UPGro Hidden Crisis Research Consortium

Unravelling past failures for future success in Rural Water Supply

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Survey 1 Results – Country Report Ethiopia

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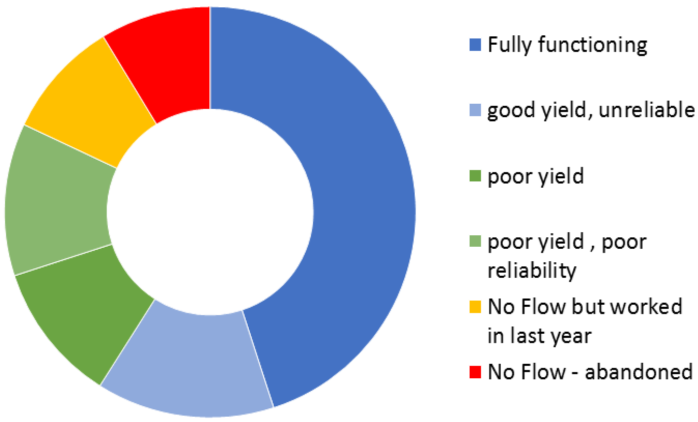
Executive Summary

Statistics on the functionality of water points from the Hidden Crisis project in Ethiopia are presented. The survey, undertaken in 2016, was focussed on boreholes equipped with handpumps (HPBs) within igneous volcanic rocks in the Ethiopian Highlands (covering approximately 400 Woredas). 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:

- 82% of HPBs were working on the day of the survey (similar to national statistics)
- 59% of HPBs passed the design yield of 10 litres per minute
- 45% passed the design yield and also experienced < 1 month downtime within a year.
- 28% of HPB's which passed the design yield and reliability, also passed WHO standards of water quality indicators (TTCs and inorganic chemistry).

The results of the survey indicate 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 85% of the sites water management arrangements were judged to be functional or highly functional.



Functionality assessed for boreholes equipped with handpumps within igneous areas of Ethiopia. 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.

The *Hidden Crisis* project

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 Ethiopia, 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 will be conducted 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[1]). 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[2]):

- 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.

[1] UN Water. 2013. A Post-2025 Global Goal on Water.
[2] 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.

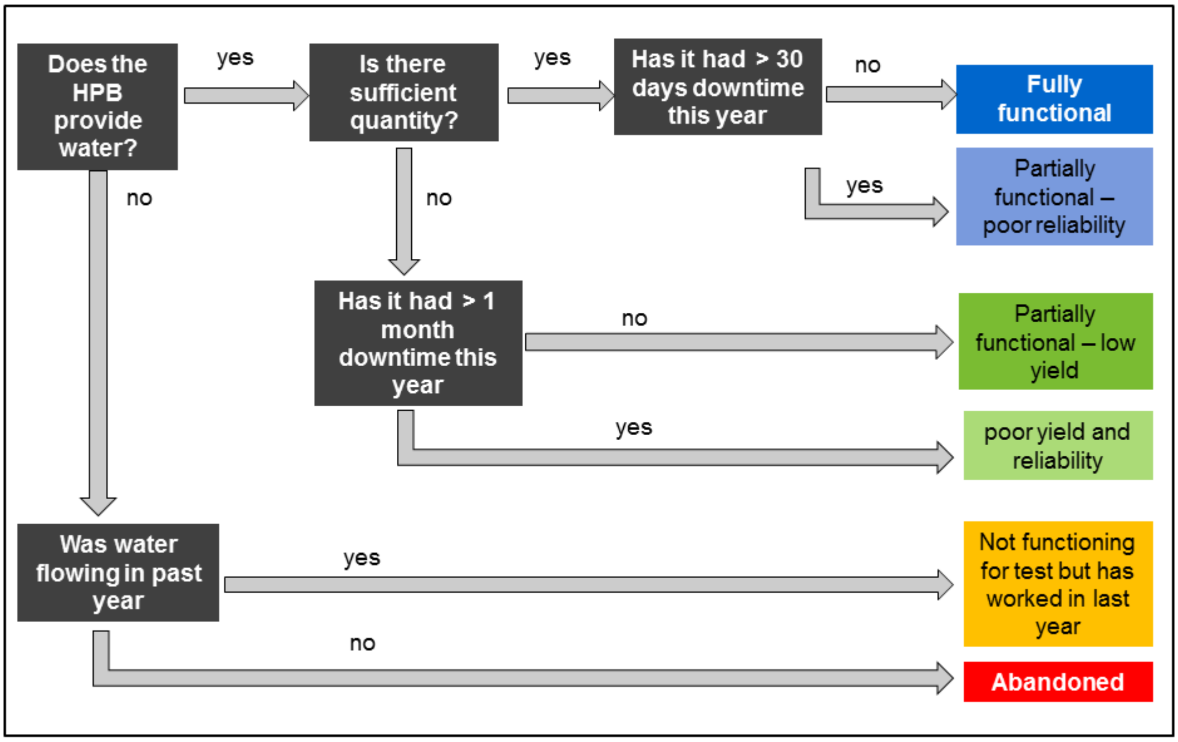


Figure 1 – A schematic diagram showing the different categories of functionality used in the Survey 1 analysis.

3. Survey 1, Ethiopia

Survey 1 in Ethiopia was conducted from 9 April to 20 June in 2016. A total of 172 boreholes across nine woredas within three regions: Oromia (Abichugna, Ejere), Southern Nations and Nationalities (Soro, Abeshege, Sodo) and Amhara, (SayaDebrina, Basona Worena, Bahir dar and Mecha) – Figure 2. Physical characteristics of the woredas included in Survey 1 are summarised in Table 1.

Site selection. The water points in Survey 1 were chosen by a stratified two-stage random sampling design. The domain to be sampled comprised those Woredas over igneous aquifers (the main aquifer type in the country) where sampling was deemed practicable by WaterAid. There are 404 Woredas over igneous aquifers, covering much of the Ethiopian Highlands. Of these, 98 were regarded as feasible to sample, and these constitute the sampling domain. Woredas were used as primary sample units and were randomly chosen from within each of four strata defined with respect to hydrogeology (fractured or porous igneous rocks) and poverty (above or below Ethiopian median). Water points were then randomly chosen from within each Woreda selected in the primary sampling phase. Only boreholes equipped with handpumps were considered.

The relative size of each stratum was computed from the numbers of shallow water points recorded in the national WASH inventory. To account for differences between the 98 Woredas in the sampling domain and all 404 Woredas within igneous aquifers, the results presented below are computed from stratum sample means and the relative size of the strata over all igneous aquifers. Treating these as an estimate for this entire domain, as opposed to the original domain of Woredas available for sampling, assumes that Woredas 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 Ethiopia was led by Addis Ababa University, and was supported by: BGS and Sheffield University in the UK; WaterAid Ethiopia, who played a key part in facilitating the fieldwork; and Woreda Water Bureaus, who helped facilitate access to communities, and assisted the survey team.

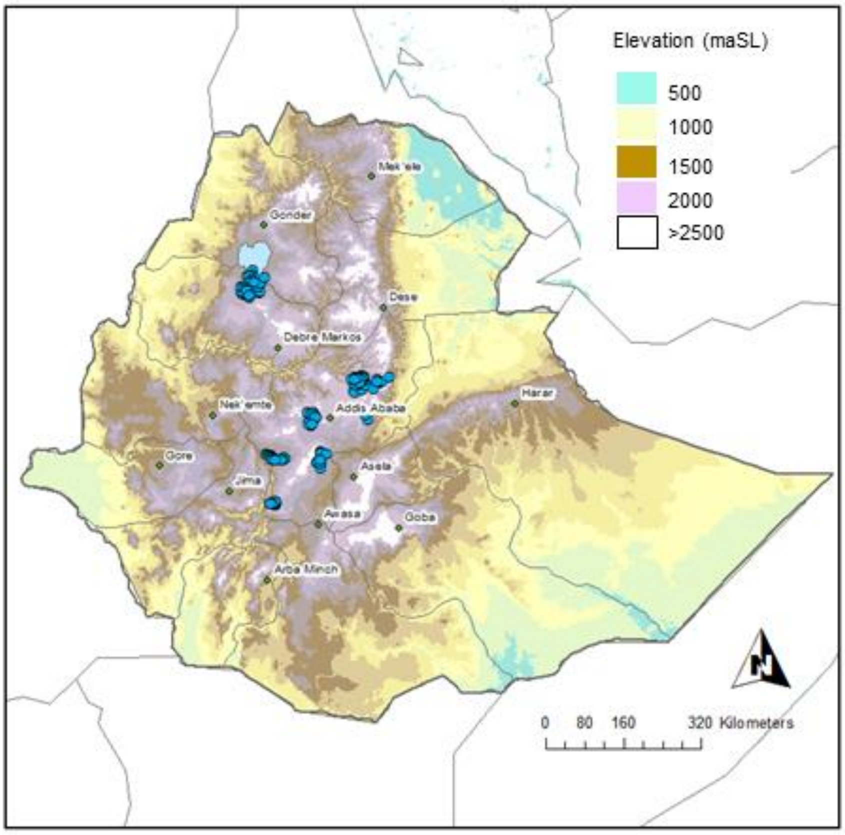


Figure 2 – Location map of sampling sites of Survey 1 Ethiopia

District	Regional state	Distance from Addis Ababa (km)	Av. Elevation (mamsl)	Mean annual rainfall (mm)	Mean annual temp. (°C)	Dry months
Abichugna	Oromia	140	2700	980	14.4	Oct-May
Ejere	Oromia	45	2300	1190	16.4	Oct-Feb
Soro	SNNP	262	2050	1200	16.5	Nov-Feb
Abeshege	SNNP	190	1700	1264	17.7	Oct-Mar
Sodo	SNNP	110	2000	1060	17.2	Oct-Feb
Seya Debrina	Amhara	165	2650	980	18.8	Oct-May
Basona Worena	Amhara	120	2785	1190	16.4	Oct-Mar
Bahir Dar	Amhara	550	1860	1450	20	Nov-Apr
Mecha	Amhara	525	2005	1452	20	Nov-Apr

Table 1 – Physical characteristics of the Survey 1 areas.

4. Survey 1 Results, Ethiopia

The results of Survey 1 in Ethiopia, representing the functionality of boreholes equipped with handpumps in Woredas underlain by igneous rocks (404 Woredas mainly in the Ethiopian Highlands) are summarised below.

Functionality performance level	% pass
Basic – working (yes/no)	82
Snapshot – provides sufficient yield (10 L/min)	59
Functionality performance – sufficient yield and reliability (<30 days downtime in last year)	45
Functionality including water quality (passes WHO inorganic parameters, and TTC)	28

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 (82%) are consistent with the estimates from the National WASH inventory. The more comprehensive assessments of functionality performance which include yield and reliability are considerably lower.

Water quality is considered a service issue rather than strictly functionality. We used the strict WHO standard of a failure being any measured TTC in the water, rather than a risk-based approach which would prioritise much higher concentrations of TTCs.

Basic functionality

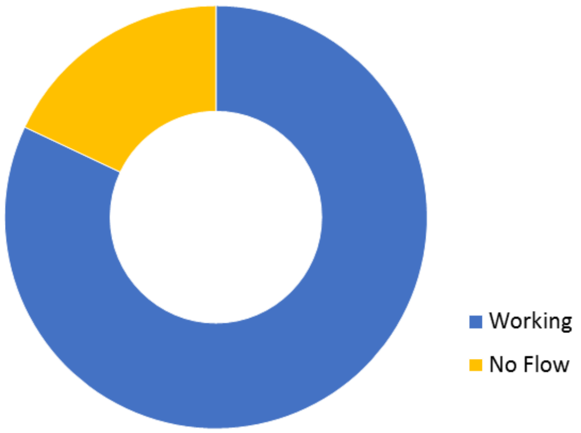


Figure 3 – Functionality assessed as working or not working

Snapshot functionality

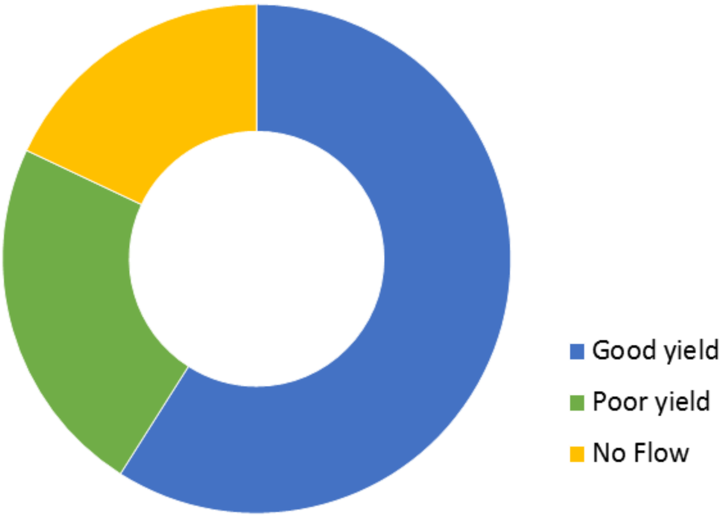


Figure 4 –Functionality assessed as working with sufficient yield (10 L/min)

Functionality performance

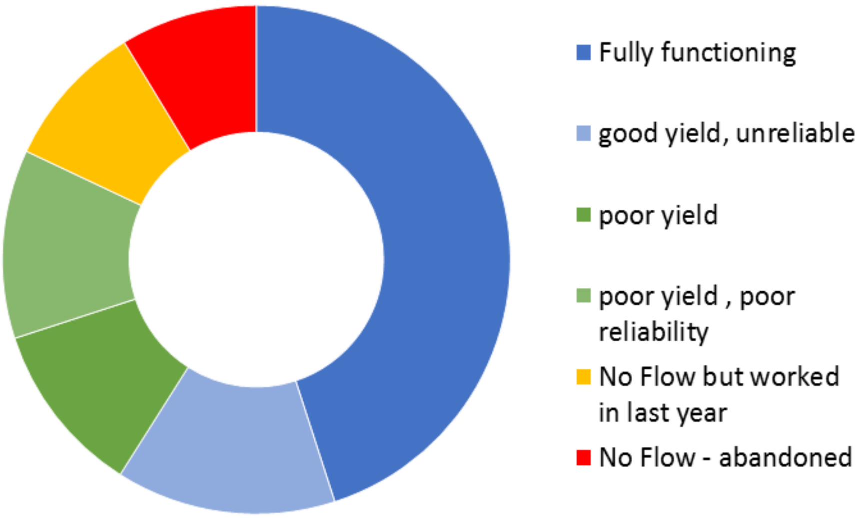


Figure 5 –Functionality performance – sufficient yield (>10 L/min) and reliability (<30 days downtime in the last year).

Functionality performance – including water quality

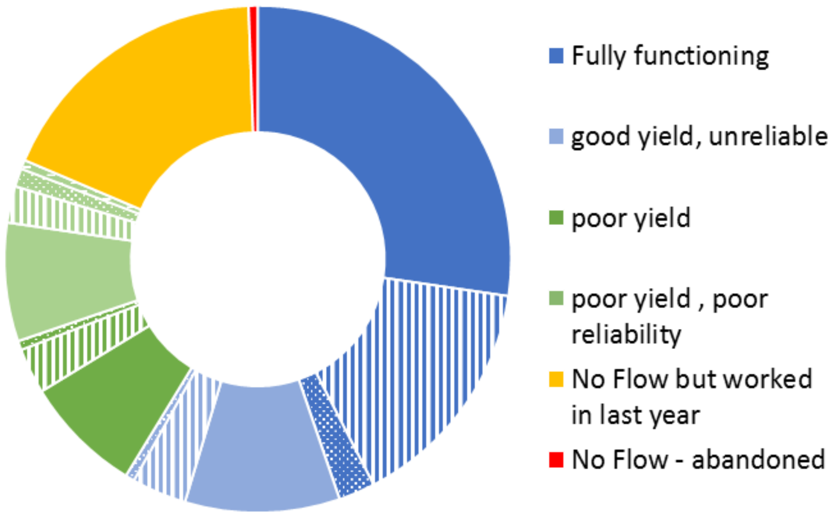


Figure 6 –Functionality performance, including water quality. Failure to meet WHO inorganic water quality parameters denoted by stipple overlay; failure to meet WHO TTC standards denoted by line overlay; failure to meet both denoted by dashed overlay.

	Water quality issues (%)			
	none	TTC	Inorganic	both
fully functioning	27.5	15.2	2.3	0
good yield, unreliable	9.9	3.5	0	0.6
poor yield	7.5	2.9	0.6	0
poor yield ,poor reliability	7.8	2.4	1.2	0.6
no Flow – not tested			18	

Table 2 – Percentage of the HPBs affected by different types of water quality issues. A significant proportion of HPBs are shown to have thermo-tolerant coliforms (TTC) in excess of the WHO drinking water standard – Table 2.

5. Water Management Arrangements

During Survey 1 in Ethiopia 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

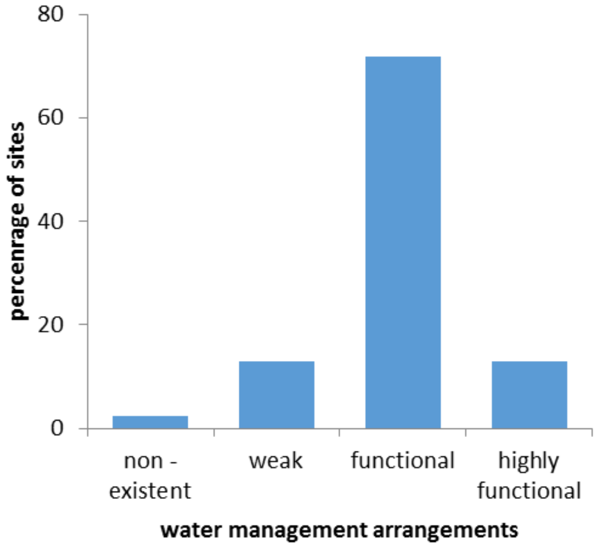


Figure 7 – Percentage of sites assessed to have non-existent, weak, functional or highly functional water management arrangements.

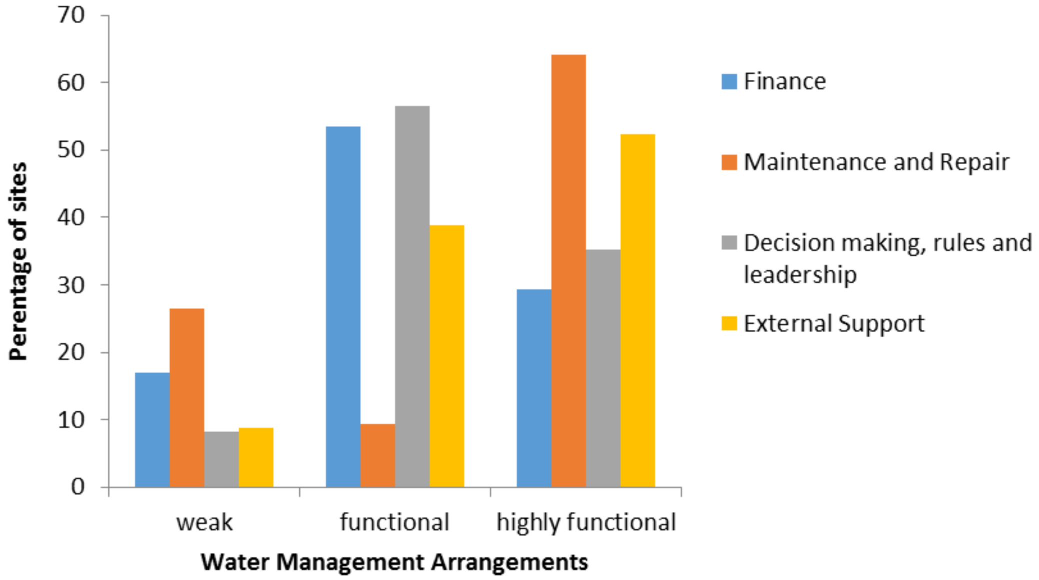


Figure 8 Water management arrangement scores disaggregated by category.

The survey indicates the vast majority of the Water Management Arrangements (85%) are functional or highly functional, but also indicates some differences in the different aspects of governance arrangements. Note the small bimodal distribution with *Maintenance and Repair* and the slightly lower scores for *Finance* and *Decision making rules and leadership*.

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 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 woreda results

Functionality performance level	Abeshege % pass	Abichugna % pass	Bahir Dar Zuria	Basona Worena	Ejere	Mecha	Sayadebirna Wayu	Sodo	Soro
Basic – working (yes/no)	75	85	70	90	95	95	95	75	60
Snapshot – provides sufficient yield (10 L/min)	25	80	65	80	60	85	90	35	20
Functionality performance – sufficient yield and reliability (<30 days downtime in last year)	20	35	20	10	30	25	25	15	10
Functionality including water quality (passes WHO inorganic parameters, and TTC)	15	15	5	10	30	10	20	15	10

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