



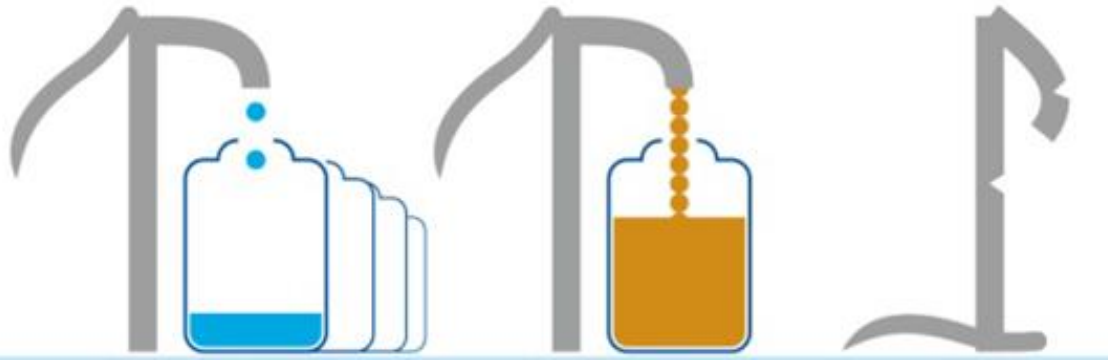
British Geological Survey

NATURAL ENVIRONMENT RESEARCH COUNCIL

Gateway to the Earth

Hidden Crisis

Understanding functionality of hand pumped borehole water supply in sub-Saharan Africa



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The University of Sheffield.



UNIVERSITY OF MALAWI



KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY



FLINDERS UNIVERSITY



UNIVERSITY OF CAMBRIDGE

UP Gro

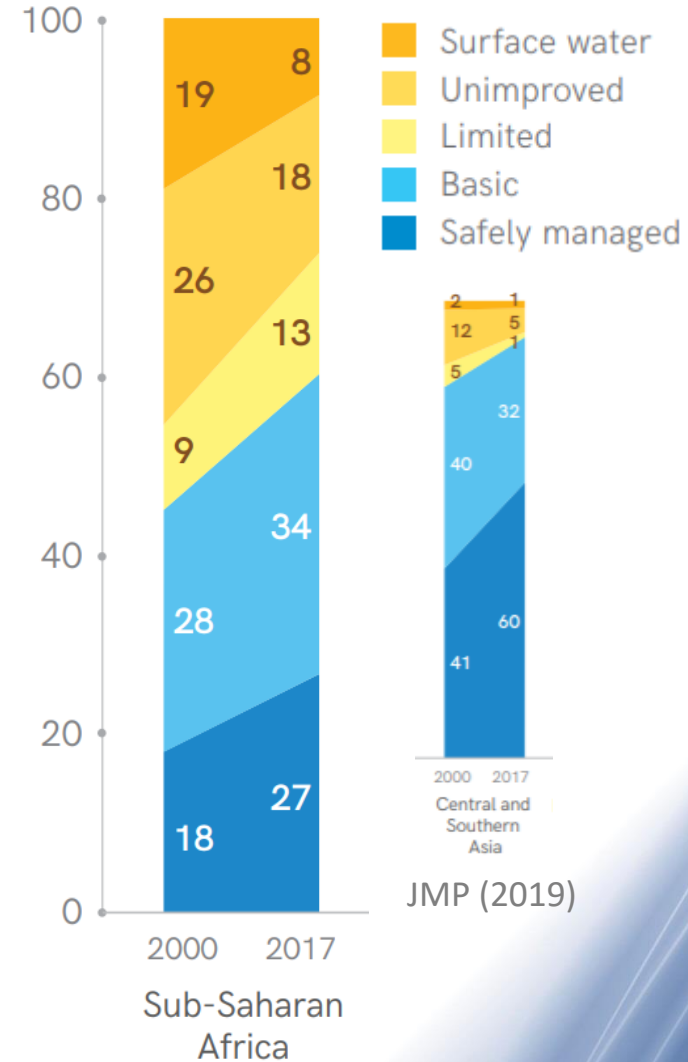
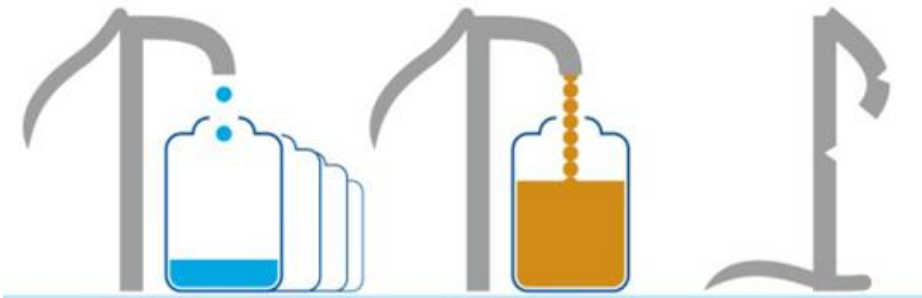
Unlocking the Potential of Groundwater for the Poor

Funded by:



Why functionality?

- Millions will continue to rely on hand pumped boreholes (HPB) for water supply.
- Growing body of evidence (1970s – now) suggests that 15 – 40% of HPBs are non-functional.
- The benefits of improved access to water are lost as a result of non-functionality.
- Non-functionality has a social and economic cost.
- Functionality and performance of HPBs are often hidden by a focus on coverage.



Hidden Crisis

*From anecdote to evidence
to understand functionality.*

Interdisciplinary. Five objectives:

1. Define functionality of boreholes and water committees.
2. Apply to Uganda, Ethiopia and Malawi to explore current status – SURVEY 1
3. Detailed interdisciplinary analysis to answer WHY questions – SURVEY 2
4. Trends and forecasts – longitudinal studies and modelling.
5. Interdisciplinary analysis.

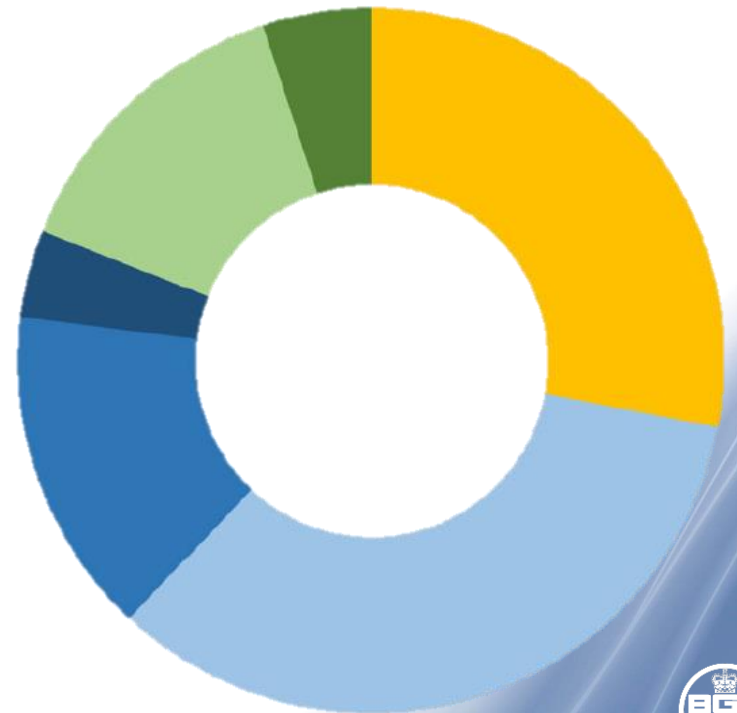


Defining functionality

Definitions from the literature

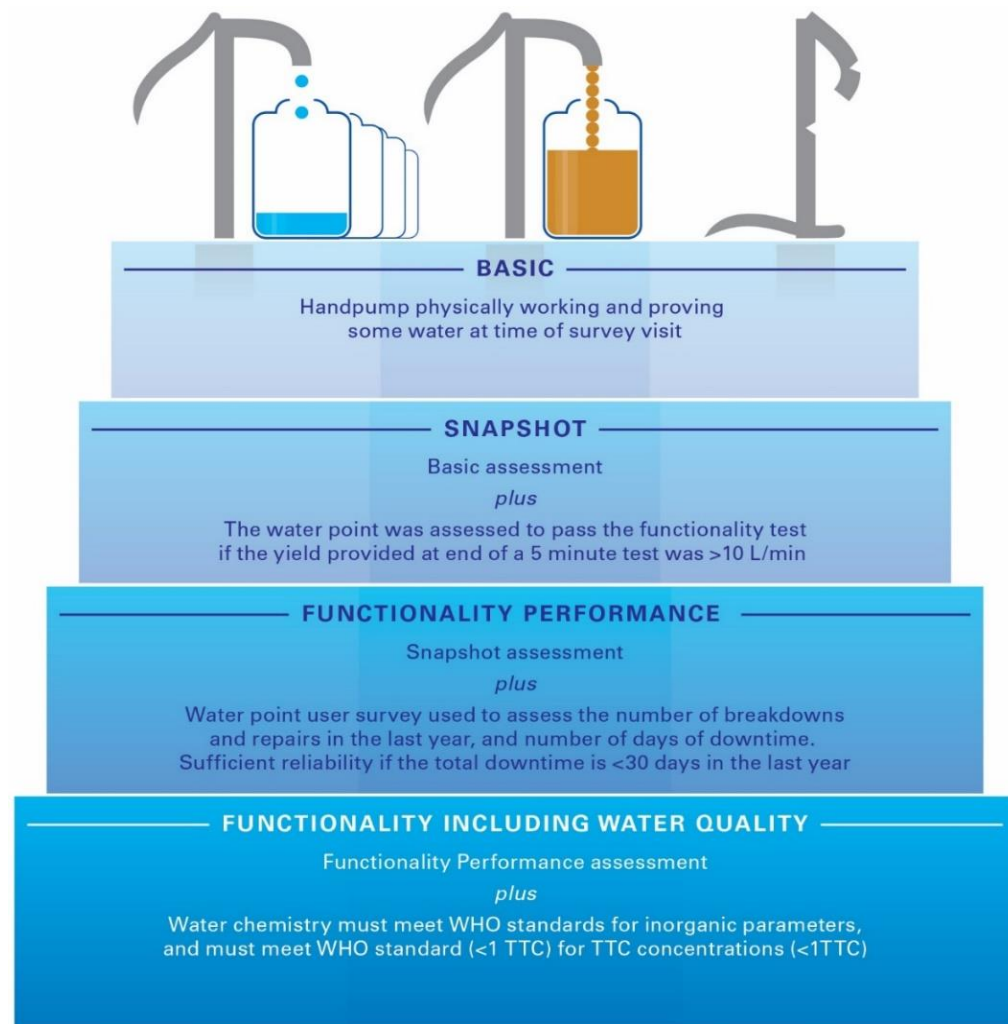
1. No definition
2. Binary: working/not working
3. More complex definitions – e.g. partially working
4. Tiered definitions
5. Broad sustainability assessment
6. Assessed against standard

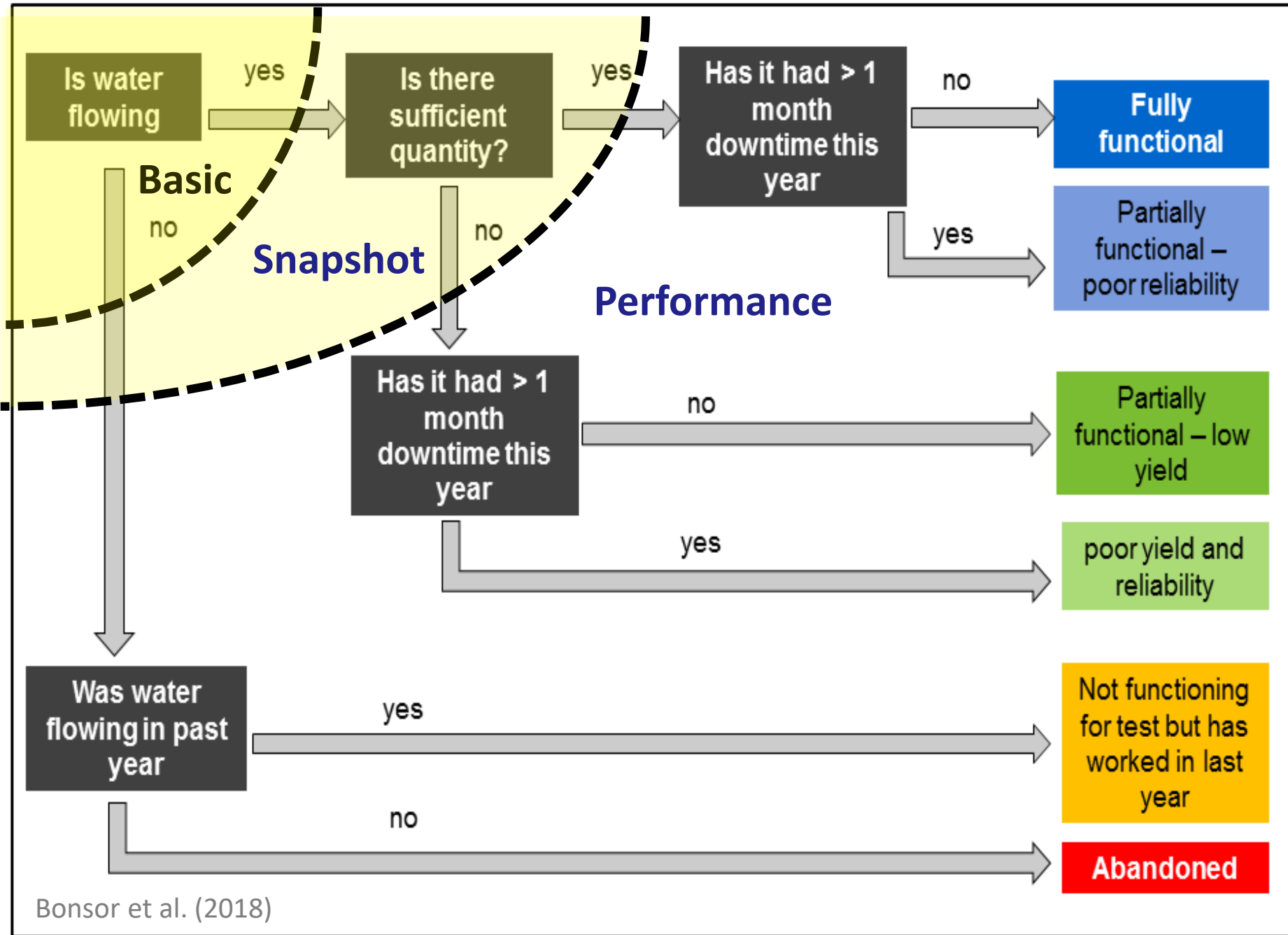
- 1 - Not Defined
- 2 - Defined binary approach
- 3 - Multi-categories
- 4 - Tiered definition
- 5 - Sustainability assessment
- 6- Design Yield



Defining functionality

- Measure against an explicit standard and population.
- Measure separately from the users' experience.
- Allow for tiered assessments.
- Distinguish between snapshot and temporal.



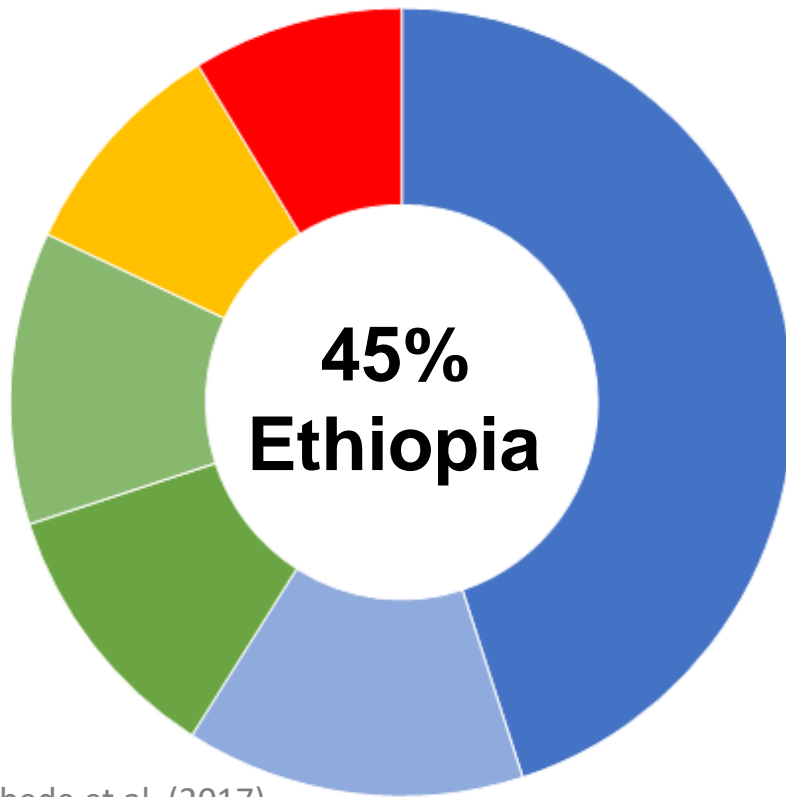


Survey 1 – 600 HPB

- Two stage randomised stratified sampling.
- Physical survey: stroke test, well head observations, water chemistry, TTCs + tryptophan, downtime.
- Social survey: 20 questions - assessing functionality of the water committee, general governance of water point, user perceptions of service level.



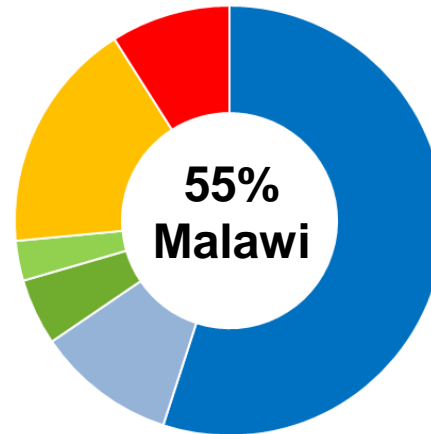
Results



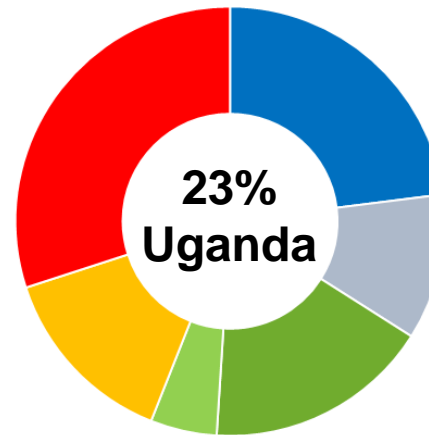
Kebede et al. (2017)

With water quality only **28%**

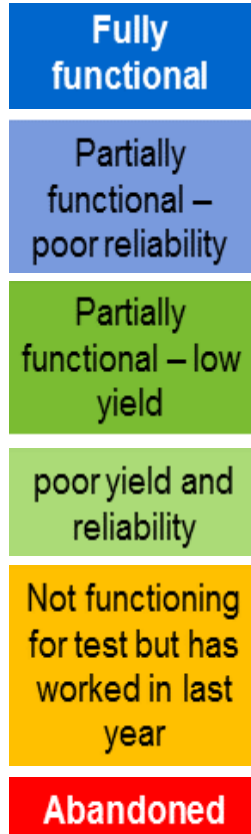
Binary results reflect national surveys.



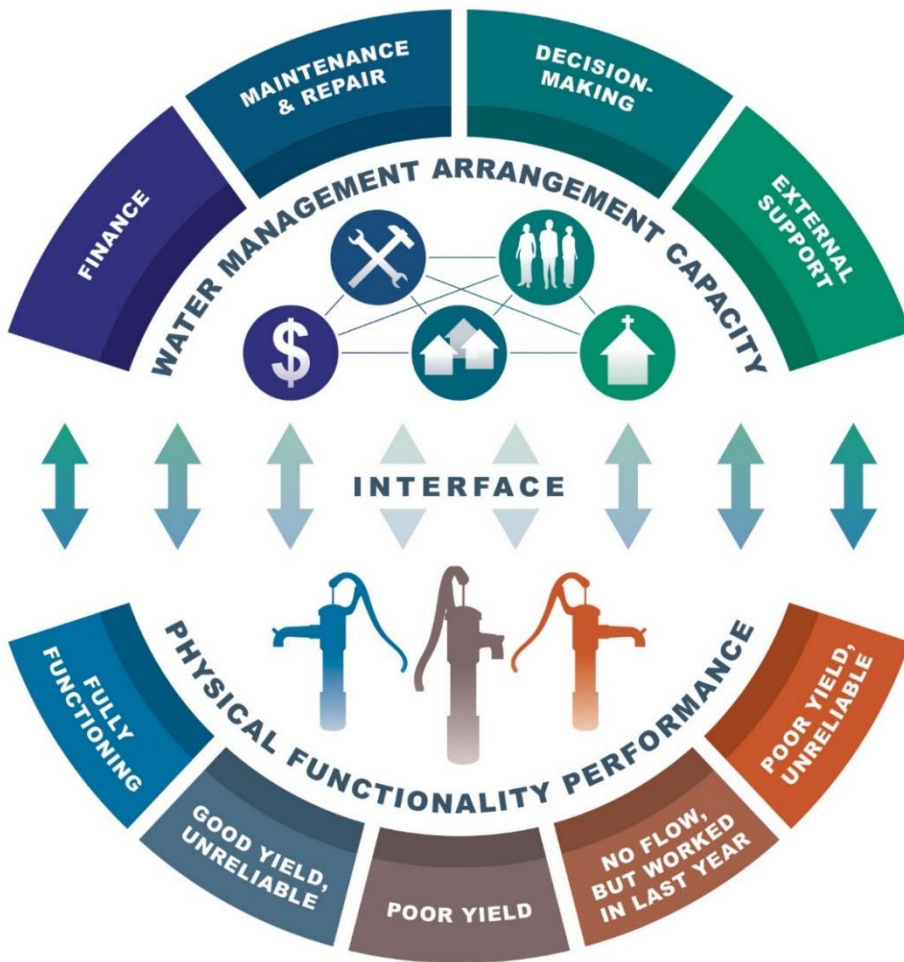
Owor et al. (2017)



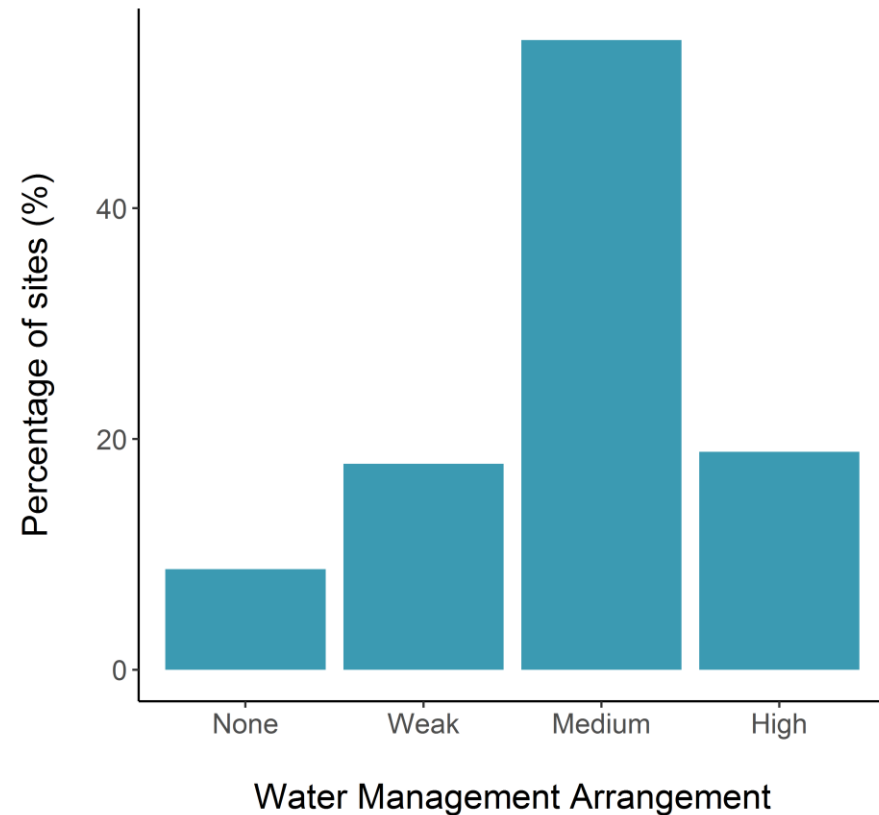
Mwanthunga et al. (2017)



Functionality and management



Whaley et al. (2019)

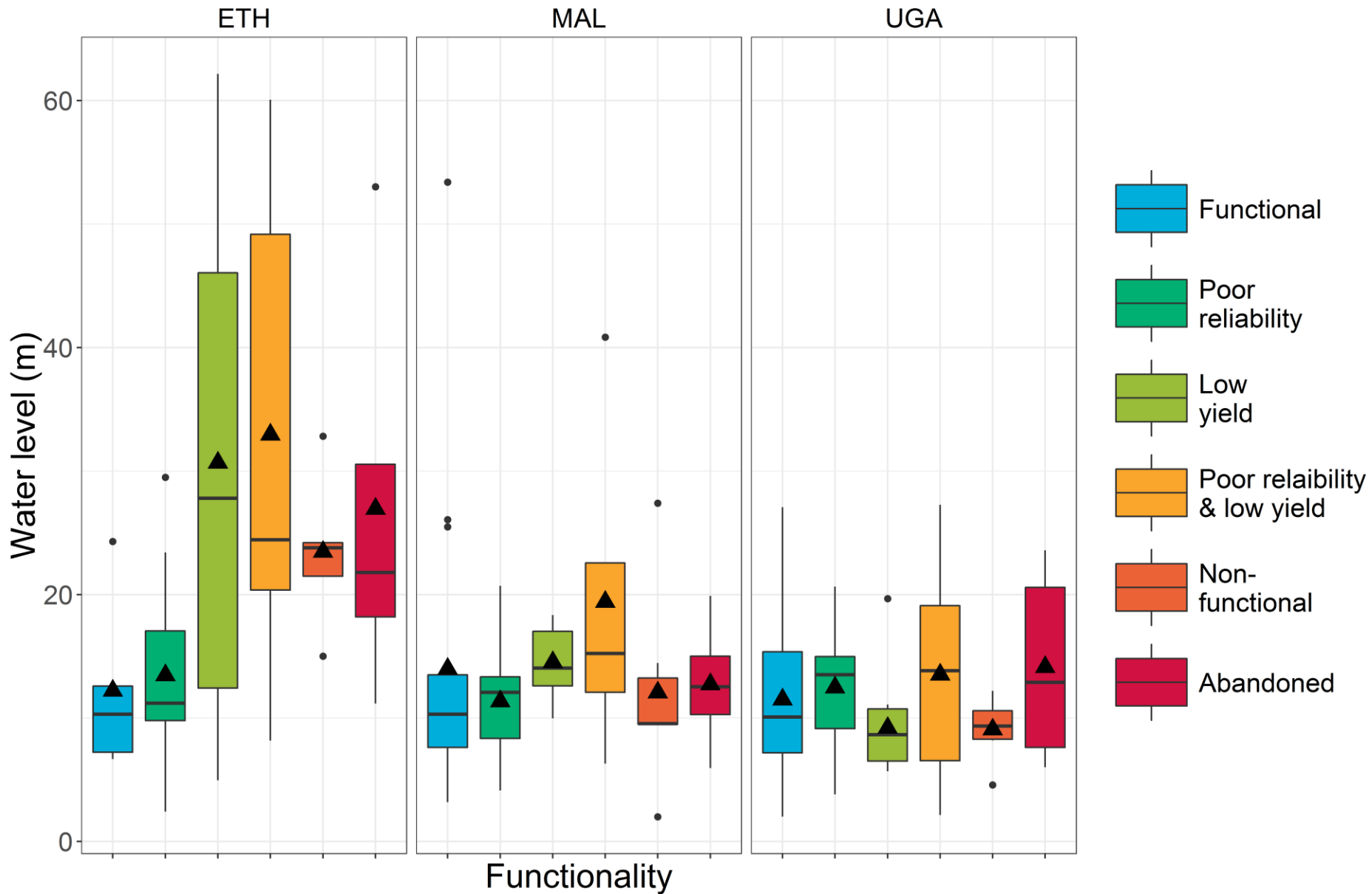


Survey 2 – 150 HPB

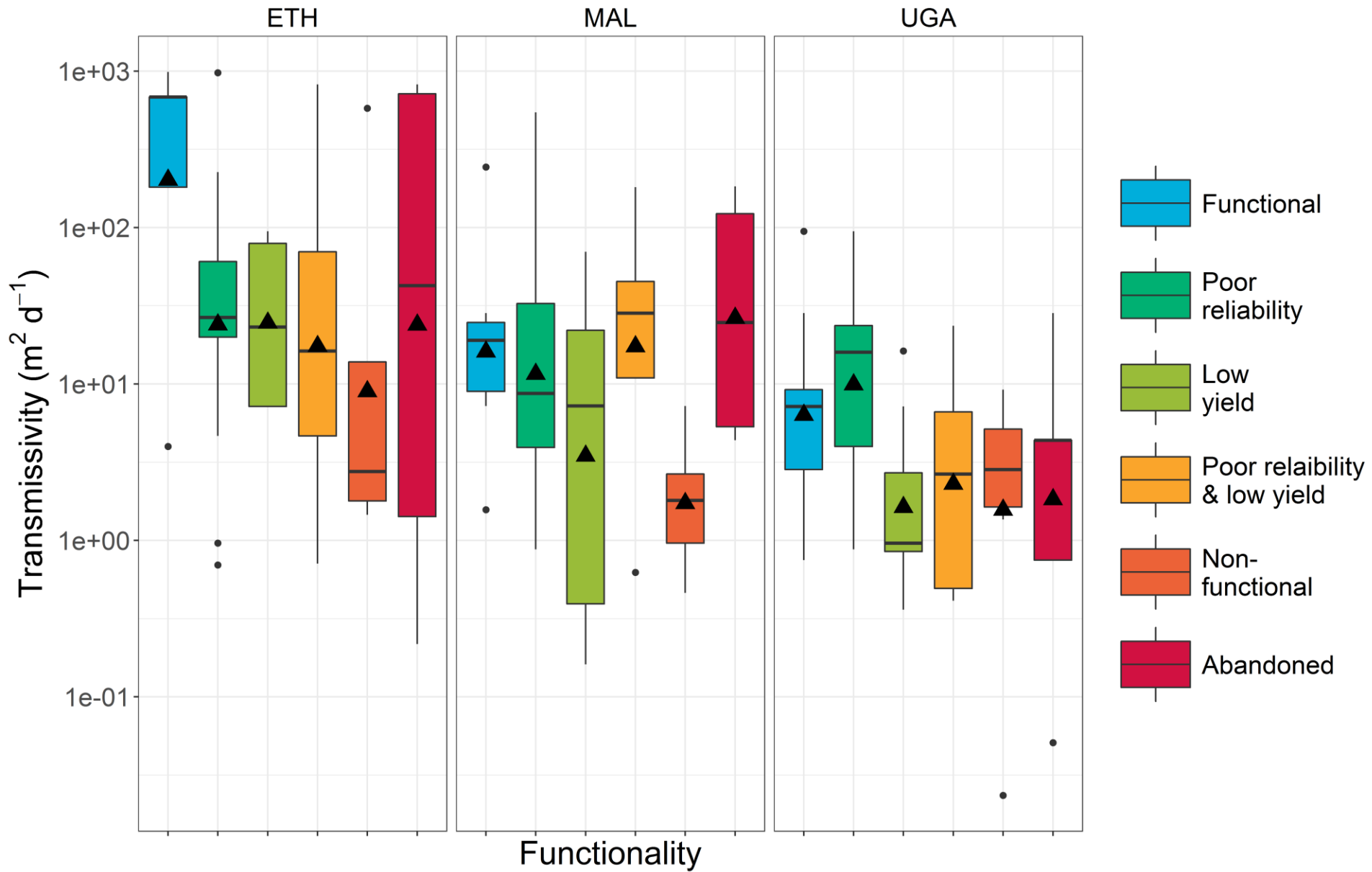
- Forensic assessments of Survey 1 sub-sample.
- Social science: focus groups, transect walks.
- Physical survey: sanitary & engineering survey, pumping test, water chemistry, CCTV survey, questionnaires (reliability, downtime, quantity, quality).



Water level

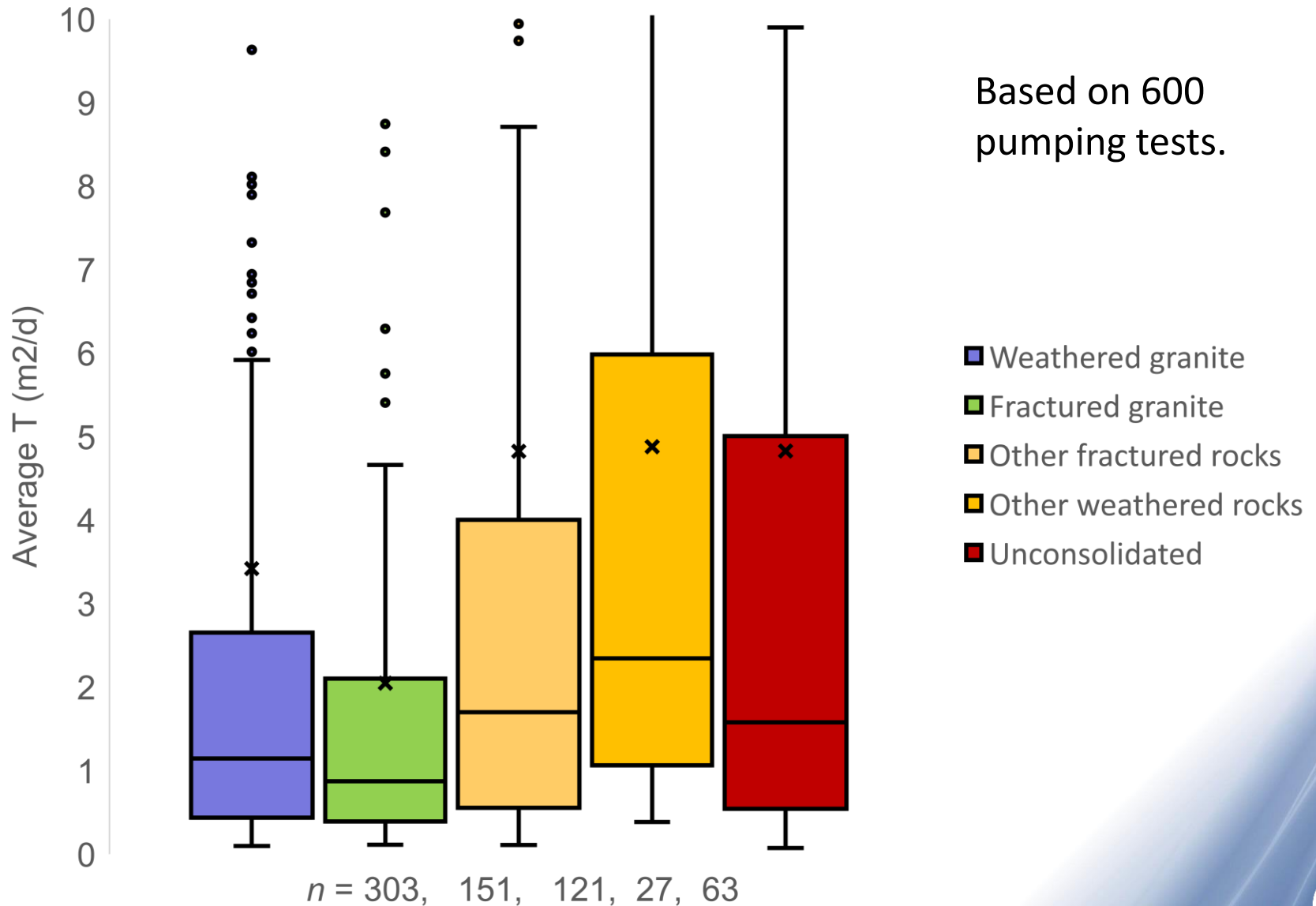


Aquifer yield

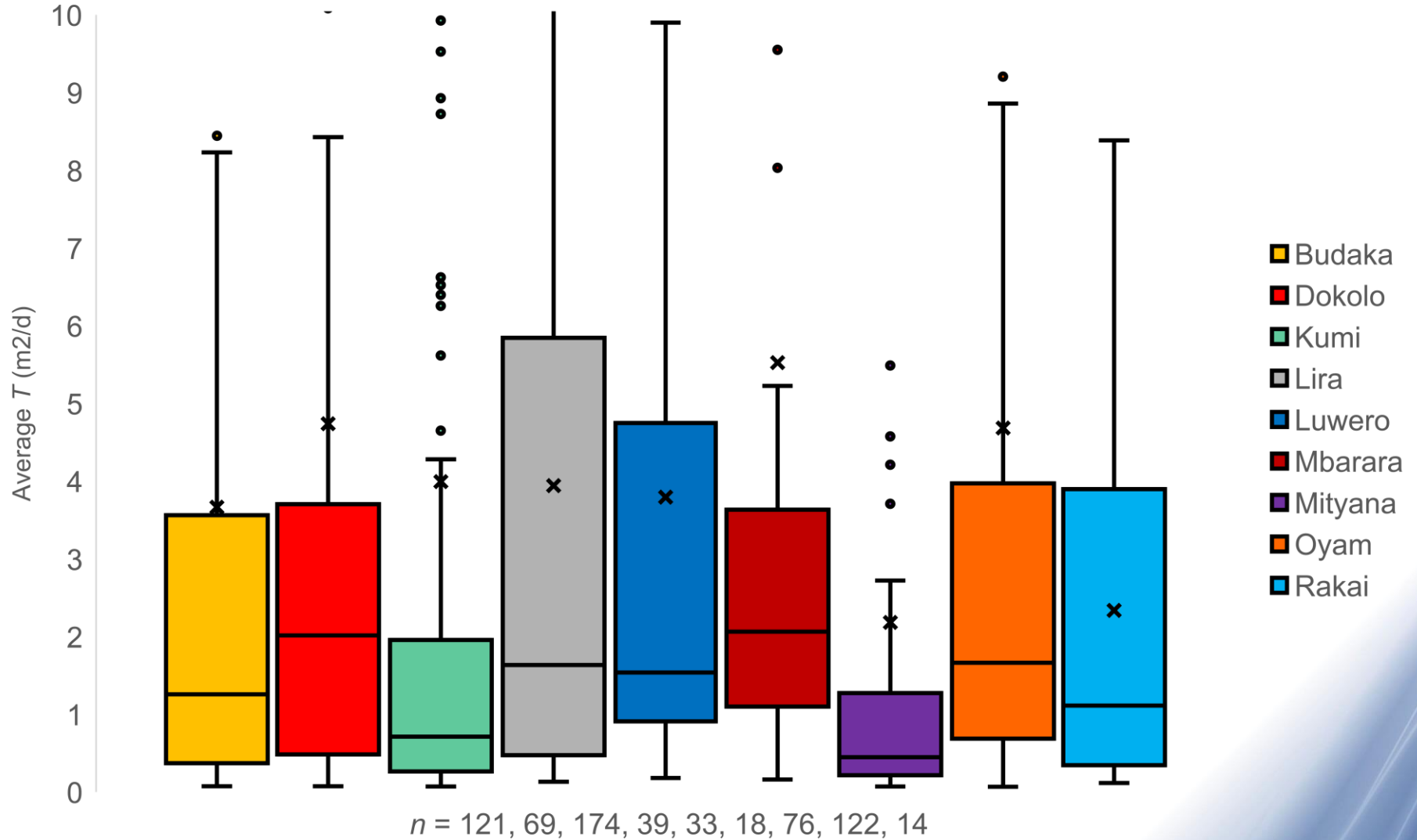


Uganda T (m²/d) - Lithology

Based on 600 pumping tests.



Uganda T (m^2/d) - District



Integrated analysis



Malawi

Hydrogeology

Borehole

Pump (rising main)



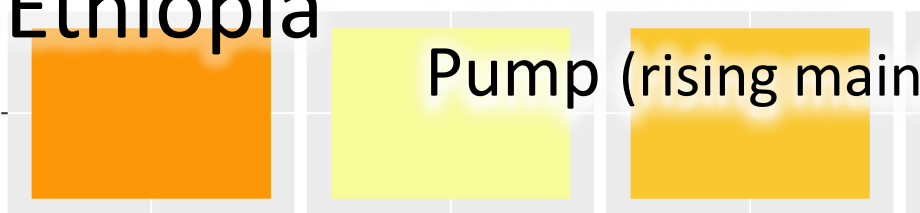
Hydrogeology

Ethiopia

Pump (rising main)

Variable

PUMP-



Uganda

Hydrogeology

Management



PUMP



Conclusions

- Nuanced definition of functionality provides:
 - Binary results reflecting national surveys.
 - Tiered categories providing extra information on yield and reliability.
- Management and functionality weakly linked.
- Determinants of functionality (initial results):
 - Hydrogeology
 - Rising main condition.
 - Borehole construction.
- The management/functionality dynamic is highly complex.
- Analysis on-going:
 - Seasonality, downtime and failure rates.
 - Exploring causal pathways.
- **Functionality is complex and multifaceted but must be understood to sustain increased access to improved water supply in SSA.**

