Estimating vulnerability and projecting needs for water supply in communities : a methodology

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Contents

Introduction

In 2015, as the UN member states shifted from the Millenium Development Goals (MDGs) to the Sustainable Development Goals (SDGs), the water, sanitation and hygiene sectors' attention went to the new ambitious target of reaching universal service coverage by 2030. But what attracted less attention is that the SDG also implied a shift in the monitoring methodology. Indeed while 'access to improved drinking-water points was previously used as the proxy indicator to measure progress (in the MDG) thus monitoring systems being based on water point data, the SDG 6.1 indicator now includes a new standard of the level of services with 'safely managed drinking water and sanitation and basic services for hand washing'. This level of services implies: located on premises, available when needed, free from microbiological and priority chemical contamination.

Measuring this level of services also implies having data at household level and putting in place new monitoring mechanisms. While country governments and their partners are required to report their progress on SDG indicators, it is very expensive to collect household data and most of the time, WASH ministries don't have the mandate to do so (the national statistical agency is often the only institution in the country to collect household data).

In this concept note, Akvo and UNICEF are exploring a methodological approach that allows WASH ministries to show their contribution to SDG 6.1 on safely managed drinking water, based on their current monitoring system (on water point data) and data model, by adding population data. It will support UNICEF and its partners to identify community vulnerabilities to support WASH planning and investment.

Definitions

Vulnerability

Country governments need information about *safe water access* for planning, allocating budget and tracking the sustainability of these investments. Many countries continue to have large unserved or underserved populations with limited access to water, which means they don't have access to water on premises or need to rely on unimproved water points or surface water, as their primary and sometimes only source of water. However, when allocating a budget for investment, it is often useful to have a ladder of vulnerability: it helps prioritise investment. As such communities relying on unimproved water or nonfunctional water point need to be identified as they are, by far, the most vulnerable and should receive top priority for investment from the government or their partners.

Distribution and disparities

Access to water is generally determined by one of two ways. Either, the number of people/households a standard water point is 'intended' to benefit, as per the set national or international standards is used to determine the amount of people that could be served with the water points available, or the percentage served is determined by comparing this number to the country's population. However, in reality, water points may be accessed by a lower or higher number of people, depending on the total availability of water points in a specific region. When 'improved' water points are not distributed in proportion to the population who should be served, data about access to improved water points becomes skewed. Some communities are provided with far more water points than needed, whereas in other communities, people resort to unimproved water points or crowd around available improved water points, due to lack of water points in their own region. This, in turn, impacts functionality and leads to frequent breakdowns resulting in repeated expenditure on repair and maintenance.

In addition to water points being improved, the time taken to collect water is an important indicator for water access. By looking at the data about distribution of water points, it would be possible to estimate the proportion of people who may report accessing an improved source (and therefore reported as covered) but spend a lot more time than others to collect water. It is common to find families walking long distances to collect their drinking water from a safe source and using unimproved water points for their other domestic needs. Availability of water is a strong determinant of the amount of water used by the family and has a direct impact on the hygiene status of the family. The SDG indicator excludes families not having access on premises from the calculation.

Safety and reliability

In the JMP ladder, *Basic* level access to water from an improved source is considered the first step for safe water consumption. The higher levels in the ladder relate to quality, quantity and reliability i.e. functionality and sustainability standards.

Methodology

Proposed methods

Most countries are unable to report on the JMP WaSH services levels as they have not been able to gather comprehensive data about all the required indicators. As an interim solution it would be worthwhile to look at available, but scattered information on WASH and attempt at making inferences and projections, albeit separately for each indicator.

In order to make estimations about the vulnerability of populations across countries and to project the real need of communities, Akvo proposes a method to estimate SDG indicators. The exercise entails review of existing WASH data and population projections to arrive at rough estimates on the basis of which planning can be attempted. We use the example of Sierra Leone and data that was collected by Akvo in 2016 and 2018.

UNICEF and its partners invest considerably on water supply in vulnerable communities. Akvo's methodology can be used as an indicative tool, on the basis of which communities can be graded in terms of vulnerability and plans and allocations can be made accordingly. Even though these estimates do not provide a comprehensive picture of the actual levels of the SDG/JMP parameters, they will assist in preparing estimates of the existing situation across locations and the future projections of proposed need and thereby make investments in accordance. Further, contributions to access increase e.g. UNICEF water supply projects, may also be deduced using this methodology and attribution may be assessed.

In 2016 the ministry of WaSH in Sierra Leone and Unicef Sierra Leone joined forces with Akvo to do a water point mapping[1] of all rural water points in Sierra Leone. This includes information about the location, water point type, functionality and water quality indicators. The district level population projections used in the methodology are based on Sierra Leone's population projections of 2015[2].

To enrich this information, high resolution population density data from the Facebook data for good initiative[3] was used. This data reports population density on a 30 by 30 meter square, based on population growth modelling, satellite imagery and building density.

[1] https://washdata-sl.org/water-point-data/
[2] https://sierraleone.unfpa.org/sites/default/files/pub-pdf/Population%20projections%20report.pdf
[3] https://dataforgood.facebook.com/dfg/tools/high-resolution-population-density-maps

The district *Western Urban* is not taken into consideration in the conclusions as the city of Freetown has piped water that is not included in the data.

Disaggregate data

The different steps of the JMP ladder, in essence, are a demonstration of the degrees of vulnerability of different sections of the population in a country. The key to understanding these existing disparities and assessing the vulnerability status of different communities, lies in the process of disaggregating available information on water supply services.

The following steps are being suggested to enable country governments to gain insights about the degree of vulnerability of populations. Inferences from the following analysis are being made against the backdrop of the SDG indicators. The data being analysed are from Akvo's information/surveys in Sierra Leone and have been triangulated with population data from secondary sources, as described in the introduction.

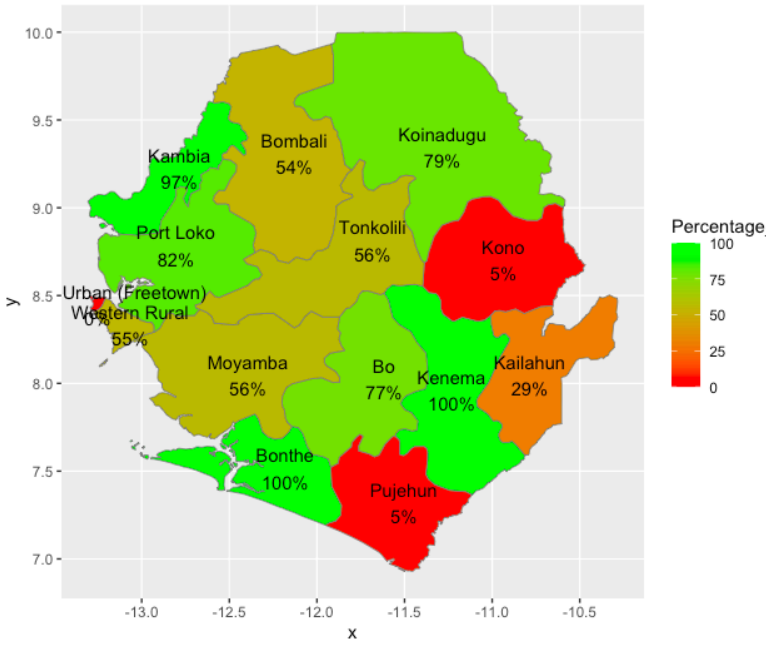
The following table shows the percentage of the population that could be covered by the water points available, assuming they are evenly distributed across the population. The percentage is determined by first calculating the amount of people the available water points could cover per district based on their water supply, and second comparing that to the number of people living in the districts. Numbers that stand out are the low percentages in Kono, Pujehun, the Western Region and Kailahun, suggesting that less than 20% of the population is covered by the present water points. The higher numbers are found in Bonthe and Kenema, exceeding 100% access.

Table 1: Water point coverage of all water points as collected in 2016 compared to 2016 population

District	Population 2016	Amount of people waterpoints could cover	Percentage of the population covered
Bo	593160	456850	77
Bombali	494473	265050	54
Bonthe	204349	250800	123
Eastern Region	1692960	778150	46
Kailahun	541202	157900	29
Kambia	355469	346450	97
Kenema	629457	1008750	160
Koinadugu	421212	332250	79
Kono	390176	21150	5
Moyamba	328373	184400	56
Northern Region	2580743	1376100	53

Port Loko	633166	519350	82
Pujehun	357105	17750	5
Southern Region	1482987	760250	51
Tonkolili	546812	303500	56
Western Region	1539712	217750	14
Western Rural	450755	248450	55
Western Urban	1088957	393750	36
Koidu New Sembehum	132125	NA	NA
Makeni	129611	NA	NA

Figure 1: Percentage of the population covered based on district level population projections (capped at 100%):



Most vulnerable: Lowest 2 levels in the JMP ladder

Communities who do not have access to an improved water source and continue to use unimproved sources or travel long distances to the nearest improved water source are the most vulnerable. Ideally these communities should receive the highest priority in country investments.

The following table shows the percentage of the population that in theory be covered by the *improved* water points available, assuming they are evenly distributed across the population. The percentage is determined by first calculating the amount of people the available improved water points could cover

per district, based on their water supply and second comparing that to the number of people living in these districts.

Almost all areas show a drop in the percentage coverage and a few, such as Bo and Bonthe show significant difference in access when excluding unimproved sources.

Table 2: Water point coverage of all IMPROVED water points as collected in 2016 compared to 2016 population

District	**WP coverage improved water points 2016**	**Population 2016**	**Percentage coverage improved water points**
Bo	281450	593160	47
Bombali	215550	494473	44
Bonthe	114800	204349	56
Eastern Region	680100	1692960	40
Kailahun	150650	541202	28
Kambia	326950	355469	92
Kenema	987000	629457	157
Koinadugu	304250	421212	72
Kono	19650	390176	5
Moyamba	121900	328373	37
Northern Region	1223150	2580743	47
Port Loko	499100	633166	79
Pujehun	16250	357105	5
Southern Region	541800	1482987	37
Tonkolili	237000	546812	43
Western Region	190250	1539712	12
Western Rural	227450	450755	50
Western Urban	317700	1088957	29
Koidu New Sembehum	NA	132125	NA
Makeni	NA	129611	NA

Moderately vulnerable: Third level of JMP ladder i.e. Limited services

Communities that have access to an improved water source but spend more than 30 minutes for a round trip for water collection fall within the 'Limited services' category. This may include those households who have no option but to travel to the distant source or may collect only their drinking water from the improved source and rely on unimproved sources for other domestic needs. Such communities are also at risk, as unclean water from unimproved sources impact hygiene levels of a family.

Somewhat vulnerable: Fourth level of JMP ladder i.e. Basic services

The bulk of the data on water supply of countries are reported under the 'Basic services' category, indicating households who have access to an 'improved' source and spend less than 30 minutes for a single trip of water collection. While households under this category are relatively better off than the earlier ones, it is important to check the availability of water from the listed sources. The data here needs to be disaggregated by 'functionality' i.e. ask whether the source is working and providing the adequate quantity of water as per the national/ international standards. Maintenance of water points have remained a challenge for most countries, especially in remote locations. This is not only because of limited resources available with country governments, but more so on account of lack of updated information about the functionality of water points. The problem is compounded by overcrowding at functional water points by households who do not have access or their own water points are in a state of disrepair. Preventive and timely maintenance can significantly reduce the repeated investments that need to be made due to major breakdown of water points.

The following table shows the percentage of the population that could be potentially covered by the available improved water points that were reported as being functional at time of data collection. The percentage is determined by first calculating the number of people these improved and functional water points could cover per district, based on their water supply and second, by comparing that to the number of people living in the districts.

Almost all areas show a drop in the percentage coverage and a few, such as Kambia and Koinadugu show significant difference in access when the non-functional sources were excluded.

Table 3: Water point coverage of all FUNCTIONAL water points as collected in 2016 compared to 2016 population

ADM2	**Population 2016**	**Coverage functional WP in 2016**	**Percentage coverage functional WP in 2016**
Bo	593160	286700	48
Bombali	494473	168150	34

Bonthe	204349	195800	96
Eastern Region	1692960	552050	33
Kailahun	541202	114750	21
Kambia	355469	179400	50
Kenema	629457	769950	122
Koinadugu	421212	233900	56
Kono	390176	16500	4
Moyamba	328373	113650	35
Northern Region	2580743	907750	35
Port Loko	633166	400700	63
Pujehun	357105	14850	4
Southern Region	1482987	551700	37
Tonkolili	546812	206800	38
Western Region	1539712	160000	10
Western Rural	450755	176350	39
Western Urban	1088957	256750	24
Koidu New Sembehum	132125	NA	NA
Makeni	129611	NA	NA

Safe water coverage: Highest level in the JMP ladder i.e. Safely managed services

Households under the 'Safely managed' category have the lowest risk as their water is free from chemical contamination and their water points function at an optimum level. Data for this category is limited, as country governments do not have the capacity to measure the set parameters in a consistent and comprehensive manner. However, it is important to review data on this, as it estimates the gaps in reporting and when disaggregated across districts or lower administrative levels, would help to identify those communities who may be reported as 'covered' but actually continue to use unsafe water. This would form the basis for designing interventions for awareness building about 'water safety' and influence behaviour to mitigate health complications.

Water point distribution

As described in the introduction, the above calculations assume equal distribution of water source among the population. This means that it is being assumed that everyone living in a specific district is

able to access the available water points in that district within reason. Sierra Leone's districts range from 12,121 km^2 (Koinadugu) to 557 km^2 (Western area), making this assumption very risky and unlikely.

The table below shows what happens to the percentage of the population having access to water when we consider the distribution of the water points and compare that to the distribution of the population.

Table 4: Water point coverage of all water points as collected in 2016 compared to population density

District	Total population density	Water point coverage (500 m radius)	Population living within 500m radius	Population living outside 500m radius	Percentage of the population living within the radius that is served by the water point	Percentage of the population living outside of the radius
Bo	732397.6956	453400	559376.0718	173021.6237	**81**	24
Bombali	503093.021	385350	292520.4151	210572.6058	**132**	42
Bonthe	175168.0823	206050	107156.0006	68012.08178	**192**	39
Kailahun	563080.4581	411150	454498.9023	108581.5558	**90**	19
Kambia	366827.8069	165200	244175.818	122651.9888	**68**	33
Kenema	704607.6535	669350	485913.8766	218693.7768	**138**	31
Koinadugu	378129.732	409100	229169.2405	148960.4915	**179**	39
Kono	322336.5743	125000	185218.5537	137118.0206	**67**	43
Moyamba	292116.9572	265000	127613.846	164503.1112	**208**	56
Port Loko	607047.0616	706200	447642.7855	159404.2761	**158**	26
Pujehun	447408.2274	367700	357117.6301	90290.59731	**103**	20
Tonkolili	484963.5064	347500	241391.2339	243572.2725	**144**	50
Western Rural	771107.6861	364550	637592.0088	133515.6773	**57**	17
Western Urban (Freetown)	698311.2786	233500	667476.9162	30834.36239	**35**	4

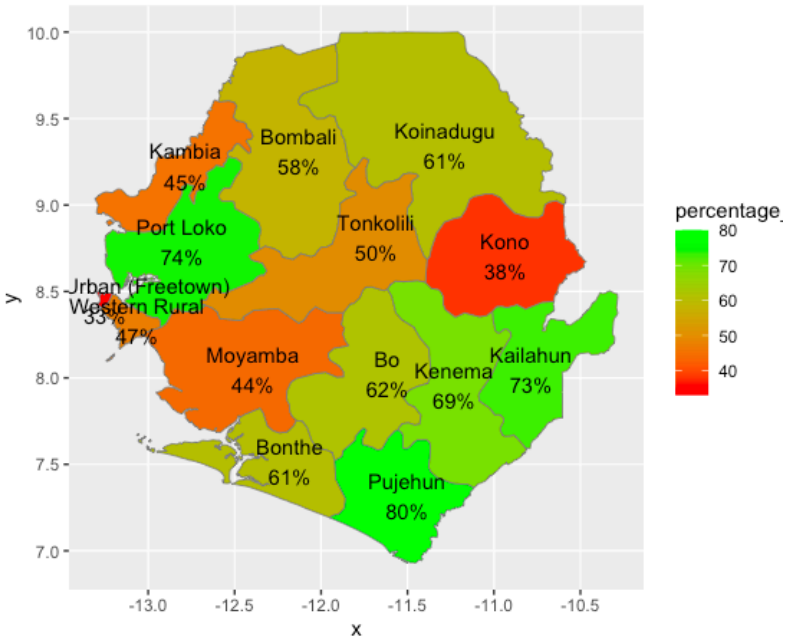
By using population density data we can determine the people that live within a reasonable distance of a water point. In this example we use a 500 meter radius around the water point. See image 1, on page 16, for an overview of how this is calculated and see a description of the exact calculation of the region of Kambia in the ASWA output 1 use case.

As you can see in table 4 the percentage of the population served within the radius is quite high and often exceeds 100% access. However, the percentage of the population living outside of the radius is high, ranging from 17 to 56 %. Looking for example ar Moyamba there is 208% access, however 56% over the population is living more than a 500 meters from a water point. This suggests that there might be enough water points, however they are poorly distributed amongst the communities.
When comparing the final two columns of table 6 and determining the population served based on the 500 meter radius you get a new percentage served, see table 5. When comparing the results of table 5 to table 1, you can see that for some districts the access percentage drops significantly, especially the districts that had a percentage exceeding 100%, however some districts show a small increase in access.

Table 5: percentage of the population served within 500m radius around a water point compared to population data from 2019.

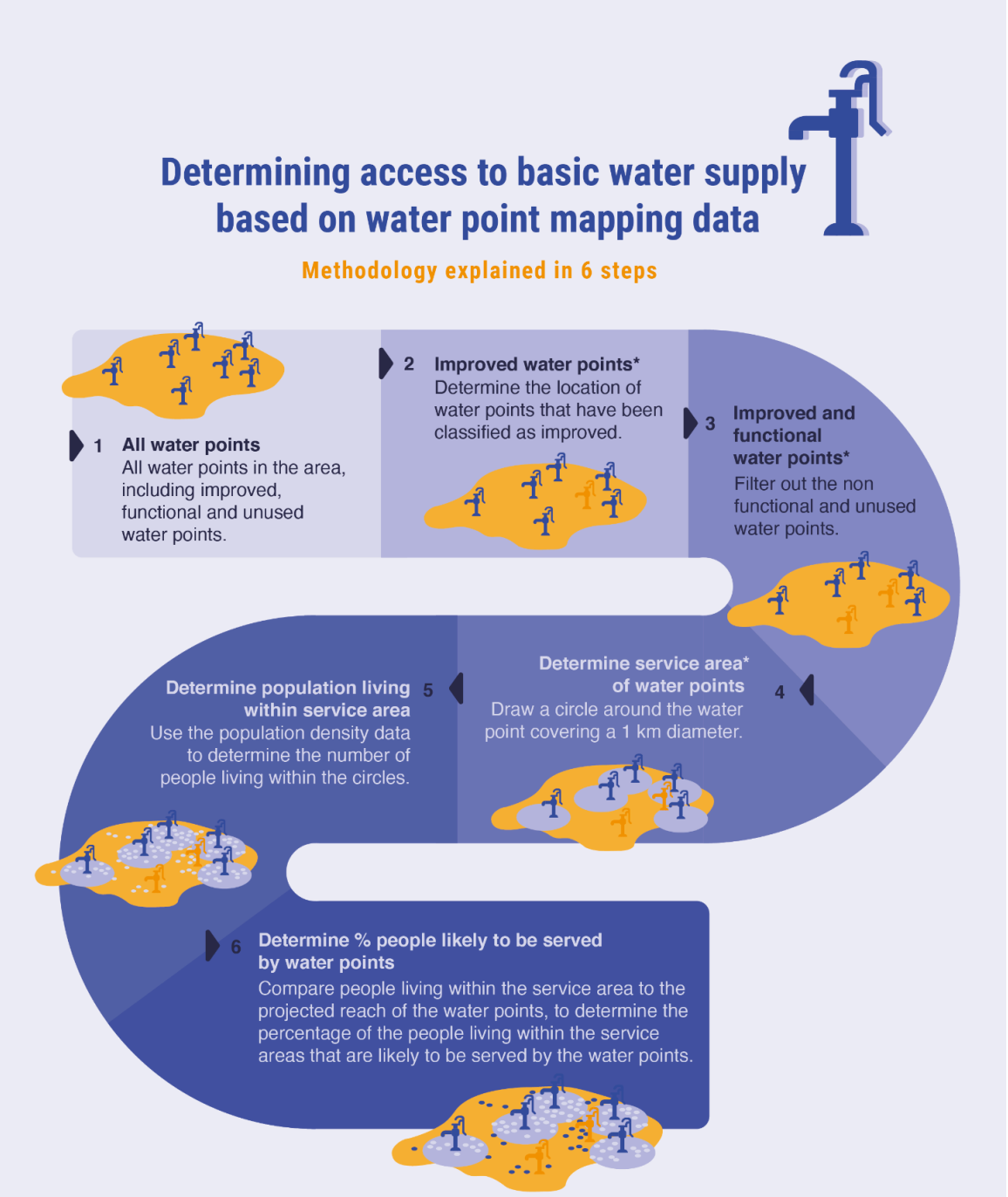
District	Population in 2019 based on FB density	Population served by the waterpoint based on population data
Bo	732397.6956	62
Bombali	503093.021	58
Bonthe	175168.0823	61
Kailahun	563080.4581	73
Kambia	366827.8069	45
Kenema	704607.6535	69
Koinadugu	378129.732	61
Kono	322336.5743	38
Moyamba	292116.9572	44
Port Loko	607047.0616	74
Pujehun	447408.2274	80
Tonkolili	484963.5064	50
Western Rural	771107.6861	47
Western Urban (Freetown)	698311.2786	33

Figure 2: Percentage of the population served within 500m radius around a water point compared to population data from 2019.



The ASWA data analytics output 1 use case gives a detailed example of these calculations for the district of Kambia, and it includes calculations for water access using the 500 meter radius of improved and functional water points. Including these characteristics allows for the estimation of the JMP water access level *Basic*, which describes households with access to improved water points within 30 minute round trip.

Image 1: Graphic overview over the methodological steps used to determine access to water using population density data.



Legend

Improved water points:	Improved drinking water sources are those that have the potential to deliver safe water by nature of their design and construction.
Functional water points:	Drinking water sources are those that have the potential to deliver.
Projected reach:	The percentage of the population that is estimated to have access to basic water supply.
Out of reach:	People that live too far from the water point (more than a 30 min walk, round trip, including queuing).

Conclusion

WaSH ministries are required to make an indication of the JMP WaSH services levels in their country. As many countries lack funds to hold intensive household surveys or collect census data, information about water access is often calculated using water point mapping data. First, by not including the water point status and functionality when determining water access the part of the population with access to water is overestimated. Second, by calculating water access by comparing the capacity of water points to district level population data, the estimated percentage of the population with access to water can be inaccurate. It assumes even distribution of the water points, and the population, across the district. The population could live too far away from improved water points, overestimating water access, or the population could be gathered around a selection of well functioning improved water points, underestimating water access.

Using the described methodology, WaSH ministries can improve the estimation of water access and use that to improve WaSH planning and maintenance activities. Also, using this methodology countries can provide an accurate estimation to the UN for the water access *basic* service level even when funds are not sufficient for household level data collection. Unfortunately, using the data sources described it is not possible to indicate households with a *safely managed* water service level. In order to determine this level water quality data is required. When water quality data of the water point is available a first estimation could be made, however behavioral factors can influence the water quality at the household. If water comes from a source with good quality water, unsafe storage can still cause the water quality of the water used in the household to be bad. Further research is needed to see if estimates about *safely managed* drinking water can be made with proxy data.