UP Gro Unlocking the Potential of Groundwater for the Poor

UPGro Hidden Crisis Research Consortium

Unravelling past failures for future success in Rural Water Supply

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Survey 1 Country Report – Malawi

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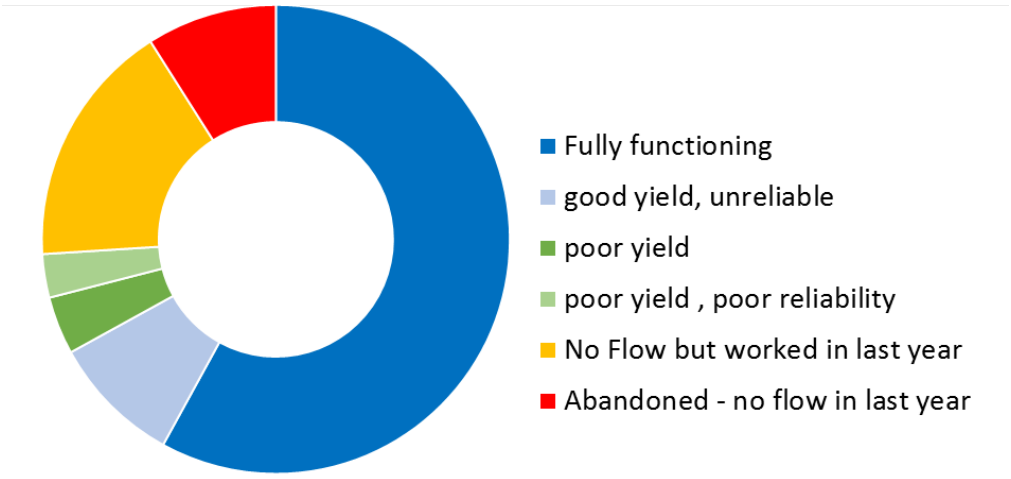
Executive Summary

Statistics on the functionality of water points from the Hidden Crisis project in Malawi are presented. The survey, undertaken in 2016, was focussed on boreholes equipped with handpumps (HPBs) within sedimentary and basement rock in Malawi across 5 districts. A stratified two-stage sampling strategy was adopted, and a tiered definition of functionality developed which enabled more nuanced definitions to be reported. The results from the survey indicate:

- 74% of HPBs were working on the day of the survey (similar to national statistics)
- 67% of HPBs passed the design yield of 10 litres per minute
- 58% passed the design yield and also experienced < 1 month downtime within a year.
- 41% of HPB's passed the design yield and reliability and also passed WHO standards of water quality indicators (TTCs and inorganic chemistry).

These figures provide a more detailed examination/understanding of the national functionality figures (MoWDI 2012[1]). Both approaches show, that at any one point in time approximately 74% of HPBs in Malawi are working. The results from the more detailed Hidden Crisis survey across a sub-sample of HPBs across Malawi, indicate that 42% of the working HPB's do not provide sufficient yield or reliability. This highlights the utility of carrying out more detailed assessments of functionality to help unpack national statistics. A linked survey of the performance of the water management arrangements at water points showed that for 86% of the survey sites water management arrangements were judged to be functional or highly functional.



Functionality assessed for boreholes equipped with handpumps within Malawi. The functionality criteria used were: sufficient yield (>10 L/min) on day of survey; and less than 30 days downtime reported for the past year.

[1] Ministry of Water Development and Irrigation (MoWDI). 2012. Malawi Sector Performance Report 2011: Irrigation, Water and Sanitation, 106pp.

The *Hidden Crisis* project is a 4 year (2015-19) research project aimed at developing a robust evidence base and understanding of the complex and multi-faceted causes which underlie the current high failure rates of many new groundwater supplies in Africa, so that future WASH investments can be more sustainable. The project is being undertaken by an interdisciplinary team of established researchers in physical and social sciences from the UK, Ethiopia, Uganda, Malawi and Australia, led by the British Geological Survey.

Acknowledgements

Whilst the authors of this report reflect the team directly responsible for undertaking and facilitating the Survey 1 field programme in Malawi, the design of the field research programme, and the definitions of functionality presented are the joint work of the whole *Hidden Crisis* project team. The project team involves an interdisciplinary consortium of established researchers in physical and social sciences from:

- British Geological Survey
- Sheffield University
- Overseas Development Institute
- Flinders University, Australia
- Addis Ababa University, Ethiopia
- Makerere University, Uganda
- University of Malawi
- WaterAid UK and country programmes (Ethiopia, Uganda and Malawi)

Contents

1. Introduction

The *Hidden Crisis* project is a 4 year (2015-19) research project aimed at developing a robust evidence base and understanding of the complex and multi-faceted causes which underlie the current high failure rates of many new groundwater supplies in Africa, so that future WASH investments can be more sustainable. The project is being undertaken by an interdisciplinary team of established researchers in physical and social sciences from the UK, Ethiopia, Uganda, Malawi and Australia, led by the British Geological Survey. The research is focused on three countries – Ethiopia, Uganda and Malawi – to examine functionality and performance of groundwater supplies in a range of hydrogeological, climatic and social, institutional and governance environments.

Three different survey phases are being undertaken over two years (2016-18) to collect a significant evidence base, which can be used to develop a more detailed understanding of the causes of poor functionality within the three countries.

1. **Survey 1** – A rapid survey of 200 hand-pump boreholes supplies within each country to establish data on the different levels of functionality performance of hand-pump equipped boreholes and the performance of the local water management committee.
2. **Survey 2** – A detailed survey of 40-50 hand-pump equipped boreholes within each country, designed to provide detailed physical and social science datasets to better understand the underlying causes of poor functionality. Data will be collated by detailed community discussions, as well as deconstructing the water point to examine the construction and hydrogeological properties.
3. **Longitudinal Studies** – are being conducted at a small number of water points (6 -12) in Uganda and Malawi for at least 12 months to monitor temporal changes in: the use and performance of hand-pump boreholes; user perceptions; the capacity of community management; community livelihoods and dynamics; groundwater levels; and rainfall.

2. Assessing Functionality – different levels of performance

The new Sustainable Development Goals (SDGs) set a much stronger focus on sustainability and performance of water services, and have highly ambitious goals to achieve universal access to safe and reliable water for all by 2030 (UN 2013[2]). Poor functionality of water points threatens to undermine progress, and a lack of knowledge of the reasons behind this makes it difficult to recommend improvements and take corrective action. As a first step it is necessary to be able to reliably monitor current rates of functionality and to have a clear benchmark as to what constitutes a functional water point. Currently, there is no single accepted definition for functionality, although organisations are working towards this as a means of tracking progress towards the SDGs.

Guidelines for assessing functionality

Within Hidden Crisis Project we suggest the following guidelines for assessing functionality[3]):

- Functionality should be measured against an explicitly stated standard and population of water points.
- It should be measured separately from the users experience of the service it provides.
- The assessments should be tiered, allowing for further information, but always being able to be reduced to a simple measure.
- A distinction should be made between surveying functionality as a snapshot (e.g. for national metrics) and monitoring individual water point performance (including a temporal aspect).

Defining functionality

Survey 1 of the Hidden Crisis project uses the guidelines above to assess functionality in terms of different levels of performance. This starts with a basic 'working yes/no' definition, and moves to a more detailed understanding of the reliability and yield of supply (Figure 1). The final level introduces water quality to the performance assessment. The project is using the following definitions of functionality:

1. **Basic** – is the water point working on day of survey (yes/no)?
2. **Snapshot** – does the water point work and provide sufficient yield (10 L/min) on the day of survey?
3. **Functionality performance** – does the water point provide sufficient yield (10 L/min) on the day of survey, is it reliable (<30 days downtime in last year) or abandoned (not worked in past year)?
4. **Functionality including water quality** – as 3 above, and also passes WHO inorganic parameters, and TTC standards.

[2] UN Water. 2013. A Post-2025 Global Goal on Water.
[3] Wilson et al. 2016. British Geological Survey Open Report, OR/16/044,

Each of these definitions requires different amounts of data to be collected, and a requisite duration of survey. The 'Basic' and 'Snapshot' assessments reflect the requirements of a widespread national survey assessments, whilst the more performance-focused definitions of 3 and 4 are more relevant to local or regional surveys looking to track the functionality of individual water points or programmes through time.

Standard approaches were used within Survey 1 to collect the different relevant data for each of these definitions (Appendix 1).

The Survey 1 data provides:

- a more nuanced understanding of the current functionality in each country in terms of performance levels; and
- an insight to the impact of using different definitions of functionality.

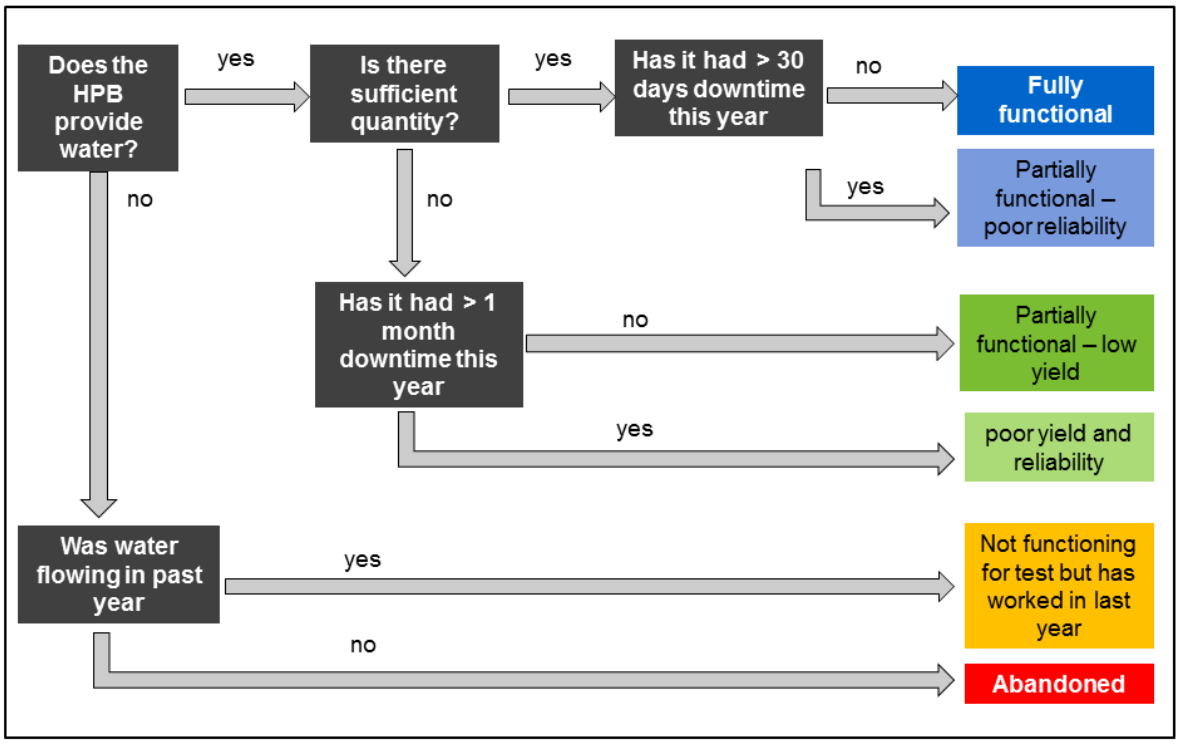


Figure 1 – A schematic diagram showing the different categories of functionality used in the Survey 1 analysis.

3. Survey 1, Malawi

Survey 1 in Malawi was conducted from 1 September to 9 December 2016. A total of 200 boreholes across five districts: Balaka, Lilongwe Rural, Machinga, Mzimba and Nkhotakota were surveyed – Figure 2. Physical characteristics of the Districts included in Survey 1 are summarised in Table 1.

Site selection. The water points in Survey 1 were chosen by a stratified three-stage random sampling design. The domain to be sampled comprised those Districts across Malawi where sampling was deemed practicable by WaterAid. There are 27 districts in Malawi and 10 were regarded as feasible to sample. Districts were used as primary sample units and five were randomly chosen from the ten, guided by two strata defined with respect to poverty (above or below Malawian median). Communities were then randomly chosen from within each District selected in the primary sampling phase. When arriving at a community, all boreholes equipped with hand pumps installed in the community were listed and one randomly chosen to sample. Only boreholes equipped with handpumps were considered.

The relative size of each stratum was computed from the number of communities in each. To account for differences between the 10 Districts in the sampling domain and all 27 Districts within Malawi, the results presented below are computed from stratum sample means and the relative size of the strata over Malawi. Treating these as an estimate for this entire domain, as opposed to the original domain of Districts available for sampling, assumes that Districts within any stratum of the sample domain are representative of that stratum over the aquifer as a whole.

Survey methods. At each hand-pump equipped borehole (HPBs) field tests were used to assess water quality, microbiology, yield of the supply, users perception of the HPB functionality performance, and the experience and capacity of community management arrangements.

Survey team. The Survey Team in Malawi was led by University of Malawi, and was supported by: BGS and Sheffield University in the UK; WaterAid Malawi, who played a key part in facilitating the fieldwork; and District Water Offices, who helped facilitate access to communities, and assisted the survey team.

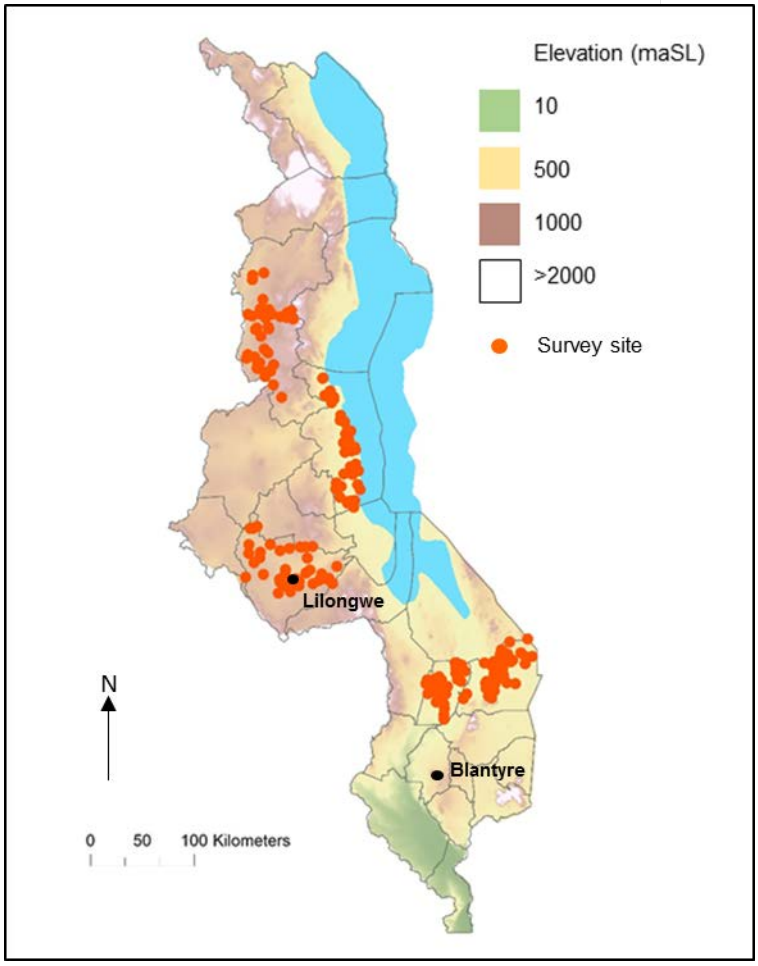


Figure 2 – Location map of sampling sites of Survey 1 Malawi

District	Distance from Lilongwe (km)	Av. Elevation (mamsl)	Mean annual rainfall (mm)	Mean annual temp. (°C)	Dry months
Balaka	185	620	840	23.1	May-Sept
Lilongwe Rural	50	1100	734	20.3	May-Oct
Machinga	225	710	844	22.1	May-Sept
Mzimba	240	1200	51	20.1	May-Oct
Nkhotakota	150	480	48	20.2	May-Oct

Table 1 – Physical characteristics of the Survey 1 Districts.

4. Survey 1 Results, Malawi

The results of Survey 1 in Malawi are summarised below.

Functionality performance level	% pass
Basic – working (yes/no)	74
Snapshot – provides sufficient yield (10 L/min)	67
Functionality performance – sufficient yield and reliability (<30 days downtime in last year)	58
Functionality including water quality - passes WHO TTC and inorganic parameters	41

The 'Basic' and 'Snapshot' assessments reflect the requirements of national survey assessments, whilst the more performance-focussed definitions are more relevant to local or regional surveys looking to track the functionality of individual water points or programmes through time.

The results of the basic survey (74%) are consistent with the estimates from the ministry (MoWDI 2012). The more comprehensive assessments of functionality performance which include yield and reliability are considerably lower.

Water quality is generally considered a service issue rather than strictly water point functionality.

A breakdown of district results is shown in Appendix 3.

Basic functionality

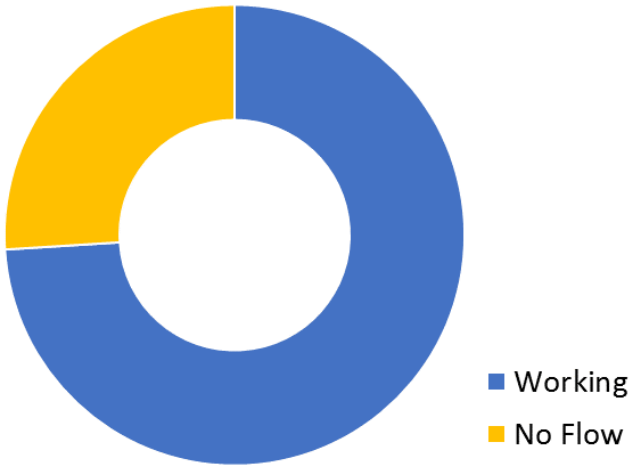


Figure 3 – Functionality assessed as working or not working

Snapshot functionality

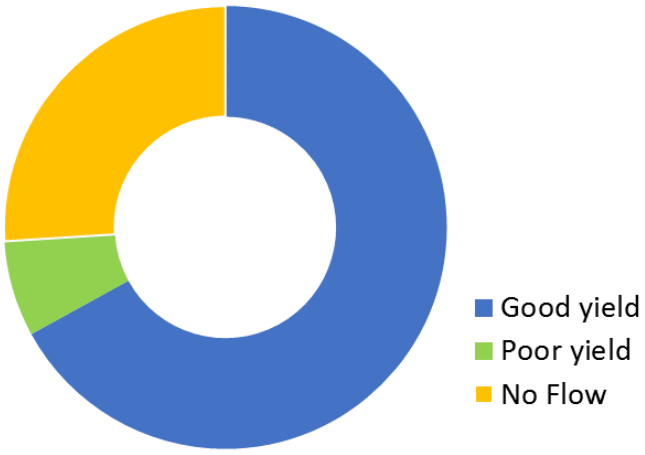


Figure 4 – Functionality assessed as working with sufficient yield (10 L/min)

Functionality performance

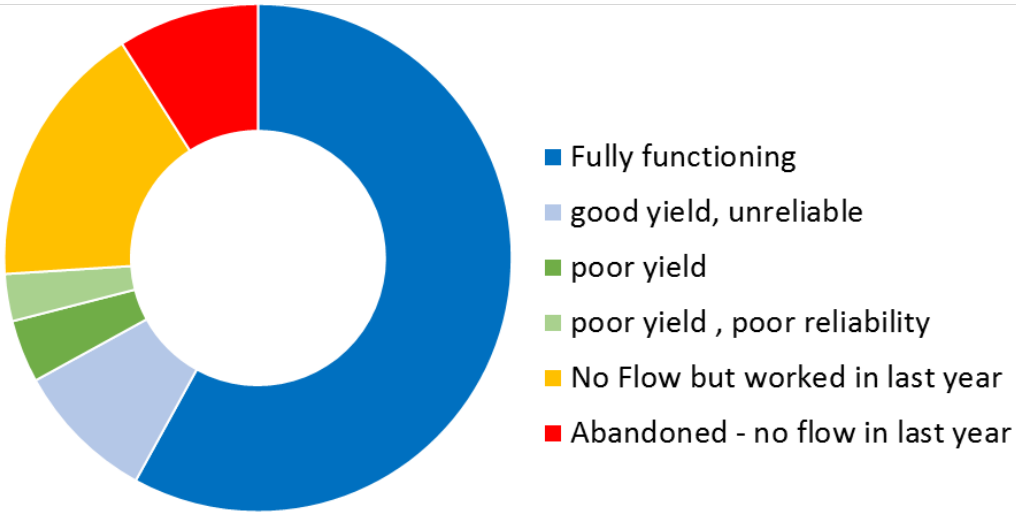


Figure 5 – Functionality performance – functionality assessed as working with sufficient yield (>10 L/min) and reliability (<30 days downtime [day not working] in the last year).

Functionality performance – including water quality

		Water quality issues (%)			
		none	TTC	Inorganic	both
Fully functioning		41	7	5.0	5.0
Good yield, unreliable		6.5	0.5	1.5	0.5
Poor yield		4.0	0	0	0
Poor yield, poor reliability		2.5	0.5	0	0
No Flow – not tested	26.0				

Table 2 – Percentage of the HPBs affected by different types of water quality issues. Twenty percent of the working water points have water quality issues.

5. Water Management Arrangements

During Survey 1 in Malawi a social survey of the village-level water management arrangements was also carried out at each water point. A core aspect of the social-science component of the Hidden Crisis project is to not assume that all local management functions are performed solely by the formally appointed water point committee. Instead, the focus of the research has been broadened to include all local actors and institutions who may play a part in managing HPBs. This is why we use the term water management arrangement (WMA), which includes the water point committee but is not limited to it.

The project developed a definition of a WMA (see Appendix 2). This definition lists 8 different attributes that need to be present to a greater or lesser extent if the WMA is to be considered 'functioning'. A structured social survey was designed with a total of 23 questions that addressed the 8 attributes of a WMA, where each question could be ranked between 1 (lowest) and 3 (highest). The survey was divided into 4 categories of questions: (1) Finance; (2) Maintenance and Repair; (3) Decision making, rules, and leadership; and (4) External Support. The quality of the Water Management Arrangements was then assessed by placing each into 4 categories depending on total score.

Scores	Functionality of WMA
Scores mostly 1s	Non existent
Scores 1s and 2s	Weak
Scores mostly 2s and 3s	Functional
Scores mainly 3s	Highly Functional

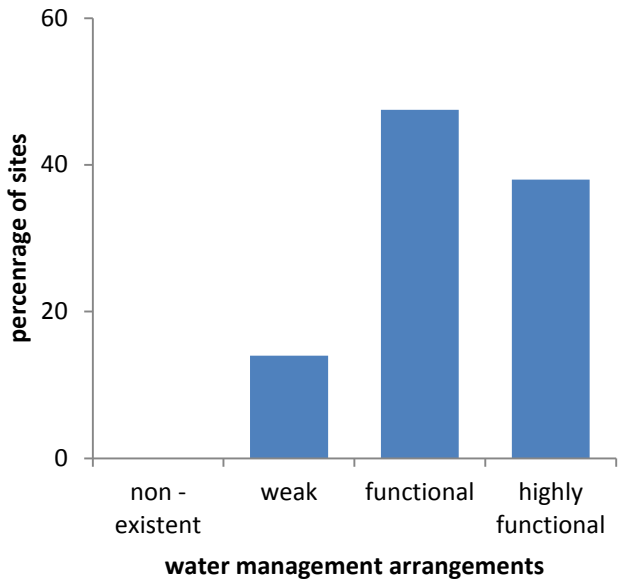


Figure 7 – Percentage of sites assessed to have non-existent, weak, functional or highly functional water management arrangements.

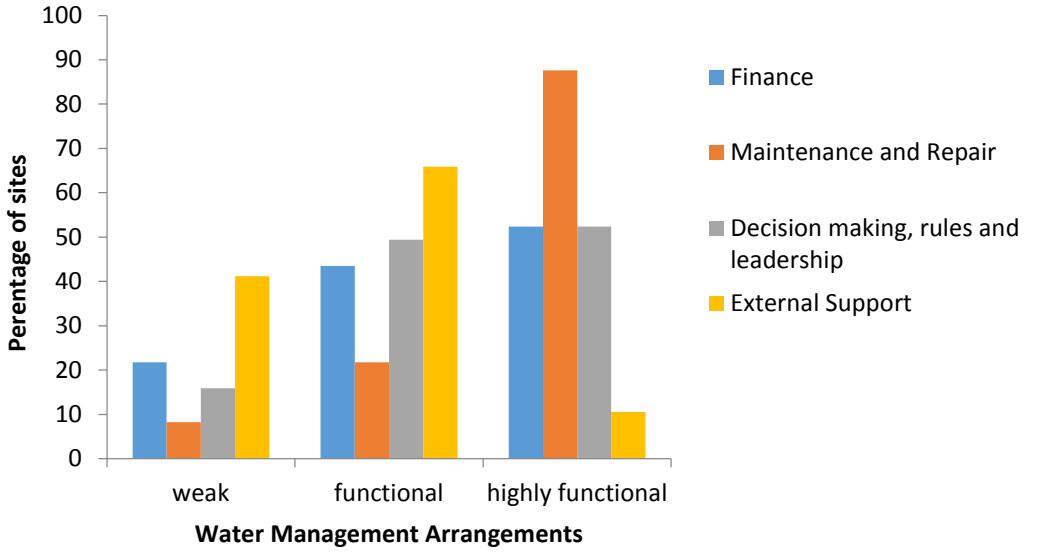


Figure 8 Water management arrangement scores disaggregated by category.

The survey indicates the vast majority of the Water Management Arrangements (86%) are functional or highly functional, but also indicates some differences in the different aspects of governance arrangements. Note the strong difference between *Maintenance and Repair* and the much lower scores for *External Support*.

Initial exploration of the data show no simple relationship between the physical functionality and water management arrangements although more sophisticated analysis is yet to be undertaken. These initial findings are consistent with the hypothesis that the relationship between WMAs and HPBs is complex and multifaceted. These complexities and inter-relationships are being investigated in more detail within the second project survey.

Appendix 1 – Survey 1 assessing physical functionality

The project used standard methods to assess the following definitions of functionality for a handpump borehole.

1. **Basic** – is the water point working (yes/no)
    - Handpump physically working and proving some water at time of survey visit.

2. **Snapshot** – does the water point work and provide sufficient yield (10 L/min)
    - Basic functionality assessment, plus:
    - Yield assessed from standard 30 minute stroke test conducted at the handpump borehole. The water point was assessed to pass the functionality test if the yield provided in the final 3 minutes was >10 L/min.
3. **Functionality performance** – (provides sufficient and reliability,<30 days downtime in last year)
    - Basic and Snapshot functionality assessment methods, plus:
    - Water point user survey used to assess the number of breakdowns and repairs in the last year, and number of days of downtime. The handpump borehole was assessed to be of sufficient reliability if the total downtime is <30 days in the last year.
    - If the waterpoint had not functioned in the past year it was classified as abandoned
4. **Functionality including water quality** (passes WHO inorganic parameters, and TTC)
    - Basic, Snapshot and Functionality performance assessments, plus:
    - Inorganic water sample analysis for major and minor ions – the water sample chemistry must meet WHO standards for inorganic parameters.
    - Thermo-tolerant coliform (TTC) water sample analysis – the TTC concentrations must meet WHO standard (<1 TTC)

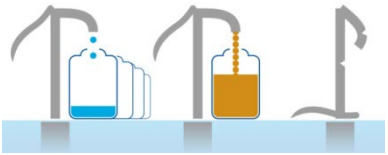
Appendix 2 – A Functioning Water Management Arrangement

A functioning water management arrangement is comprised of the following eight attributes:

1) Authoritative leadership exists;
2) Has the capacity to make and enforce decisions, including on rules-in-use;
3) Collects or sources, manages, and accounts for funds;
4) Undertakes and secures maintenance work;
5) Represents all users in a way that ensures equitable access to the water supply;
6) Recognised as legitimate by both users and the local governance structure;
7) Is aware of its own role and responsibilities and the roles and responsibilities of others;
8) Is linked to other relevant stakeholders and institutions.

Appendix 3 – Individual District results

Functionality performance level	Balaka % pass	Lilongwe % pass	Machinga % pass	Mzimba % pass	Nkhotakota % pass
Basic – working (yes/no)	85	70	65	82.5	65
Snapshot – provides sufficient yield (10 L/min)	82.5	67.5	57.5	72.5	47.5
Functionality performance – sufficient yield and reliability (<30 days downtime in last year)	65	62.5	50	67.5	30
Functionality including water quality (passes WHO inorganic parameters, and TTC)	42.5	47.5	42.5	57.5	22.5



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