Abstract

The aim of this study was to analyze the water point mapping tool, more specifically in the study cases of Liberia and Sierra Leone, identifying weaknesses and proposing improvements.

The study was divided mainly in two parts – analysis of the methodology and evaluation of the indicators – and important improvements were identified. Although the water point mapping tool exist for more than 10 years and it is already proved to be very useful, it is a tool still being developed and enhanced.

The parameters surveyed differ from one country to another, as well as the approach used to evaluate these parameters. The method lack an understanding of which are the key parameters that have to be surveyed and how it should be done. The data collected is not standardized and neither the nomenclature used by each person that add information in the databases.

Additionally, the analysis based on the data collected is apparently superficial and the indicators calculated also vary from one country to another, making it difficult to make comparisons between them.

This study describes these weaknesses and proposes improvements to overcome them, in order to contribute to the continuous improvement of the water point mapping tool.

Summary

1. The methodology of Water Point Mapping: The case studies of Liberia and Sierra Leone

1.1. Introduction

Water Point Mapping consists in an "exercise whereby the geographical positions of all improved water points in an area are gathered in addition to management, technical and demographical information" (WaterAid & ODI, 2005). It involves the presentation of these data in a spatial context, which enables a rapid visualization of the distribution and status of water supplies. A major advantage is that water point maps provide a clear message on which areas are and are not served (WaterAid, 2010).

WPM is an initiative of originally designed and promoted by WaterAid and is now supported by World Bank's Water and Sanitation Program (WSP) and UNICEF, among others. It has started to be used over a decade ago by NGOs and agencies worldwide reaching Liberia and Sierra Leone in 2011 and 2012, respectively.

WPM main goal is to provide decision-makers a clear picture of the distribution of improved water points in a given territory, and so the level of people's access to safe water, in order to enhance planning and encourage investments in this area.

1.2. Comparison of the methodology applied in Liberia and Sierra Leone

The definition of improved and unimproved water point used is the same in both case studies and is illustrated in

Table 1.

The definition follows international parameters. According to the international definition provided by the World Health Organization and UNICEF, an improved water point is "one that, by nature of its construction or through active intervention, is protected from outside contamination, in particular from contamination with faecal matter.

This is essentially a technical definition, the water itself is not being tested. This simplification is used because it is generally not possible and cost efficient to test the water quality in a laboratory for each and every water point in large or remote areas.

In practice, water points that were constructed with at least a raised concrete apron and a permanent lid were generally counted as improved points.

Table 1: Definition of improved and unimproved water points

Improved water sources	Unimproved water sources
Piped water into house or yard	Unprotected spring / creek
Public tap or standpipe	Unprotected dug-well
Pump on hand-dug well or borehole	Water sold from handcart
Protected spring / creek	Tanker-truck
Rainwater collection	Surface water (e.g. Lake, river)
Protected dug well	Bottled water (case-by-case)

The methodology used in both countries is almost the same. In both countries the aspects that supposedly ensure safe water access are surveyed, such as quality, functionality and seasonality. In Sierra Leone, however, aspects regarding maintenance were included (Table 2).

Table 2: General parameters for each mapping

	Sierra Leone	Liberia
Date	2012	2011
Led by	Ministry of Energy and Water Resources + partners[1]	Ministry of Public Works + partners[2]
Coverage	100% public improved WPs	100% public improved WPs
Area	Urban and rural areas	Urban and rural areas
Number of WPs mapped	Over 28,000	Over 10,000
Measures functionality?	Yes	Yes
Measures seasonality?	Yes	Yes
Measures quality?	Perceived quality	Perceived quality
Info about maintenance	Yes	No

[1]: World Bank's Water and Sanitation Program (WSP), UNICEF, the Adam Smith International and other national and international partners.

[2]: Ministry of Health, the Liberian Institute of Statistics and Geo-Information Services (LISGIS), World Bank's Water and Sanitation Program (WSP), UNICEF, CHF/USAID, the NGOs that form the Liberian WASH Consortium, in particular OXFAM, and other national and international partners.

The questionnaires used to measure these aspects, and consequently the data collected, however are slightly different. Questions were added for the Sierra Leone survey as well as other questions were excluded from the Liberian questionnaire.

Table 3: Data collected for each water point

Data collected in Liberia	Data collected in Sierra Leone
Total number of water points	Total number of water points
Urban or rural water point	Urban or rural water point
Location (county, district, clan and community)	Location (province, district…)
Functionality (fully functional, broken down, functional but with problems)	Functionality (technically functional, functional but partially damaged, broken down, under construction)
Type of water point (hand pump…)	Type of water point (hand pump…)
-	Specific water point type
Hand pump type	Hand pump type
Number of taps	Number of taps
Tank capacity	-
Damage type (Well, Apron, Pump, other)	Damage type (Well, Apron, Pump, other)

Installer (NGO, government..)	Installer (NGO, government..)
Specific installer	Specific installer
Price per gallon (ranges)	-
Exact price per gallon	-
Water point status (in-use or not)	Water point status (in-use or not)
Date of construction	Date of construction
-	Construction start (in case it is still under construction)
Perceived quality	Perceived quality
Specific quality problem	Specific quality problem
Existence of a water committee	-
Seasonality	Seasonality
Quantity of water provided by the point	-
Management (who manages the water point)	Management (who manages the water point)
Fee collection (If the water is paid for at the point)	Fee collection (If the water is paid for at the point)
Existence of water treatment	-
Who treats the water	-
-	If the point is regularly chlorinated
-	Availability of a trained mechanic
-	Location of the closest spare part supply

Table 3 demonstrates that, although water point mapping is being used for over a decade, it is still being developed and enhanced, and there isn't a standardized questionnaire that embraces all key aspects in an efficient way.

To illustrate this, let's use the data collected on maintenance. The Liberia survey seeks to measure the treatment of the water in each water point by collecting information about the existence of water treatment at that point and the responsible for this treatment. In Sierra Leone, on the other hand, the survey contains one question regarding the regularity of water chlorination and none about who is the responsible for this chlorination.

Even the most basic question in the survey, functionality of the water point, shows variations in both cases. In Liberia, the three possible answers are "working and protected", "working but with problems" and "broken down system", while in Sierra Leone there are four possible answers: "yes – functional", "yes – but partly damaged", "no – still under construction" and "no – broken down".

This variability exemplifies the weakness of the used questionnaires and also the lack of method to define which data should be collected and how this data should be collected. A full analysis of the data obtained and indicators used is provided in chapter 3.

1.3. The experience bias in the major cities

Water point mapping initially covered only the rural areas of the studied countries. However the tool is now used in a more comprehensive way and maps 100% of each country's area, including both rural and urban areas.

This new approach has consequently created a bias in the results of the indicators that measure population per water point. The explanation is simple. The method maps public improved water points and contrasts this number with the total population in each area. However, the main cities in urban areas do not depend entirely on public water points for their water supply. Private water pipe networks or other private systems supply many people in these areas. Consequently, these cities appear to have a lower coverage than others, which is not true.

The solution to adequate the method to this new scenario where urban areas are also mapped would be either to map also private connections or, a simpler and, at first sight, more feasible solution, to subtract the population supplied by private systems of the total population in a given area.

The cases of Monrovia (Liberia) and Freetown (Sierra Leone) are shown below:

- Freetown, the capital of Sierra Leone, has the second lowest coverage: 1237 people per non-seasonal protected in-use water point. The explanation for the apparent underperformance of the city is that its urban area has more than 10,000 private connections provided Guma Valley Water Company, and private water-tanks also supply a considerable number of residents. In other words, some areas that appear particularly underserved by public points (e.g. the wealthier Western neighborhoods) may simply be supplied by private sources instead, which were not mapped.

District	Population per protected in-use point[vi] (non-seasonal in brackets)
Bo	157 (235)
Bombali	302 (617)
Bonthe	239 (440)
Kailahun	261 (527)
Kambia	480 (1426)
Kenema	203 (289)
Koinadugu	251 (496)
Kono	311 (549)
Moyamba	291 (583)
Port Loko	363 (935)
Pujehun	530 (755)
Tonkolili	535 (1012)
W.A. Rural	147 (187)
W.A. Urban (Freetown)	866 (1237)
Total	**300**

Figure 1: Experience bias in Freetown (Sierra Leone Waterpoint Report, 2012)

- Data from Monrovia face the same bias. The district is only one with a piped water network, however private connections are not counted on this survey. Consequently, the capital has the worst performance among the county.

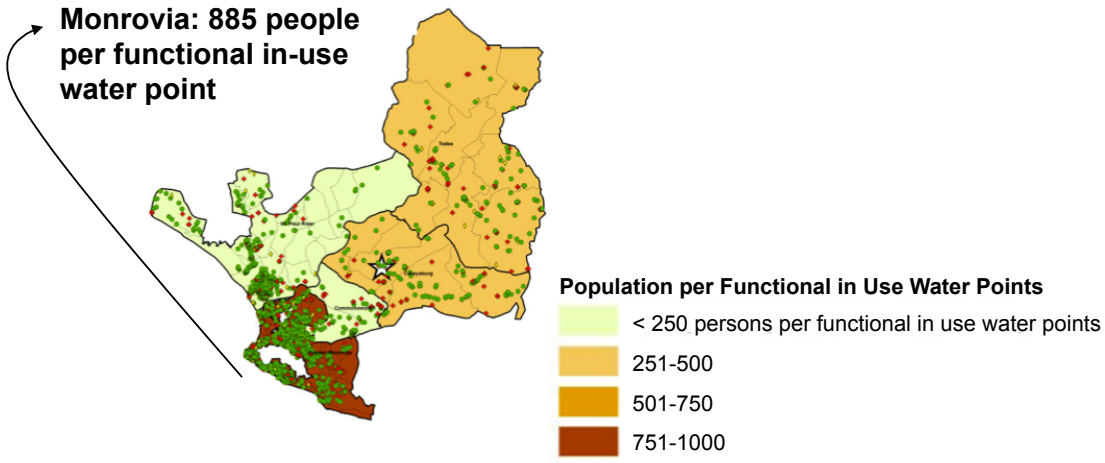

Figure 2: Experience bias in Monrovia (Liberia Waterpoint Atlas)

2. Description of indicators used

The main indicators used and showed in each country reports are shown and described below

2.1. Indicators used in Liberia (2011)

Although the survey contains data regarding the seasonality of the water points, this aspect was not taken into account in the calculus of theses indicators. Both seasonal and not-seasonal water points were considered in the calculation of "*total functional in-use water points*", thus affecting *"coverage"* and "*access"* indicators.

Table 4: List of indicators used in Liberia

Indicator	Description
Population per functional in-use water point	District's populations divided by the number of functional in-use water points
% of functional in-use water point	Number of functional in-use water points divided by total number of water points
Coverage	Percentage of people living within 1.5 miles of a fully functional in-use water point
Access*	Percentage of population within 1.5 miles of a functional in-use point (assuming that each point provides access to a maximum of 250 people)
% of schools without water point	(within 0.25 miles)
Water points required for 100% access	How many water points should be built in a given district so everybody could have access to water

*Access is defined as the percentage of the population that can be supplied taking into account that each water point only has a capacity of serving 250 persons in an improved, sustainable manner, and that only water points in the vicinity of a settlement (up to 1.5 miles) can supply that settlement.

2.2. Indicators used in Sierra Leone (2012)

The indicators used are described in Table 5.

Table 5: List of indicators used in Sierra Leone

Indicator	Description

Population per protected in-use points	Population divided by the combined number of water points that are either fully functional or at least without major damage*
Population per non-seasonal protected in-use points	Population divided by number of protected in-use points that are non-seasonal
% of Impaired Water points (partly damaged or broken down)	Impaired water points divided per total water point
Percentage of broken down points in-use	This indicator shows the demand of easily accessible water points
Percentage of partially damaged points in-use	This indicator shows the demand of easily accessible water points

*: Major damage here refers to partially damaged points that have damage or pollution of the well itself, or damage to the apron or reservoir, or multiple types of damages. All "broken down" points are also excluded i.e. automatically counted as having major damage that renders the points unsafe.

2.3. Observations

The observation of the two figures shows how underdeveloped is the analysis conducted. It becomes evident, once again, the lack of continuity between the WPM approaches over the years, causing the loss of important improvements made in the past experiences.

In Liberia's report, the main indicator is *Access*. This metric shows the percentage of the population that has access to a functional in-use water-point within a maximum distance of 1.5 miles and respecting the limit of 250 people per water point, i.e. this indicator not only measure if there is a water point for each 250 people in a given area, but also the distribution of these water points. Using *Access*, one can tell how many people lack access to safe water, while the use of *Population per Water Point* does not. Despite this clear improvement that the indicator *Access* represent, it was not used in Sierra Leone.

In Sierra Leone's report the main indicators are: *Population per protected in-use water points*, and *Population per non-seasonal protected in-use water points.* The advantage is that the seasonality is now taken into account. Also, new interesting indicators were created like *percentage of partly damaged points in use* and *Percentage of broken down points in use*.

Besides the loss of improvements in the development of indicators between WPM experiences, the indicators analysis also demonstrates the absence of a proper method to define the data that will be collected and the indicators that will be used.

In Liberia, the survey provided data regarding seasonality, however the maps and indicators developed didn't use this data, which is hard to understand. Each question that is added to the questionnaire represents an addition in the use of resources, therefore it is important a proper planning to ensure that only the desired data will be collected and that every data collected will be useful to generate further analysis.

In conclusion, there was possible to identify two important weaknesses regarding the indicators used:

- The improvements developed in one country's WPM are not automatically taken in the next one, weakening some parts of the analysis.
- There isn't a proper method to define which data must be collected, which indicators must be created from these data and which analysis will be further taken. Some data is not used on the analysis, representing either a waste of resources or an underuse of the generated information.

3. Analysis of the data bases

The analysis of the data collected in each country was carried out as follows:

- First: analysis of the responses frequency
- Second: search for inconsistencies

The aim of analyzing the frequency of the responses is to see weather there are questions with a large majority of a single response or with a too low incidence of one of the responses. This is made in order to try to determine if the question is really helping to create useful information and to test if the possible responses are properly determined.

The frequency tables (in the annex to the report) showed normal results, where the possible responses had a good distribution of responses, very little data were collected as "unknown" and very little weren't collected (blank space in the database).

shows the percentage of unknown data in each question of the surveys.

Questions	SIERRA LEONE			LIBERIA		
	Unknown	*Total WPs**	*% Unknown*	*Unknown*	*Total WPs**	*% Unknown*
Water point type	0	28845	0,0%	5	10001	0,0%
Hand pump type	694	20188	3,4%	158	10001	1,6%
Functionality	0	28845	0,0%	0	10001	0,0%
Age	4136	28845	14,3%	999	10001	10,0%
Installer	1567	28845	5,4%	795	10001	7,9%
In-use?	0	27635	0,0%	0	10001	0,0%
Quality	1933	27635	7,0%	237	10001	2,4%
Manager	49	28845	0,2%	3189	10001	31,9%
Money collection	28	27635	0,1%	53	10001	0,5%
Seasonality	0	27635	0,0%	0	10001	0,0%
Regularly chlorinated?	1296	27635	4,7%	-	-	-
Trained mechanic	882	28845	3,1%	-	-	-
Spare part supply	0	28845	0,0%	-	-	-
Construction start	84	1480	5,7%	-	-	-
Fee pay	-	-	-	0	10001	0,0%
Price per gallon (PPG)	-	-	-	15	360	4,2%
Exact PPG	-	-	-	37	360	10,3%
Water treat	-	-	-	2	10001	0,0%
Who Treat	-	-	-	0	10001	0,0%

Notes: *: Total number of water points where the question is applicable

Table 6: Percentage of unknown data on both databases

Questions	SIERRA LEONE	LIBERIA

	Unknown	*Total WPs**	*% Unknown*	*Unknown*	*Total WPs**	*% Unknown*
Water point type	0	28845	0,0%	5	10001	0,0%
Hand pump type	694	20188	3,4%	158	10001	1,6%
Functionality	0	28845	0,0%	0	10001	0,0%
Age	4136	28845	14,3%	999	10001	10,0%
Installer	1567	28845	5,4%	795	10001	7,9%
In-use?	0	27635	0,0%	0	10001	0,0%
Quality	1933	27635	7,0%	237	10001	2,4%
Manager	49	28845	0,2%	3189	10001	31,9%
Money collection	28	27635	0,1%	53	10001	0,5%
Seasonality	0	27635	0,0%	0	10001	0,0%
Regularly chlorinated?	1296	27635	4,7%	-	-	-
Trained mechanic	882	28845	3,1%	-	-	-
Spare part supply	0	28845	0,0%	-	-	-
Construction start	84	1480	5,7%	-	-	-
Fee pay	-	-	-	0	10001	0,0%
Price per gallon (PPG)	-	-	-	15	360	4,2%
Exact PPG	-	-	-	37	360	10,3%
Water treat	-	-	-	2	10001	0,0%
Who Treat	-	-	-	0	10001	0,0%

Notes: *: Total number of water points where the question is applicable

The results indicate that the countries had difficulty to assess water points' information approximately in the same categories. The categories that the countries differ the most are "manager" and "quality".

The points worth a comment are:

- High rate of water points with unknown age in both cases (14.3% and 10%).
- High rate of water points with unknown installer in both cases (5,4% and 7,9%).
- High rate of unknown manager and exact price per gallon in Liberia, 31,9% and 10,3% respectively.
- High rate of water points with unknown quality in Sierra Leone, 7%.

Besides the results of the frequency tables, some important inconsistences and potential enhancements were recognized by evaluating some specific categories of water points. The findings for Sierra Leone are listed and discussed below:

- Year of construction start: this information was collected for those points which were still under construction, however a part of this "under construction" points started being built in the 80's, 90's and early 2000, i.e. these points are actually abandoned. Classifying them as under constructions can produce a misleading image of the reality. These points should be classified as abandoned or shouldn't be mapped at all.

- Specific quality: as discussed in the previous chapters, quality is measured by the perceived quality by the users, which are, many times, inaccurate (Jiménez & Pérez-Foguet, 2011). In addition, there is no point in collecting "specific quality" as an open question generating a lot of different subjective descriptions of the problems. This question should be in the survey with a limited number of possible answers, which would embrace all the major problems.
- It is not clear how the water chlorination is made in some types of water points like protected springs.

The findings for Liberia are listed and discussed below:

- Nomenclature wasn't standardized, so the same data was added with different names for different water points, complicating the analysis of the results. In the specific problem field, for example, there are points categorized as "Apron damage", "Apron damaged", "Apron damaged|" and so on. This problem occurs in various fields, such as "problem specific", "precise installer" and precise quality.
- The nomenclature problem persisted in the case of an unknown data. The unknown data were included in the database as "unknown", "Unknown", "0000", "9999" and so on.
- "Other" represents 39.3% of total installers.

4. Correlation tests

The reports of the WPM for each country already contain some analysis of correlation – functionality x age and functionality x installer are evaluated in both reports. The aspects that were already evaluated were not studied here.

Correlation tests (using IBM SPSS Statistics) were taken in order to evaluate which aspects surveyed could have correlation not only with functionality but also with quality and seasonality. The correlation was determined using the chi-square test (0.05 significance) using confounding variables to refine the results. The tables with the results are provided in the Annex.

4.1. Sierra Leone

- Quality:

After running the tests using confounding variables, the only correlation verified was between “perceived quality” and “regular chlorination” ($p<0.05$). It must be remembered, however, that the water quality is based on users’ perception and consequently conclusions cannot be strong. Moreover, it wasn’t possible to understand how certain types of water points (such as protected springs) could be regularly chlorinated, as the reports didn’t describe exactly what was considered “regular chlorination” and how was it made.

Below, in Table 7, it is possible to see that apparently there is no strong relationship between water point type and the quality of the water provided (“Manual pump on hand dug well” also include protected wells without a pump).

Table 7: Correlation between quality and point technology data, in both countries

LIBERIA						SIERRA LEONE				
			Quality of the water					Quality of the water		
			Quality problem	Soft, Clean, Sweet	Total			Not clean	Clean (good smell- taste and color)	Total
Water point type	Manual pump on hand-dug well	Recuento	1831	6117	7948	Pump on hand-dug well	Recuento	1054	8014	9068
		% dentro de Water point type	23%	77%	100%		% dentro de Water Point Type	12%	88%	100%
	Automatic pump	Recuento	2	1	3	Protected Well (no pump)	Recuento	1284	6600	7884
		% dentro de Water point type	67%	33%	100%		% dentro de Water Point Type	16%	84%	100%
						Submersible pump	Recuento	1	25	26
							% dentro de Water Point Type	4%	96%	100%
	Manual pump on borehole	Recuento	275	967	1242	Pump on borehole	Recuento	225	1539	1764
		% dentro de Water point type	22%	78%	100%		% dentro de Water Point Type	13%	87%	100%
	Protected spring	Recuento	7	22	29	Protected Spring	Recuento	22	211	233
		% dentro de Water point type	24%	76%	100%		% dentro de Water Point Type	9%	91%	100%
	Stand pipe	Recuento	123	161	284	Standpipe or Tapstand	Recuento	216	5729	5945
		% dentro de Water point type	43%	57%	100%		% dentro de Water Point Type	4%	96%	100%
	Water kiosk with elevated tank	Recuento	62	94	156	Water Kiosk with Tank	Recuento	44	397	441
		% dentro de Water point type	40%	60%	100%		% dentro de Water Point Type	10%	90%	100%
	Water kiosk without elevated tank	Recuento	26	73	99	Rain Harvesting	Recuento	3	12	15
		% dentro de Water point type	26%	74%	100%		% dentro de Water Point Type	20%	80%	100%
Total		Recuento	2326	7435	9761	total	Recuento	2849	22527	25376
		% dentro de Water point type	24%	76%	100%		% dentro de Water Point Type	11%	89%	100%

- Seasonality:

Neither hand-pump type, nor water point type seems to have a strong correlation with the seasonality of the water point. Table 8 illustrates the comparison between the countries and the rate of seasonal water points for each type of them.

Table 8: Correlation between seasonality and point technology data, in both countries

LIBERIA							SIERRA LEONE				
			Seasonality					Seasonality			
			Not seasonal	Dry (permanently)	Seasonal	Total		Water year-round	Dry Always / Never water	Seasonal	Total
Water point type	Manual pump on hand-dug well	Recuento	5870	640	1609	8119	Pump on hand-dug well	4417	312	4702	9431
		% dentro de Water point type	72%	8%	20%	100%		47%	3%	50%	100%
	Automatic pump	Recuento	2	1	0	3	Protected Well (no pump)	4526	206	3403	8135
		% dentro de Water point type	67%	33%	0%	100%		56%	3%	42%	100%
							Submersible pump	23	3	3	29
								79%	10%	10%	100%
	Manual pump on borehole	Recuento	1047	112	110	1269	Pump on borehole	1160	121	610	1891
		% dentro de Water point type	83%	9%	9%	100%		61%	6%	32%	100%
	Protected spring	Recuento	23	5	1	29	Protected Spring	189	9	45	243
		% dentro de Water point type	79%	17%	3%	100%		78%	4%	19%	100%
	Stand pipe	Recuento	239	53	27	319	Standpipe or Tapstand	3647	1064	2326	7037
		% dentro de Water point type	75%	17%	8%	100%		52%	15%	33%	100%
	Water kiosk with elevated tank	Recuento	130	21	6	157	Water Kiosk with Tank	185	79	261	525
		% dentro de Water point type	83%	13%	4%	100%		35%	15%	50%	100%
	Water kiosk without elevated tank	Recuento	62	34	4	100	Rain Harvesting	0	0	15	15
		% dentro de Water point type	62%	34%	4%	100%		0%	0%	100%	100%
Total		Recuento	7373	866	1757	9996	total	14147	1794	11365	27306
		% dentro de Water point type	74%	9%	18%	100%		52%	7%	42%	100%

- Functionality:

The three tests indicated correlation: fee collection, availability of trained mechanic and availability of spare part supply ($p<0.05$). All three aspects contribute for better functionality. It is true, however, that the water points that have a trained mechanic nearby is usually the ones that have also a spare part supply (Table 9).

Table 9: trained mechanic x spare part supply

			Availability of spare part supply nearby			
			In this community	Within 20 miles	More than 20 miles	Total
Availability of trained mechanic nearby	No	Recuento	2842	3094	6687	12623
		% dentro de Availability of trained mechanic nearby	23%	25%	53%	1,0
	Yes	Recuento	7351	2900	5089	15340
		% dentro de Availability of trained mechanic nearby	48%	19%	33%	1,0
Total		Recuento	10193	5994	11776	27963
		% dentro de Availability of trained mechanic nearby	36%	21%	42%	1,0

4.2. Liberia

- Quality:

When using “water treatment” as a confounding variable, water point type showed correlation ($p<0.05$). Water treatment (used instead of “regular chlorination”) also appears to have a correlation, while “fee pay” does not.

- Seasonality:

As discussed in 4.1, the water point type doesn’t seem strongly correlated with the seasonality of the water point. The same types of water points showed very different rates of seasonality (Table 8) among the two countries.

- Functionality:

Functionality is apparently correlated with money paid to water committee, according to the tests’ results ($p=0.027$). One important finding, however, is that the regularity of the payment to the water committee, apparently, does not matter. Both cases – “ate least once a month” and “only in case of a breakdown” – showed the same results, and both are better than when there is “no water committee” (Table 10).

Table 10: Functionality x committee receives money

Committee receives money?		Functionality			Total
		Broken down system	Working and protected	Working but with problems	
No water committee	Recuento	1353	2421	477	4251
	% dentro de Committee receives money?	32%	57%	11%	100%
Yes but only in case of breakdown	Recuento	501	2015	337	2853
	% dentro de Committee receives money?	18%	71%	12%	100%
Yes at least once a month	Recuento	311	1031	109	1451
	% dentro de Committee receives money?	21%	71%	8%	100%

5. Improvements on methodology and definition of indicators

5.1. Improvements on the methodology

Water Point Mapping is applied to provide information about whether people have access to safe water or not in different locations. For this purpose, the following requirements are currently accepted to indicate access to safe water:

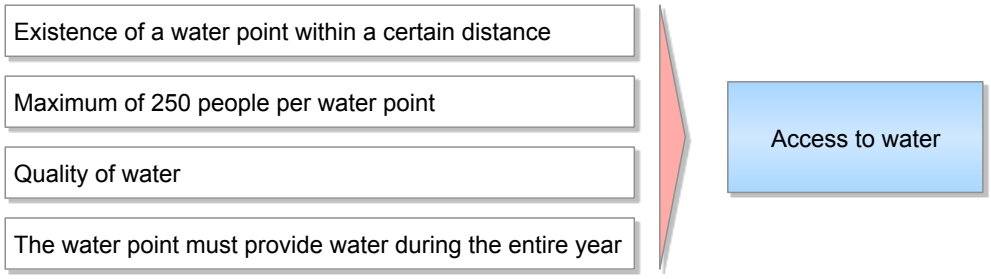

Figure 3: Parameters that indicate safe water access

Based on this framework, the major weaknesses identified in the methodology were:

- The data collected about quality was based on user's perception in both cases, what reduces the reliability of the further analysis taken.
- The advances achieved in one countries' WPM are not always availed in the next experience. The absence of continuity results in the loss of improvements on the methodology over the years.
- The absence of a set of key standardized indicators that would measure water access and its related aspects (for example maintenance, management, quality…)
- The absence of standardization of responses (responses are not standardized in "specific installer", "specific quality" and "manager" in Sierra Leone, and in "specific problem", "precise installer" and "precise quality in Liberia").
- Use of open questions leading to a wide variety of responses what make it harder to develop further analysis.
- Presence of bias in the results in major cities, where significant part of the population have access to water through private connections. Rethink Definition of a new method for urban areas is needed.
- Lack of standardization of nomenclature

The proposals to overcome the weaknesses identified are listed below:

- Quality should be assessed in a more reliable way. Stakeholders should work in order to either: onsite water quality analysis
    - Develop ways of financing quality tests like the one used in the study of or
    - Create viable alternatives to make quality tests.
- Water Point Mappings shouldn't be taken as an independent experience in each country, i.e. the entities involved should assure that all the knowledge generated in the last experiences would be availed in the next ones, creating a process of continuous improvement.
- Creation of a set of comprehensive standardized indicators that would be used in all WPM experiences in order to make it possible to compare countries and to assure that all countries are measuring and monitoring the key parameters.

- Standardization of nomenclatures for the data collection and standardization of the questionnaire. Once it is proven the efficiency of a question to assess a certain aspect, the question and its possible answers should be used in the next WPMs. Please specify
- Use of "population that depend on public water supply" (total population minus population supplied by private connections) to calculate the indicators in order to avoid the bias in areas where the share of people served by private connections is significant.

Although it is proposed the use of a set of standardized indicators, it is also understood that each country has its particularities and intend to measure some aspects that wouldn't make sense for other countries. Hence, the standardized questions in the questionnaire and indicators used would form the body of the Water Point Mapping analysis and each country could add specific questions and indicators to the analysis. A proposal of a set of key standardized indicators is provided in 5.2.

5.2. Proposal of indicators

The set of key indicators, based on the improvements achieved in the two Water Point Mappings studied and on the framework presented on figure Figure 3, would be divided in 5 groups:

- "Access to safe water" that is the final target, and
- "Infrastructure", "Quality of service", "Management" and "Maintenance" that would be the indicators that measure the parameters to ensure sustainable safe water access.

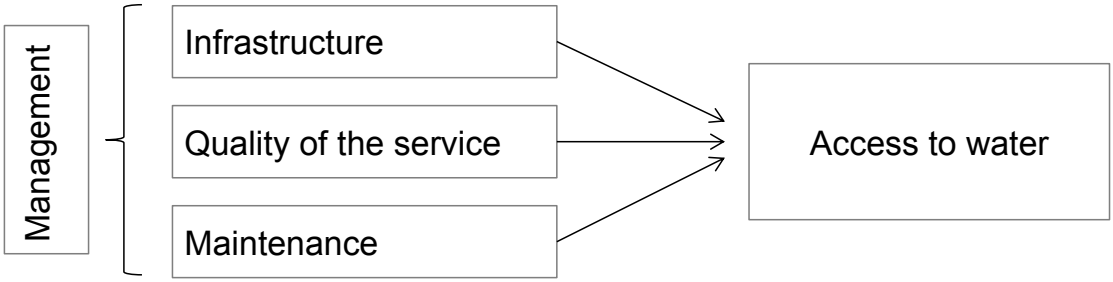

Figure 4: Relation between the groups of indicators

Access to safe water

Increasing access to safe water is the final target and main objective of Water Point Mapping. Two indicators would be used to measure the overall performance in this area.

- *Access*: the indicator *Access* used in Liberia would be improved by calculating it for both "access to functional in-use water points" and "access to non-seasonal functional in-use water points".
- σ^2_{access}: the variance of the access indicator would measure the equality of the access to safe water within different regions.
- To measure inequality at the intra-village level, it could be used an indicator calculated as the number of sub villages with a functional in-use water point divided by the total number of sub villages.

$$EI = \frac{\text{Subvillages with FCWP}}{\text{Total number of subvillage}} \times 100$$

Infrastructure

This group of indicators would measure the quantity of water points.

- Population per functional in-use water points.
- Population per non-seasonal functional in-use water points.
- % of functional in-use water points = functional in-use WP / total WPs

Quality of service

This group would measure both the quality of the water provided and the seasonality of the water points:

- % of seasonal in-use water points = seasonal in-use WP / total WPs
- % of clean in-use water points = clean in-use WP / total WPs

By “clean in-use WPs” it is meant functional in-use water points which are reported to provide clean water.

Management

This group would measure the aspects related to the management of the water points, which contributes to sustain the good condition of the water point and the good quality of the service provided.

- % of the functional water points which the water is paid
- % of the functional water points which water committee receives money

Maintenance

This group contains indicators related to the maintenance of the water points and the quality of the water provided.

- % of WPs with a trained mechanic
- % of WPs with spare part supply
- % of WPs that are regularly chlorinated

6. From data to decision-making: tools to disseminate WPM outputs to promote decision-making

The usual way to illustrate the output of the water point mapping is by providing a map like the one on Figure 5.

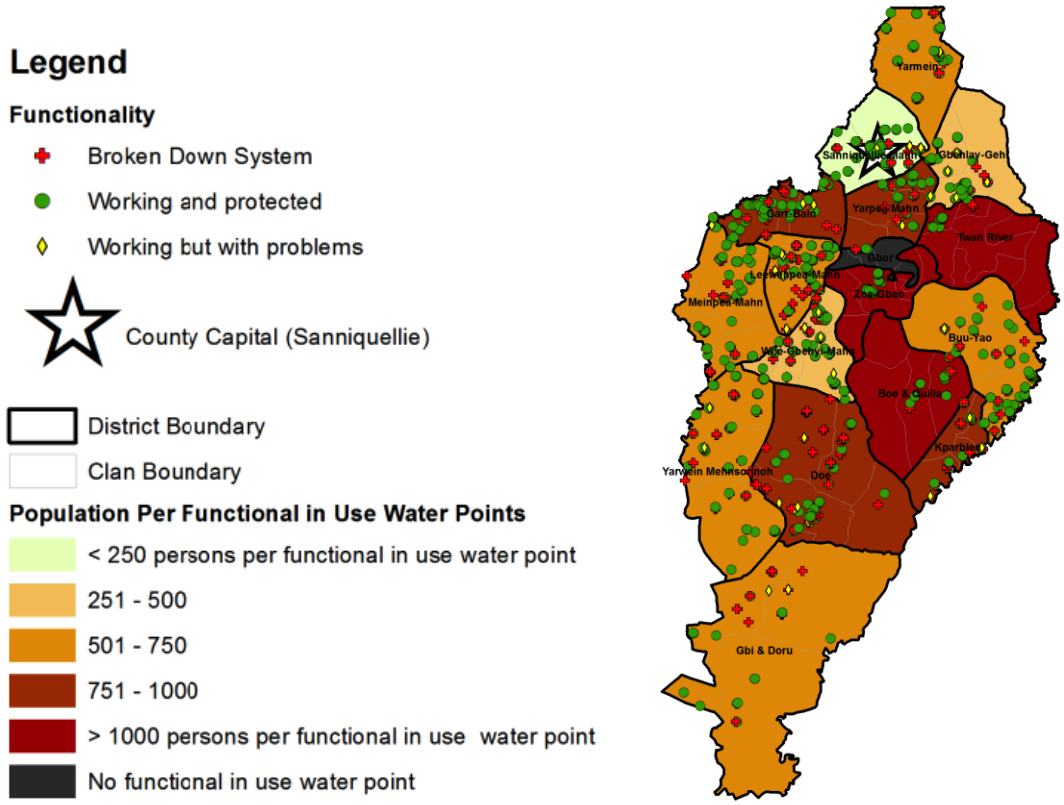

Figure 5: Example of a usual map developed from water point mapping (Source: Liberia Waterpoint Atlas)

It is possible to see which regions are less provided and also where the water points are, however it is not possible to know where exactly the villages that are lacking access to safe water are. Hence, a better map for planning investments in the sector would be a map provided in the Liberia's report and presented in Figure 6.

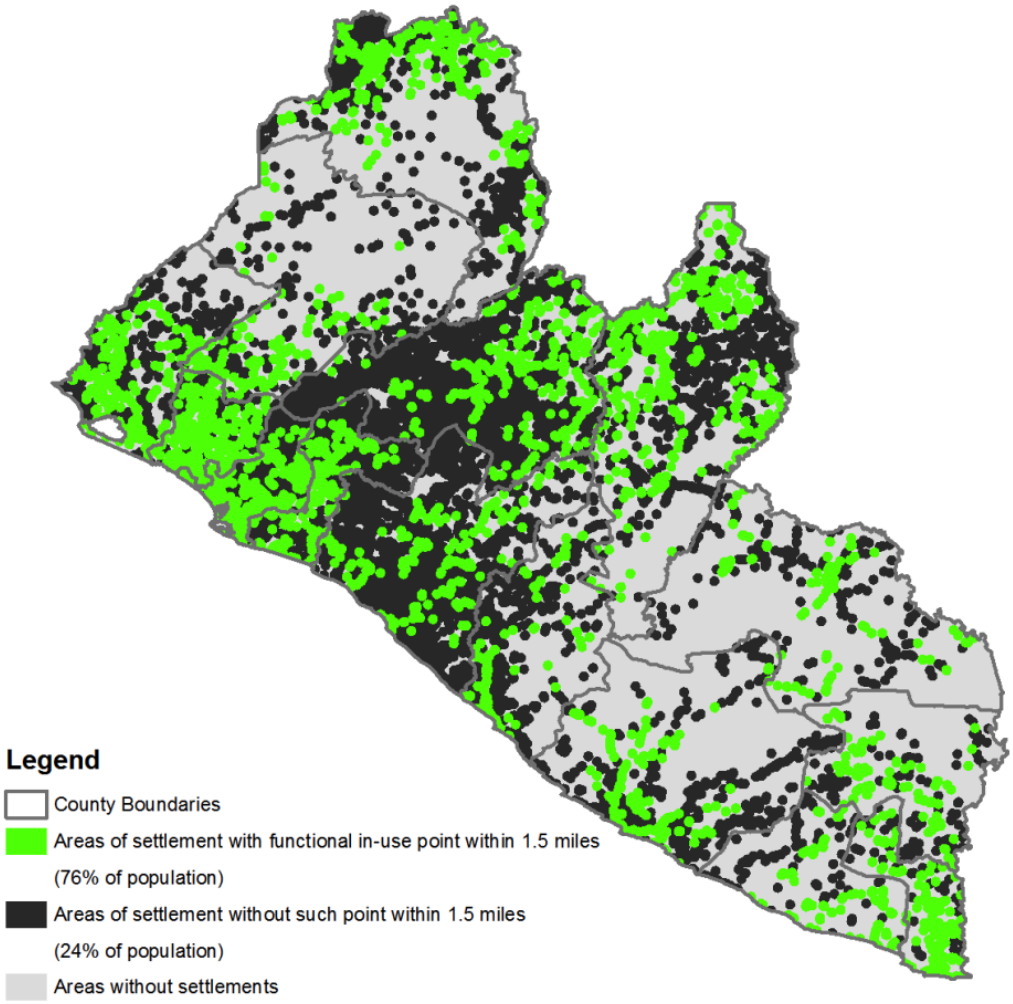

Figure 6: Map highlighting the settlements that lack access to safe water (Source: Liberia Waterpoint Atlas)

Other important tools to help planning are lists that order the regions (communities, villages, counties…) in ascending order of level of Access, like the one below.

District	Priority	Population	Access
Jeadepo	1	7,895	7%
Jaedae	2	3,539	12%
Kulu Shaw Boe	3	8,555	37%
Pynes Town	4	3,067	52%
Kpayan	5	10,661	65%
Juarzon	6	6,088	68%
Butaw	7	3,432	73%
Greenville	8	15,715	89%

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