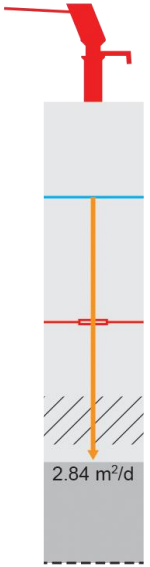
Abeshge, Ethiopia (EAE07)

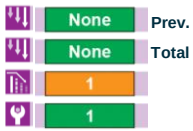
- Strong governance within the community (HP committee, village council, and ‘idir’ – a traditional burial society) and good ***hydrogeological*** conditions, has resulted in good HP performance.
- This has allowed the governance structure to evolve beyond the waterpoint.
- The community increased HP fees (***finance***) from 10 to 25 cents to fund other projects, including piped water with tap stands.
- However, the HP can also be used as an instrument of control. The HP is locked to ensure community members attend meetings or contribute time and labour to projects.



Oyam, Uganda (UOY08)

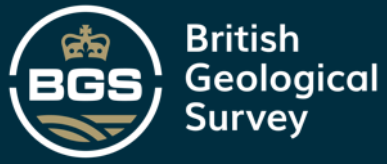
- Reasonable ***hydrogeology*** and an effective management arrangement, evidenced by minimal downtime, have resulted in the HP ***finance*** system evolving into an interest-accruing loan scheme.
- The need to finance this scheme, and the potential to accrue interest, has increased the impetus to collect user fees.
- The scheme has been accompanied by a harsher system of fines and rules relating to the use of the HP are strictly enforced.
- Good performance of this HP is implicated in the evolution of an institutional innovation that, despite enabling that good performance, has the potential to promote perverse incentives and is liable to abuse.





Conclusions

- Handpumps (HP) can provide a reliable and resilient form of improved rural water supply.
- HP performance and response outcomes vary considerably between countries.
- Key factors influencing performance and response outcomes:
  - Social factors: Finance, Skills, Support
  - Analysis of social factors shows external support and finance are the most problematic issues.
  - Physical factors: Hydrogeology, Borehole construction and layout.
- Complex multidimensional interactions exist between social, physical and technical factors, and performance and response outcomes.
- Rural water programmes need to recognise and work with the unique and complex socio-material context encountered in individual communities (*going with the grain*) .
- Understanding socio-material dynamics can increase likelihood of success of new technologies, e.g. solar, and improve access to water and resilience of communities.



THANK YOU

Any questions?

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