Water, sanitation, hygiene and rural poverty: issues of sector monitoring and the role of aggregated indicators

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ABSTRACT

Water and sanitation improvements together with hygiene (WASH) are central to health. However, progress in ensuring access to these basic services remains inadequate, particularly in the rural developing world. To remedy this appalling situation, decision-makers need reliable data on which to base planning, targeting and prioritization. However, the challenges of collecting such data and producing consistent evidence are diverse. To influence policy, data has to be easily and meaningfully interpreted. In addition, the evaluation framework needs to capture the complexity inherent in the delivery of rural services. And with limited resources, the neediest must be prioritized. In this paper we compare three different monitoring and evaluation approaches: health impact indicators, standard indicators of the World Health Organization (WHO)/United Nations Children’s Fund (UNICEF) Joint Monitoring Programme (JMP), and one multidimensional, WASH-focused indicator. From a policy-making perspective, the likely utility of the outcomes produced by each approach is discussed. The epidemiological study produces misleading results, which do not help draw relevant
conclusions. JMP indicators provide reasonable quality basic estimates of coverage across different contexts, but are inappropriate to build up a complete picture of such context. The index approach takes into account a broader view of service level, and proves useful as a policy tool to guide action towards improved service delivery.

Keywords

Aggregated Indicators; Health Impact; Joint Monitoring Programme; Kenya; Water, Sanitation and Hygiene

INTRODUCTION

Water, sanitation and hygiene (WASH) have a profound effect on human health (Esrey et al., 1991; Cairncross et al., 2010), and their interconnections with education, livelihoods and well-being make WASH initiatives a cornerstone of development (Briscoe and de Ferranti, 1988; Billig et al., 1999; Cairncross and Valdmanis, 2006). In brief, the health benefits are an outcome that partially arises from people drinking safe water (Fewtrell et al., 2005). The benefits are also evident when the quantity of water available is enough to promote adequate personal and domestic hygiene (Feachem, 1984), particularly the practice of washing the hands with soap (Curtis and Cairncross, 2003). In fact, it is better to ensure larger volumes of reasonable quality water than limited quantities of excellent quality (Cairncross, 1990; Howard and Bartram, 2003). Health implications are also greater if people make use of the improved sanitation facilities to which they have access (Esrey and Habicht, 1986; Clasen et al., 2010), especially where sanitation is community-wide and prevents environmental pollution (Kar and Milward, 2011).

In consequence, global concern towards the provision of water and sanitation infrastructure with personal hygiene promotion for people worldwide is rapidly increasing, and related international targets have been instrumental in driving the development agenda. To measure progress towards these targets, reliable and updated information is essential for the sake of efficiency and sound decision-making. In addition, such data may be employed to assess performance, to influence
resource allocation, to advocate for financing, to improve transparency in budgetary procedures, and to increase downward accountability to local citizens, among others (Cotton and Bartram, 2008; Joint Monitoring Programme, 2011). Against the need for providing policymakers with adequate evidence to support strategic and operational planning, the sector has witnessed the development of different approaches to monitor and evaluate drinking water supply and sanitation initiatives. This paper discusses three approaches which are being extensively used for the purposes cited above; that is, health impact indicators; standard indicators employed by the WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation (JMP); and aggregated indices, specifically one WASH-focused, thematic composite of rural poverty.

Over the past decades, the idea of evaluating water and sanitation on the basis of health has tempted both researchers and decision-makers, but the challenges are many and of different nature. Among others, epidemiological studies present methodological shortcomings in their ability to achieve reliable results (Blum and Feachem, 1983), which clearly reduce their validity as policy tools (Cairncross, 1990). A further problem is that health-based assessments do not attempt to measure use of infrastructure or behavioural changes, which are in fact main drivers for health improvement (Cairncross and Feachem, 1993; Hunt, 2001). Against these flaws, the JMP employs a technology-based definition to assess water supply and sanitation coverage, and this is done through household-based national surveys (Joint Monitoring Programme, 2006). The JMP’s reports therefore provide an internationally comparable dataset which determine progress and trends at national, regional and global scale. Despite its evident value, more precise and complete measurements are required to drive the sector forward (Joint Monitoring Programme, 2011). In particular, the recent recognition of access to safe water and basic sanitation as a human right (United Nations General Assembly, 2010; United Nations Human Rights Council, 2011) highlights the need for improved evaluation mechanisms that address the issues of affordability, quality, reliability and non-discrimination, among others. Also inherent in the human rights framework is the willingness to operate at the appropriate level. Accurate information should thus be available for decentralized decision-making,
to gain better understanding of local needs and priorities. In all, there is a call for interdisciplinary approaches to monitoring and evaluation, in which WASH issues are blended with socio-economic and environmental dimensions. They should not only provide information on the progress of specific targets (number of people with access to safe water and improved sanitation), but also indicate if the progress actually contributes to poverty alleviation. The index approach attempts to simplify the complexity inherent in rural services delivery, while keeping water, sanitation and hygiene in focus. In so doing, it provides a powerful tool for supporting decisions about planning and prioritization of poverty reduction initiatives.

This paper assesses the adequacy of these three monitoring instruments from a policy-making point of view, and specifically spotlights the potential and limitations of each approach to produce reliable estimates that might be used for planning support. They are all reviewed with reference to experience in Kenya, where the Government launched a countrywide initiative to accelerate the achievement of sector-related national targets. Integral to this process was a comprehensive baseline survey of households in relation to the use of safe water, adequate sanitation and hygiene education, in which this paper draws on. The case study is introduced in the next section, followed by a detailed account of the methodology used to collect the data from the field and the computation of the data to produce the estimates. The three approaches are analysed separately, and their strengths and weaknesses are highlighted. The paper closes with a discussion of adequacy of each monitoring instrument to influence policy and ultimately improve strategic and operational planning.

THE STUDY AREA

In Kenya, a large proportion of population does not have access to safe water and sanitation facilities. According to the last national official statistics (Kenya National Bureau of Statistics (KNBS) and ORC Macro, 2010), about two-thirds of the people (60.2%) use improved sources of drinking water, and only 24.3% of the population have access to adequate sanitation facilities. Overall, the situation in rural areas is below the national average (53.1% and 21.8% respectively),
and regional disparities are remarkable, a large number of rural districts do not even reach these coverage ratios. Water and sanitation-related diseases arising from lack of access to water, poor drinking water quality, inadequate sanitation facilities and poor hygiene practices are contributing to high mortality of children under five. This stands at 74 per 1,000 children, of which diarrhoeal diseases might cause about 20% of the deaths in high-risk areas (Kenya National Bureau of Statistics (KNBS) and ORC Macro, 2010).

Table 1 Population, area, and density

<table>
<thead>
<tr>
<th>District</th>
<th>Population</th>
<th>Area (Km²)</th>
<th>Density</th>
<th>District</th>
<th>Population</th>
<th>Area (Km²)</th>
<th>Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bondo</td>
<td>157,522</td>
<td>593.0</td>
<td>265.6</td>
<td>Molo</td>
<td>542,103</td>
<td>2,371.9</td>
<td>228.6</td>
</tr>
<tr>
<td>Busia</td>
<td>327,852</td>
<td>681.0</td>
<td>481.4</td>
<td>Mwingi</td>
<td>244,981</td>
<td>5,224.3</td>
<td>46.9</td>
</tr>
<tr>
<td>Garissa</td>
<td>190,062</td>
<td>5,589</td>
<td>34.0</td>
<td>Nyando</td>
<td>350,353</td>
<td>1,168.0</td>
<td>300.0</td>
</tr>
<tr>
<td>Isiolo</td>
<td>100,176</td>
<td>15,517</td>
<td>6.5</td>
<td>Rachuonyo</td>
<td>382,711</td>
<td>950.7</td>
<td>402.5</td>
</tr>
<tr>
<td>Kajiado</td>
<td>549,816</td>
<td>15,490</td>
<td>35.5</td>
<td>Siaya</td>
<td>550,224</td>
<td>1,534.0</td>
<td>358.7</td>
</tr>
<tr>
<td>Kieni</td>
<td>693,558</td>
<td>3,337</td>
<td>207.8</td>
<td>Tana River</td>
<td>143,411</td>
<td>22,822.9</td>
<td>6.3</td>
</tr>
<tr>
<td>Kisumu</td>
<td>618,556</td>
<td>918</td>
<td>673.9</td>
<td>Turkana</td>
<td>855,399</td>
<td>68,680</td>
<td>12.5</td>
</tr>
<tr>
<td>Kitui</td>
<td>447,613</td>
<td>7,616.0</td>
<td>58.8</td>
<td>Uasin Gishu</td>
<td>894,179</td>
<td>3,345</td>
<td>267.3</td>
</tr>
<tr>
<td>Kwale</td>
<td>151,978</td>
<td>1,031.2</td>
<td>147.4</td>
<td>Wajir</td>
<td>661,941</td>
<td>56,686</td>
<td>11.7</td>
</tr>
<tr>
<td>Mandera</td>
<td>1,025,756</td>
<td>25,991</td>
<td>39.5</td>
<td>West Pokot</td>
<td>512,690</td>
<td>9,169</td>
<td>55.9</td>
</tr>
<tr>
<td>Marsabit</td>
<td>46,502</td>
<td>2,052.0</td>
<td>22.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Within this high-risk environment, in 2010, the Government, in collaboration with UNICEF, launched an initiative to increase the access to safe drinking water and sanitation: the most vulnerable rural populations were targeted. This study focuses on these populations (Table 1 and
Figure 1), which are found in the pastoral arid and semi-arid districts of Isiolo, Wajir, Garissa, Mandera, West Pokot, and Turkana, in the Lake Basin Districts of Busia, Kisumu, Siaya, Bondo, Rachuonyo and Nyando; in the Coastal district of Kwale and Tana River; in the Eastern province districts of Mwingi, Marsabit and Kitui; in the Rift Valley province districts of Kajiado, Uasin Gishu and Molo; and in the Kieni district of Central province (United Nations Children’s Fund and Government of Kenya, 2006).

![Map of Kenya with WASH Programme Districts](image)

**Figure 1** Map of Kenya with WASH Programme Districts

**METHODS**

Evidence-based decision-making requires a comprehensive monitoring framework. The first step is to identify pertinent and measurable indicators as the basis of monitoring. The second step is to develop appropriate survey instruments for each indicator’s assessment. Third, the survey design has to enable the compilation of accurate primary data to produce statistically representative estimates. Finally, information has to be adequately examined and disseminated to promote its validity in decision-making processes. As one emergent sector challenge is to move from coverage-
based to pro-poor programming, survey data has to be disaggregated by geographic and poverty levels to improve targeting and prioritization.

**Survey indicators and assessment tools**

The framework proposed relies on a specific compilation of indicators as a starting point, which demands a balance between avoidance of redundancy and comprehensiveness with respect to the survey’s goals. A WASH approach was adopted for indicator definition, and a set of relevant variables were formulated to cover all areas of study, that is, health issues, access to water supplies, use of sanitation facilities, and hygiene behaviour.

In order to acquire the information needed for each indicator’s assessment, the survey employed a combination of quantitative and qualitative instruments, and field inspections of the water points and household interviews were used as study tools. First, service level was captured through a structured household-based questionnaire and direct observation. In every visited household, the questionnaire was administered to primary caregivers, as they are largely responsible for WASH-related issues at the dwelling. Issues covered included, among others: i) type of main drinking water source, ii) distance from dwellings to the source, iii) domestic water consumption, iv) household water treatment, v) access to and proper use of sanitation facilities, vi) disposal of children’s stools, vii) hand-washing behaviour, and viii) key socio-economic aspects. Second, relevant data for all drinking water sources identified at households were collected using a standardized checklist of key criteria. Water point audits focused on issues of i) technology, ii) operational status, iii) seasonality, iv) construction quality, v) existence of water point committees, and vi) operation and maintenance.

Furthermore, all sources were sampled for on-site water quality surveillance, and a complementary sanitary inspection was performed as a form of risk assessment to evaluate the likelihood of contamination occurring (Howard, 2002). The water analysis was carried out with a portable kit and included bacteriological testing (thermotolerant coliforms) as well as other critical parameters: i) pH; ii) conductivity; iii) turbidity; v) free chlorine (where water was disinfected using chlorine); and
v) nitrates. From each water point, one household accessing the source was also selected and one additional water sample was collected and analysed at household level.

All assessment tools were elaborated in a participatory manner through consultation with primary stakeholders. Care was taken to tailor the questions to represent the rural situation in Kenya. Likewise, questionnaires were reviewed and issues of question order, wording and intention were systematically checked in such a way as to minimize misleading outcomes. They all were piloted in three villages, and the outcomes were useful to spotlight challenges both in the field and with the instruments. Following the pilot, further fine-tuning was required. The questionnaires were then translated into local dialects (e.g., Kiswahili, Kikuyu, Kamba, Luo, Turkana, Somali, etc.). Finally, training sessions were held with project staff that would administer the survey. The enumerators were taken through the questionnaires and various other issues concerning the fieldwork, such as making GPS coordinate readings, water quality testing, etc.

The sampling method

The survey was mainly household-based, and the sample design was in line with methodological principles implemented in other major data collection exercises on water, sanitation and health (Bennett et al., 1991; Howard et al., 2003, draft; United Nations Children’s Fund, 2006). Key features of the sampling frame included: i) selection of a sample size that allowed for separate estimates for each of the recipient districts, ii) cluster-sample design instead of simple random sample, iii) self-weighting sampling procedure for selection of clusters, and iv) a random probabilistic technique for household selection at cluster level. This was done based on the Kenya National Bureau of Statistics (KNBS) fourth National Sample Survey and Evaluation Program (NASSEP IV), which was developed on the platform of a two-stage sampling design. The first stage involves selection of clusters from the national master sample frame. In Kenya, 1,800 clusters (1,260 are rural and 540 are urban) have been identified by sampling with probability proportional to size (pps) from an initial list of 62,000 enumeration areas covered in the 1999 population and
housing census. The second stage of selection involves the systematic sampling of households in each cluster from an updated list of households. In the NASSEP IV approach, the sample is stratified into urban and rural, and particularly urban estimates are oversampled. According to these differing sample proportions and since the focus of the study was on rural areas, a deliberate attempt was made to increase the size of selected clusters to get enough cases for the analysis.

In all, 5,050 households (HHs) were surveyed and 407 water points (WPs) were audited across 317 rural clusters to cover 21 targeted districts (Table 2). Data was collected from January 2010 to March 2010 (during the rainy season).

**Data analysis**

Information has to be post-processed, analysed and disseminated effectively to avoid data misinterpretation or misuse. Prior to data analysis, however, some quality control procedures should be in place. In this study, for instance, selected variables were assessed through more than one questionnaire to allow for triangulation and systematic checking of data consistency. Indicators were also reviewed for outliers, and frequency tables were produced to show the minimum and maximum values as well as some basic statistics (median, average, standard deviation, etc.). All suspicious values were checked and corrected where necessary, or removed as missing data in case correcting was not possible.

**Table 2 List of districts, distribution of clusters and sample size**

<table>
<thead>
<tr>
<th>District</th>
<th>No. of clusters</th>
<th>No. of HHs</th>
<th>No. of WPs (Improved / Unimproved)</th>
<th>District</th>
<th>No. of clusters</th>
<th>No. of HHs</th>
<th>No. of WPs (Improved / Unimproved)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bondo</td>
<td>18</td>
<td>252</td>
<td>6/13</td>
<td>Molo</td>
<td>200</td>
<td>19/14</td>
<td></td>
</tr>
<tr>
<td>Busia</td>
<td>15</td>
<td>240</td>
<td>24/5</td>
<td>Mwingi</td>
<td>15</td>
<td>240</td>
<td>2/14</td>
</tr>
<tr>
<td>Garissa</td>
<td>14</td>
<td>434</td>
<td>4/12</td>
<td>Nyando</td>
<td>18</td>
<td>252</td>
<td>13/5</td>
</tr>
<tr>
<td>Isiolo</td>
<td>13</td>
<td>234</td>
<td>8/7</td>
<td>Rachuonyo</td>
<td>18</td>
<td>252</td>
<td>5/13</td>
</tr>
<tr>
<td>County</td>
<td>Code</td>
<td>Pop (18+)</td>
<td>SMR</td>
<td>SMR 18</td>
<td>Code</td>
<td>Pop (18+)</td>
<td>SMR</td>
</tr>
<tr>
<td>----------</td>
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<td>-----------</td>
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<td>--------</td>
<td>------</td>
<td>-----------</td>
<td>-----</td>
</tr>
<tr>
<td>Kajiado</td>
<td>18</td>
<td>252</td>
<td>25/1</td>
<td></td>
<td>Siaya</td>
<td>19</td>
<td>247</td>
</tr>
<tr>
<td>Kieni</td>
<td></td>
<td>200</td>
<td>1/23</td>
<td></td>
<td>Tana River</td>
<td>15</td>
<td>224</td>
</tr>
<tr>
<td>Kisumu</td>
<td>9</td>
<td>225</td>
<td>8/3</td>
<td></td>
<td>Turkana</td>
<td>15</td>
<td>128</td>
</tr>
<tr>
<td>Kitui</td>
<td>18</td>
<td>252</td>
<td>9/17</td>
<td></td>
<td>Uasin Gishu</td>
<td>17</td>
<td>238</td>
</tr>
<tr>
<td>Kwale</td>
<td>20</td>
<td>238</td>
<td>15/11</td>
<td></td>
<td>Wajir</td>
<td>14</td>
<td>238</td>
</tr>
<tr>
<td>Mandera</td>
<td>15</td>
<td>240</td>
<td>10/5</td>
<td></td>
<td>West Pokot</td>
<td>15</td>
<td>240</td>
</tr>
<tr>
<td>Marsabit</td>
<td>15</td>
<td>224</td>
<td>8/8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

After data cleaning, the analysis focused on identification, from the viewpoint of planning and decision-making, of the strengths and limitations of the three monitoring approaches that are being extensively used in the sector:

- Health indicators to evaluate impact and performance of WASH initiatives.
- International standard indicators defined in the JMP (Joint Monitoring Programme, 2006).
- A WASH-focused, thematic indicator of rural poverty, the WASH Poverty Index (Giné Garriga and Pérez Foguet, 2013).

To do this, the statistical analysis employed tools such as the Pearson’s chi-square test and the Principal Component Analysis (PCA), using in both cases a standard statistical package (SPSS 15.0, 2006). The Pearson’s chi-square test, specifically the SPSS Exact Tests v7.0 (Mehta and Patel, 1996), was performed to assess relationship between survey variables. In this test the null hypothesis is independence, and the value $P = 0.05$ is used as the cut-off for rejection or acceptance (meaning there is a 5% chance or less that the variables are actually independent, given the assumptions of the test are valid). PCA was used in index construction to create and validate the composite. Main goal of this analytical approach is to explore how variables are correlated with each other, and how they can be summarized to avoid any risk of repetition prior to their aggregation.
Equity issues

The recognition of the right to water and sanitation corroborates the need for mechanisms that address equity and non-discrimination. To plan through a pro-poor lens, monitoring and evaluation systems should not mask regional or socio-economic disparities. Therefore, as an essential condition to prevent that the most vulnerable are overlooked in the process of increasing access, data have to be disaggregated by geographic area (at the lowest appropriate scale) and by poverty levels, which provides the evidence base for equity-oriented planning.

This paper addresses equity as a background characteristic that was investigated to i) explore regional differences and to ii) identify socio-economic groups at risk. First, WASH estimates were computed at the intervention area level (i.e. district) to i) understand particularities of each district, ii) design context-specific interventions accordingly, and iii) better identify the neediest locations. Second, those groups most in need were identified, to observe whether gaps in service provision between the poor and the better off were remarkable. To do this, we used the socio-economic conditions at the household level, which are likely to determine the level of service. However, assessing household economic status poses considerable problems, and this raises the question of how best it can be done. The conventional approach is through ‘direct’ measures of living standards, such as household income or expenditure, but in low-income settings these data are often unreliable, unavailable or expensive and difficult to collect (Filmer and Pritchett, 2001). In the absence of accurate money-metric information, another approach is to use a ‘proxy’ measure of wealth. Assets that households have acquired, housing quality, water and sanitary facilities and other amenities are good indicators of ‘long-run’ welfare (Cortinovis et al., 1993; Filmer and Pritchett, 2001; O’Donnell et al., 2007; Booyzen et al., 2008). Although this alternative also presents considerable limitations (Houweling et al., 2003), it has the merit of employing only data that can be easily collected in a single household interview (O’Donnell et al., 2007). In this study, a wealth index was developed for descriptive and monitoring purposes by assembling a long list of
household durables (e.g. radio, television, bicycle, etc.) and various attributes of the household’s dwelling (type of flooring; materials used for the roof and walls). Data on drinking water supply and type of sanitation were explicitly excluded from the measure for being direct determinants of the analysis. PCA was performed to handle the vexing problem of weights, and it was assumed that the first component represented an adequate measure of welfare (Filmer and Pritchett, 2001; O’Donnell et al., 2007). When constructing the index, all asset items were summed and weighted by the elements of the first eigenvector.

**ESTIMATING THE HEALTH IMPACT OF WATER AND SANITATION**

The health benefits of improved water supply, household sanitation and hygiene behaviour are broad in scope (Esrey et al., 1991; Fewtrell et al., 2005; Cairncross and Valdmanis, 2006). Hence, there is a strong temptation to conduct health impact assessments of WASH-related interventions. In practice nonetheless, there are many challenges and attempts to measure this impact have often produced meaningless results (Cairncross, 1990; Samanta and Van Wijk, 1998). One reason for this is that many different pathogens cause diarrhoea through various transmission routes; it is thus not easy to identify how people caught diarrhoea. In addition, incidence of diarrhoea may be influenced by a variety of other factors besides access to a water supply or sanitation, such as the socio-economic status of the household, education of the mother and access to health care (Cairncross and Feachem, 1993). Other problems are more related to methodological flaws of evaluation techniques employed to assess health benefits (Blum and Feachem, 1983). Against this background, one might conclude that health impact indicators are not easily defined and accurately measured, particularly in the short run (Samanta and Van Wijk, 1998).

**Results**

The survey results apparently support this hypothesis (Table 3). The number of diarrhoea episodes were recorded, where diarrhoea was defined as more than three loose stools passed in a 24 hour
period (Baqui et al., 1991). Out of the sampled households; there were 1,647 households with children aged less than 36 months, and episodes of diarrhoea were only reported in 78 households (4.7%). Lower percentages were found in the rest of the age bands. In contrast, and according to the last ‘2008–09 Kenya Demographic and Health Survey’, diarrhoea prevalence among children (less than 36 months old) in Kenya stands at 21.8% (Kenya National Bureau of Statistics (KNBS) and ORC Macro, 2010). There are different reasons which might partially justify such large disparities from baseline survey data; such as, i) Kenya Demographic and Health Survey estimates were collected at national level (including both urban and rural areas); and ii) seasonality issues (although it should be borne in mind that baseline data was collected during rainy season, which represents the peak season for diarrhoeal diseases). At best, the analysis confirms that health estimates need to be interpreted with caution when evaluating benefits of water and sanitation to health.

Table 3. Percentage of children with diarrhoea in the two weeks preceding the survey

<table>
<thead>
<tr>
<th></th>
<th>No episodes of diarrhoea</th>
<th>At least one episode of diarrhoea</th>
<th>Sample size (no. households)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 36-months-old</td>
<td>Count (%)</td>
<td>1,569 (95.3)</td>
<td>78 (4.7)</td>
</tr>
<tr>
<td>36-months to 5-years-old</td>
<td>Count (%)</td>
<td>1,567 (97.0)</td>
<td>49 (3.0)</td>
</tr>
<tr>
<td>5–15-years-old</td>
<td>Count (%)</td>
<td>3,672 (98.1)</td>
<td>73 (1.9)</td>
</tr>
</tbody>
</table>

First, a closer look at the data (children aged less than 36 months) shows that six districts (i.e., Kieni, Molo, Garissa, Mandera, Kisumu and Turkana) recorded no cases of diarrhoea, while at the other end of the scale, Uasin Gishu (8 cases, 12.1%), Tana River (22 cases, 25.6%) and Kwale (27 cases, 24.3%) reported the highest number of cases. These estimates, however, do not help to reveal major causes that explain regional differences; and in those districts where the situation is more
risky, the assessment does not itself shed light on how a health benefit may be materialized, or vice versa.

**Table 4. Prevalence of diarrhoea by wealth and WASH indicators**

<table>
<thead>
<tr>
<th>Wealth Status</th>
<th>Episodes of diarrhoea (children &lt; 36 months old)</th>
<th>Pearson Chi-Square</th>
<th>Exact Sig. (2-sided)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No episodes of diarrhoea</td>
<td>At least one episode of diarrhoea</td>
<td></td>
</tr>
<tr>
<td>Highest quintile</td>
<td>Count (%)</td>
<td>286 (95.02)</td>
<td>15 (4.98)</td>
</tr>
<tr>
<td>Fourth</td>
<td>Count (%)</td>
<td>321 (96.40)</td>
<td>12 (3.60)</td>
</tr>
<tr>
<td>Middle</td>
<td>Count (%)</td>
<td>336 (95.45)</td>
<td>16 (4.55)</td>
</tr>
<tr>
<td>Second</td>
<td>Count (%)</td>
<td>218 (93.97)</td>
<td>14 (6.03)</td>
</tr>
<tr>
<td>Lowest quintile</td>
<td>Count (%)</td>
<td>408 (95.10)</td>
<td>21 (4.90)</td>
</tr>
<tr>
<td>Access to water</td>
<td>Improved</td>
<td>710 (96.60)</td>
<td>25 (3.40)</td>
</tr>
<tr>
<td></td>
<td>Unimproved</td>
<td>859 (94.19)</td>
<td>53 (5.81)</td>
</tr>
<tr>
<td>Access to sanitation</td>
<td>Improved</td>
<td>279 (94.58)</td>
<td>16 (5.42)</td>
</tr>
<tr>
<td></td>
<td>Unimproved</td>
<td>1290 (95.41)</td>
<td>62 (4.59)</td>
</tr>
<tr>
<td>Disposal of children’s stools</td>
<td>Sanitary disposal</td>
<td>897 (94.03)</td>
<td>57 (5.97)</td>
</tr>
<tr>
<td></td>
<td>Unsaniitary disposal</td>
<td>648 (96.86)</td>
<td>21 (3.14)</td>
</tr>
</tbody>
</table>

a) 0 cells (0.0%) have expected count less than 5.

The health impact of wealth and other key WASH indicators may also be examined. It is gleaned from Table 4 that there is significant association between prevalence of diarrhoea and i) access to improved water supplies \( (P = 0.026) \), and ii) sanitary disposal of children’s faeces \( (P = 0.009) \). In contrast, no significant reduction in diarrhoea is observed with i) wealth and with ii) access to basic
sanitation. In brief, slight positive impacts are observed when an improved water supply is accessed by the household and when children's faeces are disposed of safely. But Table 4 also shows that the number of cases of diarrhoea reported among the poorest (4.9% of households, 21 cases) and the richest (5%, 15 cases) is nearly the same; and that using an improved sanitation facility would make no difference in relation to health. Where a significant health impact is found, the association is further studied by disaggregating water and hygiene variables by wealth. It is noted from Table 5 that previous estimates are probably influenced by socio-economic status at the household level, which act as confounding factor.

**Table 5. Prevalence of diarrhoea by wealth and WASH indicators**

<table>
<thead>
<tr>
<th>Wealth Quintile</th>
<th>Access to water</th>
<th>Disposal of children's stools</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><em>No. of Valid Cases</em></td>
<td><em>Pearson Chi-Square</em> (2-sided)</td>
</tr>
<tr>
<td>Highest quintile</td>
<td>301</td>
<td>1²</td>
</tr>
<tr>
<td>Fourth</td>
<td>333</td>
<td>1⁴</td>
</tr>
<tr>
<td>Middle</td>
<td>352</td>
<td>0.613²</td>
</tr>
<tr>
<td>Second</td>
<td>232</td>
<td>0.161⁴</td>
</tr>
<tr>
<td>Lowest quintile</td>
<td>429</td>
<td>0.035³</td>
</tr>
</tbody>
</table>

a) 0 cells (0.0%) have expected count less than 5.

b) 1 cell (25.0%) has expected count less than 5. The minimum expected count is 1.66.

c) 1 cell (25.0%) has expected count less than 5. The minimum expected count is 2.21.

d) 1 cell (25.0%) has expected count less than 5. The minimum expected count is 4.68.

On the basis of achieved results, it might be concluded that adequacy of health indicators to support operational and strategic decision-making should be at least questioned, which seriously diminishes
the soundness of epidemiological studies as a tool to guide sector development. Instead of striving to measure the health impact, a more useful approach emerges from an understanding of the causal relations between the provision of water supply or sanitation and any improvement in hygiene which may result, such as washing of hands, use of a sanitary facility, or the safe disposal of children’s stools (Cairncross and Feachem, 1993). For example, no potential benefits might stem from a water supply if it is not used. And it cannot be used if it is not functioning. Thus, one first should look at whether the water supplies are functioning and if they are being adequately used. If domestic water use increases, there is a good chance that most of the increase will be used for hygiene purposes, and then health benefits are likely to be materialized (Cairncross and Feachem, 1993). Similarly, a consistent use of a sanitation facility, not its mere existence, will probably result in health and environmental improvements; since use of sanitation isolates contaminated faeces from the environment, thus breaking down the transmission route of disease (Hunt, 2001).

In terms of planning, the measurement of behavioural changes is likely to produce much more useful information for policymakers, since they are easily attributable to the sector strategy and related interventions. An input and behaviour oriented approach thus seems to be more feasible and practical, providing greater power to diagnose problems and indicate opportunities for improvement (Cairncross, 1990; Samanta and Van Wijk, 1998).

THE JOINT MONITORING PROGRAMME

A first step towards achieving this is the implementation, at the international level, of the WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation (JMP). This initiative regularly reports on the coverage and status of drinking water and sanitation, and in so doing helps countries in their efforts to monitor the sector. However, this monitoring has presented various challenges. The coverage figures in assessments prior to 2000 referred to ‘safe’ water supply and ‘adequate’ sanitation, but consistent definition of ‘safety’ and ‘adequacy’ remained elusive (Joint Monitoring Programme, 2000). Another key limitation was the variety of information
sources and reporting formats employed for data collection. To improve on the comparability of data, the JMP formulated a set of core questions (Joint Monitoring Programme, 2006). Its expanded use worldwide in regularly conducted household-based surveys would produce more accurate estimates at country and regional levels.

In the end, the harmonized definitions of coverage are technology-based, since this is the data that can be consistently collected at a large scale. The JMP assumes that certain types of technology are safer or more adequate than others; and consequently the terms ‘safe’ and ‘adequate’ are replaced with ‘improved’. The following water technologies are treated as improved: piped water to the dwelling, plot or yard, public standpipe, borehole with hand pumps, protected (lined) dug well, protected spring and rainwater collection; and a water service ladder with three different levels is proposed to describe the incremental progress in service delivery: ‘unimproved’, ‘improved’ and ‘piped’. ‘Reasonable access’ is then defined as the availability of at least 20 litres per capita per day from an improved source within one kilometre of the user’s dwelling (Joint Monitoring Programme, 2000). With regard to sanitation, a wide range of technologies might be in place, particularly for settings where low-cost solutions are required. Instead of distinguishing between technologies, the excreta disposal system is considered adequate as long as it is private (but not shared/public) and hygienically separates human excreta from human contact (Joint Monitoring Programme, 2010). As a result, ‘improved’ sanitation is defined to include a house connection to a sewer or septic tank, a pour-flush latrine, a simple pit latrine and a ventilated improved pit latrine. In much the same way as with water supply, sanitation coverage is ultimately presented as a four-step ladder that distinguishes between ‘open defecation’, ‘unimproved’, ‘shared’ and ‘improved sanitation’. Only population with access to improved water supply and sanitation is considered to be ‘covered’.

This section presents the JMP indicators based on their nature: i) drinking water, ii) sanitation, and iii) hygiene; followed by an in-depth discussion of their adequacy from the viewpoint of monitoring and evaluation.
Indicators for drinking water

The harmonized questions for drinking water assess the type of water source used, the time spent in fetching water, and the water-hauling burden. A separate indicator also evaluates the adequacy of the water treatment at the point of use.

Access to improved water supplies

The first indicator provides information about the household’s main source of drinking water, and, as above-mentioned, the type of technology is used as a proxy for a binary categorization of households.

In the study area, the use of improved sources is by and large poor, with 43.5% of all households getting their drinking water from such sources. More specifically, 2.3% of households have piped water on the premises, while the predominant improved technology is the borehole (23.1%). On the other hand, more than half of surveyed households (56.5%) get their water from an unimproved source, mainly surface water from lakes, streams, and rivers (44.5%). There are marked regional variances, as shown in Figure 2. Also, it is observed that differences exist with wealth regarding access to water ($P < 0.001$), and, for example, the benefits of piped water on the premises are enjoyed only by the wealthiest.

Collection of drinking water

Lack of ready access to a water source may limit the quantity of suitable water that is available to a household for domestic purposes. In particular, research has shown that those spending more than half an hour per round trip progressively collect less water (Whittington et al., 1990; Cairncross and Feachem, 1993; Hutton and Haller, 2004), and this has been proposed by the JMP as the threshold distance.

Notably, a large percentage of households (45.4%) spend more than half an hour per round trip to collect water, despite significant regional differences (Figure 3). It is shown that time spent in
hauling water significantly decreases with wealth ($P < 0.001$). In contrast, data indicate that households opt against spending ‘extra time’ to get an improved water source, and distances from dwellings to improved and unimproved sources are basically the same in all ($P > 0.05$) but the richest quintile ($P = 0.007$), in which ‘household connection’ represents a not inconsiderable option (7.4%).

**Figure 2.** Access to improved drinking water sources (% of HH), at district level

**Figure 3.** Time to fetch water (% of HH), at district level

Another issue in evaluating the accessibility to water is gender disparities in water collection, since the burden of water-hauling responsibility often falls on female members of the household. The survey indicates that this is the case in 87.2% of households; while in 5% of households it is children who carry the main responsibility for collecting water, with girls under 15 years of age roughly being twice as likely to carry this responsibility as boys of the same age band (3.4% of
households compared with 1.6% respectively). When the analysis focuses on socio-economic issues, an improvement of previous percentages is seen in the wealthiest quintiles ($P < 0.001$).

**Point-of-use water treatment**

Recently, it has been argued that the quality of the water delivered at the tap might not be an issue if users can treat water at their dwellings. Adequate household water treatment appears to be a cost-effective solution in the short-term, to complement the continuing expansion of coverage and upgrading of services (Gundry *et al.*, 2004; Fewtrell *et al.*, 2005; Haller *et al.*, 2007). However, before widespread promotion of point-of-use water treatment, some related concerns should be better understood. The impact of household water treatment on health has not yet been sufficiently documented, and the acceptability, scalability and feasibility of this approach are still to some extent uncertain (Schmidt and Cairncross, 2009).

It is gleaned from Figure 4 that household water treatment is common throughout the area of intervention. Half of households (50.1%) treat water before consumption and the vast majority (94%) employ an adequate method (based on the categorization provided by the JMP). The main treatment practice is addition of bleach (24.9%), which is most likely related to campaigns that promote this method, while 20% of households boil water to make it safer for drinking. The differences across districts are large, and the percentage of households with adequate point-of-use water treatment increases with wealth status ($P < 0.001$).

**Indicators for sanitation**

The questions related to sanitation focus on access to sanitation facilities, and determine the type of sanitation infrastructure used by the household and whether it is shared with others (Joint Monitoring Programme, 2006).

Based on the ‘sanitation ladder’ described before, the current coverage of improved sanitation is alarming, averaging only 21.6% for the whole survey. From Figure 5, it can be seen that sharing the
facility is common (33.7%), although the largest percentage of households (41%) practise open defecation. Among the improved technologies, pit latrine with slab accounts for the highest proportion, while the most common unimproved toilet is an open pit or one without slab.

**Figure 4.** Adequacy of household water treatment (% of HH), at district level

**Figure 5.** Access to improved sanitation (% of HH), at district level

As is the case with the drinking water situation, disparities exist by districts. It is also noted that use of basic sanitation is positively related to wealth ($P < 0.001$). For instance, the richest 20% of the population is almost fourteen times as likely to use an improved sanitation facility as the poorest quintile; and the poorest 20% is around eight times more likely to practise open defecation than the richest quintile. Still, even among the wealthiest, 10% practises open defecation.

**Indicators for hygiene**
In terms of hygiene behaviour, the programme has failed to identify a robust indicator (Cotton and Bartram, 2008). The harmonized question deals with the disposal of children’s stools as suitable proxy. When faeces are left uncontained, disease may spread by direct human contact. The safe disposal of children’s faeces is extremely important in this regard, since they are the most likely cause of faecal contamination to the immediate household environment. The preferred disposal method is putting or rinsing stools into a sanitation facility, or burying waste if a toilet is not accessible.

On average, in 58.1% of households, the disposal of the stools of children under age three are disposed of safely. It is observed that the most commonly used method is rinsing stools into a toilet or latrine (43.6%), while unsanitary disposal methods include burying stools in the open (14.6%) or throwing them into the domestic refuse (23.6%). A closer look at the data shows marked regional differentials; and again, increasing levels of wealth are strongly associated with increased safety in disposal of children’s faeces ($P < 0.001$); that is, those households in the poorest quintiles are less likely to dispose stools in a sanitary way.

**CRITICISM OF THE JMP**

At the global level, the JMP has considerably improved the processes and approaches to monitoring the sector, strengthening the comparability of the WASH outcomes over time and within countries. However, it has been criticized on several grounds, and an ongoing consultative process is currently debating a consolidated proposal of improved targets and indicators for the post-2015 monitoring framework (Joint Monitoring Programme, 2011b, 2012). One shortcoming is related to the scale in which estimates are produced, as it is not adequate to assist decentralized governments with local planning (Hunt, 2001). A further issue concerns the definitions employed, which are too infrastructure-based. The human rights framework demands reinforced monitoring mechanisms to measure progress towards the realization of the right to water and sanitation (Roaf et al., 2005); and beyond coverage data, monitoring systems should provide a more complete picture of the context in
which the service is delivered (Hunt, 2001; Cotton and Bartram, 2008; Sutton, 2008; Jiménez and Pérez-Foguet, 2012). Issues such as physical accessibility, availability (quantity and reliability), safety, affordability, management, accountability and non-discrimination should be effectively integrated.

This section examines the main flaws of the JMP from the perspective of national and local actors with their different data requirements. In so doing, it makes a small contribution to frame a global post-2015 monitoring strategy for water and sanitation.

**Drinking water**

Access to water is primarily determined by distance to the source or time spent in fetching water, though the quantity of water that will be collected for domestic purposes may reduce where supplies are not reliable, water quality is not adequate or tariffs are unaffordable (Howard and Bartram, 2003). Therefore, water coverage might be categorized in terms of service level and consider among other above-mentioned requirements. The survey shows that water consumption for domestic purposes is by and large low, and specifically the average consumption in three-quarters of households (78.2%) is less than 20 litres per capita per day. There are regional disparities (Figure 6), despite the risky situation countrywide. And as expected, a clear correlation is observed between the per capita consumption with i) distance to the water point, shown in Figure 7 ($P < 0.001$); ii) wealth ($P < 0.001$); and iii) number of people in each household ($P < 0.001$). The further the source and the poorer/the larger the household, the lower the consumption per member.

Moreover, there is weak evidence to establish the relationship between safe water and improved sources, and this has been acknowledged in literature elsewhere (Sutton, 2008; Rietveld et al., 2009; Joint Monitoring Programme, 2011a; Jiménez and Pérez-Foguet, 2012) and in a series of country reports which have been recently published by WHO and UNICEF (e.g. WHO/UNICEF, 2010b, a). In the area of intervention, the assessment of drinking water quality at the source confirms this
hypothesis, and bacteriological contamination is detected in almost half (47.9%) of sampled improved water points. Similarly, and although water safety plans are being promoted to ensure sustainable access to safe water (Joint Monitoring Programme, 2010), it is noted that 40% of improved sources in adequate sanitary conditions still show microbiological contamination.

**Figure 6.** Water consumption in litres per capita per day (lpcd) at district level (% of HH)

**Figure 7.** Water consumption with time to source

Another flaw is related to the issue of service reliability, since the health benefits attributed to the consumption of safe water are almost entirely lost if raw water is consumed even once over the course of a few days (Hunter et al., 2009). A water service can be interrupted because of functionality/management reasons or seasonality issues. Regardless of the cause, lack of continuity may lead to prolonged periods without supply, which obliges households to search for alternative sources, often of inferior availability and poorer quality. The audit of water points reveals that
functionality rates are surprisingly high in comparison with other sub-Saharan countries (Harvey and Reed, 2004; WaterAid, 2009a), and specifically, 94.6% of inspected sources were found operational at the time of the survey. One possible explanation could be that only main drinking water supplies identified at household level were audited, and interviewed households only provided information about operational sources. In terms of seasonality issues, roughly three-quarters of supplies (76.2%) are year-round (not seasonal), though this percentage varies across the districts. As expected, seasonality issues are of primary importance in those districts classified as arid (i.e., Wajir, Marsabit, Mandera, Tana River, Isiolo and Garissa) or semi-arid (i.e., Mwingi, West Pokot and Kwale), Turkana being the only exception (where the sample size of water points was not large enough to provide reliable estimates).

**Sanitation**

The definition of sanitation coverage also presents important drawbacks, as it does not adequately address the hygiene-behaviour change. First, the JMP indicator does not take into account sanitary conditions of the facility or safety issues, which not only might constrain a continued use of the infrastructure, but a lack of the latrine’s maintenance may also result in a focus of disease transmission (Scott *et al.*, 2003). Second, coverage figures do not distinguish between open defecation and latrine sharing, and both practices are categorized as unimproved. Open defecation contributes in various ways to a heavy disease burden (Museumi, 2010; Kar and Milward, 2011), while as sanitation practice, latrine sharing is markedly better in terms of environment protection (WaterAid, 2009b). Third, sanitation infrastructure should be available at a price that everyone can access them (COHRE *et al.*, 2008), thus affordability issues should be properly dealt with in the sanitation definition. And finally, it should include the aspect of household hygiene promotion. It is therefore believed that sanitation needs to be defined in a broad and more holistic sense.
Figure 8. Sanitary conditions of latrines (% of latrines), based on wealth

Figure 9. Household drinking water quality inspection (% of HH), at district level

In those surveyed households where a latrine was used, its sanitary condition was visually evaluated, and particularly four different proxies were verified: i) inside cleanliness, ii) presence of insects, iii) smell, and iv) privacy. Data show that on average i) only two-fifths of observed latrines were found clean, ii) very few were fly-proof and insects were observed in 71% of the latrines, iii) an unpleasant smell was reported in almost three-quarters of inspected latrines, and iv) nearly half did not present adequate conditions of privacy. Based on these proxies, an aggregated indicator estimates the sanitary conditions of the latrine, and it is highlighted that less than one-quarter of improved facilities (22%) present ‘good’ hygienic conditions. It is worth noting that the conditions of shared latrines are not noticeably worse than those that are improved; and variations by wealth, despite being statistically representative ($P < 0.001$), follow an unclear trend (Figure 8): one-quarter of facilities among the richest (24.6%) are found in good conditions, and a similar percentage (26%) is observed in the lowest wealth quintile. However, it is noted that a common sanitation practice
within the poor is open defecation, so sample size of latrines decreases as the level of wealth increases (877 households in the highest wealth quintile against 250 households in the poorest quintile).

Affordability of sanitation services was also assessed, and those households without their own latrine were asked why did they not have one. On average, more than four-fifths cite cost as the reason; that is, no money (77.8%), or no adequate terrain on which to build the latrine (6.5%). In 3.3% of households the main reason is lack of habit to use the facility, and a further 3.9% report cultural-based obstacles. Among poor families, cost-related issues significantly increases ($P < 0.001$), although it is observed that sanitation services are by and large unaffordable, even for the wealthiest.

**Hygiene**

The Global Water Supply and Sanitation Assessment 2000 Report (Joint Monitoring Programme, 2000) identifies, apart from the safe disposal of children’s faeces, two further hygiene behaviours that are of greatest likely benefit to health, that is, i) safe water handling and storage, and ii) hand-washing with soap.

The survey therefore evaluated, where water was stored in a separate container within the home, whether the tank was covered and whether it was located away from potential sources of contamination. Such inspections prove useful to assess the hazards and contaminant pathways into the water tank that may cause contamination to occur (Howard, 2002). From Figure 9, it is observed that the majority of households (55.3%) store drinking water in a separate container that is correctly protected. However, regional disparities are remarkable; the districts of Turkana and Marsabit exhibit the riskiest practices. The correlation between safe water handling and wealth is also significant ($P < 0.001$); that is, the better off stores drinking water more safely.
Finally, simple hygiene behaviours, especially hand-washing with soap, have been suggested to break the faecal–oral route of disease transmission and reduce the occurrence of gastro-intestinal infections in poor settings (Cairncross and Feachem, 1993; Curtis and Cairncross, 2003). Billig et al. (1999) state that proper hand-washing behaviour includes two different dimensions: i) technique (use of water, use of soap or ash, washing of both hands, and hygienic drying), and ii) frequency (after defecation, after cleaning babies’ bottoms, before food preparation, before eating, and before feeding children). In this study, data was obtained through a questionnaire interview conducted with the primary caregiver, and results show that the vast majority (97.2%) washes their hands. However, both the method employed and hand-washing frequency are by and large inadequate, and more specifically, of those caregivers who wash their hands, only 40.1% use an adequate technique and half of them (40.9%) fail to wash their hands at critical times. A closer analysis reveals that technique improves with wealth status ($P < 0.001$), although an unexpected negative association is also observed with hand-washing frequency. Another remarkable factor is that a complementary evaluation (not shown here) of hand-washing devices in the vicinity of latrines shows that, on average, a water point is only found in less than 10% of facilities; and soap is available in only 0.9% of inspected latrines. Since water and soap act as determinants of hand-washing (Schmidt et al., 2009), and as methodological problems of the evaluation technique might have biased achieved results (Billig et al., 1999), it may be concluded that while hand-washing knowledge is adequate, hand-washing behaviour is not.

**THE WASH POVERTY INDEX**

There is evidence from the previous Section that beyond data on infrastructure coverage and access, operational planning requires a broader view by which the reality on the ground is described. Information about institutional, financial, management and environmental issues would help gain an insight into sector performance, and further synthesis might guide the elaboration of development initiatives. However, while a number of selected individual fields can be assessed by separate single
indicators, an assessment of the overall context also requires the integration of these individual fields with regard to their interlinking. In the WASH sector, where decision-making feeds on information of different nature and from diverse sources, the search for new tools for monitoring, evaluation and planning purposes has prompted the development of a variety of composite indices (Sullivan et al., 2003; Webb et al., 2006; Cohen and Sullivan, 2010; Giné Garriga and Pérez Foguet, 2010; Pérez-Foguet and Giné Garriga, 2011; Flores et al., 2013). They condense information from different disciplines, thus integrating in measurement the socio-economic, physical, environmental and institutional drivers which link drinking water, basic sanitation and household hygiene. Indices capture and simplify the complexity inherent in rural services delivery, and by doing so provide powerful tools for policy analysis.

In this section, an interdisciplinary, WASH-focused approach is adopted through a multidimensional estimate, the WASH Poverty Index (WASH PI), which is proposed by Giné Garriga and Pérez Foguet (2013) to support poverty-alleviation-oriented planning where delivery of water, sanitation and hygiene remains elusive. To do this, the index builds on a combination of three composites that are not aggregated to produce a single value. Rather, index components are presented individually as parts of a thematic indicator. It is arguable whether to lump the three sub-indices together, and the rationale for not doing so is to keep the water, sanitation and hygiene idiosyncrasies in focus. Similarly, institutional roles and responsibilities of WASH issues in many countries are in practice assumed by different stakeholders. Any aggregation process would therefore reduce the validity of the measure for planning, targeting and accountability purposes. The step-by-step procedure for index construction is described elsewhere (Giné Garriga and Pérez Foguet, 2013), and a brief explanation of each composite’s components follows:

- The water supply index is founded on the Water Poverty Index (WPI) framework from Sullivan (2002) and Sullivan et al. (2003). This composite combines a range of indicators that track the physical, economic and social issues which link water and poverty. It therefore distinguishes
the broad themes that reflect major preoccupations and challenges in low-income regions related to the provision of water: physical availability of water (Resources, $R_{WPI}$), extent of access to water (Access, $A_{WPI}$), capacity for sustaining access (Capacity, $C_{WPI}$), ways in which water is used for different purposes (Use, $U_{WPI}$), and the environmental factors impacting on the ecology which water sustains (Environment, $E_{WPI}$). Environment-related aspects, though, are partially assessed by indicators included in the sanitation and hygiene indices; hence, this component has been removed from the WPI structure to avoid the inclusion of redundant information which might bias the final result.

- The Sanitation Poverty Index (SPI) considers whether or not people have access to improved sanitation. However, it is the consistent use of the facility, not its mere existence, which leads to health and environmental improvements. To this end, sanitation must be safe, physically accessible and affordable; and consequently SPI gauges the extent of access to sanitation, both in terms of accessibility and affordability (Access, $A_{SPI}$), assesses people’s ability to construct and repair the latrine (Capacity, $C_{SPI}$), and includes those hygienic and safety issues that enable a continued usage of toilet facilities (Use, $U_{SPI}$).

- The hygiene sub-index (HPI) is measured by the aggregation of four different components (Webb et al., 2006), each one representing a different transmission route by which oral–faecal contamination may occur: drinking water ($D_{HPI}$), food ($F_{HPI}$), personal hygiene ($P_{HPI}$); and domestic household hygiene ($D_{HPI}$).

Results

WASH PI proves useful to unravel the linkages between poverty and access to basic services; and specifically, it improves the identification of target groups and allows a more equitable allocation of resources. However, the ultimate goal is to provide policymakers with clear and accurate messages,
and the way the index is disseminated is essential for this purpose as this influences its interpretation.

To start with, the diagram in Figure 10 shows at a glance that all three sectors require urgent policy attention. The water-related sub-index presents the lowest average (0.43), and although the two remaining sub-indices (SPI, 0.50; and HPI, 0.48) score higher, sanitation presents marked regional disparities (Std Dev. 0.14). The visualization of such heterogeneous pattern inherent in rural poverty is considerably improved through poverty maps (Figure 11), which identify the vulnerable areas in a spatial context and therefore allow for accurate geographic targeting (Davis, 2002; Henninger and Snel, 2002; Cullis and O’Regan, 2004).

![Spider diagram with WASH PI results for all 21 surveyed districts. Source: Giné Garriga and Pérez Foguet (2013)](image)

**Figure 10.** Spider diagram with WASH PI results for all 21 surveyed districts. Source: Giné Garriga and Pérez Foguet (2013)
In terms of planning, each individual sub-index can be used as a performance indicator, and a straight comparison can be made when any district is compared for example to the leader, the laggard or the average performance. And to support prioritization, sub-index values might serve as the basis to rank all districts and establish priorities, where a rank of 1 denotes the ‘highest’ priority and is assigned to those districts with lowest WPI, SPI and HPI values. A closer analysis – not shown here, see Giné Garriga and Pérez Fogue (2013) – reveals that in the area of intervention WASH poverty is linked to population density and territorial aridity; that is the provision of WASH services in sparsely populated and remote areas remains challenging, and water poverty becomes more severe in arid and semi-arid regions, a problem which will be exacerbated by climate change.

When each sub-index is studied separately, the analysis helps identify the root of the problem in each particular area and direct attention to those sector needs that require urgent intervention. As regards the WPI, regional disparities are observed in Figure 11a, although the level of water poverty is high throughout the study area. An accurate focus on a sub-index’s components assists in capturing a more comprehensive picture of water-related challenges, and results from Table 6 suggest that areas for prioritization include those related to the ‘Access’ and ‘Capacity’ components, which average 0.25 and 0.21 respectively. A major sanitation challenge is undoubtedly related to the marked heterogeneous pattern, displayed in Figure 11b. The map shows that sanitation-related issues are particularly acute in the northern and eastern districts, in which SPI presents the lowest values (< 0.4). A closer look at the components, though, points out a clear distinction between access to (0.44) or use of (0.4) basic sanitation and abilities to construct/repair the facility, which scores noticeably higher (0.72). This difference highlights that to a large extent, the lack of access to sanitation services is not related to the inability of families to construct the latrine but to a lack of affordable sanitation technologies. Much like the WPI and SPI, a map is developed to visualize the level of household hygiene (Figure 11c), showing that geographic differences are not pronounced (Std. Dev. 0.07). The index can also be decomposed such that the contribution of each individual component is analysed, which shows that poor personal hygiene
(0.36) represents the most likely pathway by which oral–faecal contamination may occur. In contrast, handling practices and point-of-use treatment of drinking water perform reasonably high (0.64).
Figure 11. The WASH PI, at district level. a) The Water Poverty Index. b) The Sanitation Poverty Index. c) The Hygiene Poverty Index. Source: Giné Garriga and Pérez Foguet (2013)

Finally, when estimating wealth effects on the WASH PI (Figure 12), it is seen that all three sub-indices show a strong positive association ($P < 0.001$); that is, water supply and sanitation infrastructures as well as hygiene knowledge are invariably worse among the poor. The figures cited above confirm the urgent need for policymakers to focus on improving service delivery among the most vulnerable segments of the population.

Table 6. Summary statistics of WPI, SPI, HPI and its components

<table>
<thead>
<tr>
<th>Water Poverty Index</th>
<th>Sanitation Poverty Index</th>
<th>Hygiene Poverty Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>A</td>
<td>C</td>
</tr>
<tr>
<td>0.48</td>
<td>0.09</td>
<td>0.09</td>
</tr>
<tr>
<td>0.81</td>
<td>0.41</td>
<td>0.38</td>
</tr>
<tr>
<td>0.66</td>
<td>0.25</td>
<td>0.21</td>
</tr>
<tr>
<td>Std Dev.</td>
<td>0.09</td>
<td>0.09</td>
</tr>
</tbody>
</table>

Note: Water Poverty Index (WPI); Resources (R); Access (A); Capacity (C); Use (U); Sanitation Poverty Index (SPI); Access (A); Capacity (C); Use (U); Hygiene Poverty Index (HPI); Drinking water (DW); Food (F); Personal hygiene (PH); and Domestic household hygiene (DH)
Figure 12. The WASH PI (% of III), based on wealth. a) The Water Poverty Index. b) The Sanitation Poverty Index. c) The Hygiene Poverty Index. Source: Giné Garriga and Pérez Foguet (2013)

CONCLUSION

Expanding access to safe drinking water, improving sanitation infrastructure and promoting household hygiene are cornerstones of development, based primarily on their interconnections with health and well-being. These internationally accepted priorities have been instrumental in driving the development agenda in recent years. Consistent reporting of progress is essential in order to provide the evidence base for informed decision-making. Despite the achievements in the approaches to monitoring and evaluating the WASH sector, there are certainly areas for improvement which should be tackled. And the recognition of access to safe drinking water and sanitation as a human right specifically spotlights new dimensions that monitoring and evaluation mechanisms should address. The aim of the present study is to contribute to the existing debate about strategies for improved sector monitoring and evaluation, and specifically assesses the utility of their respective outcomes to support planning. Two different approaches that are widely promoted in decision-making are compared. The first one describes the situation in terms of health impact. The other alternative, which includes two types of integrated indicators, focuses on inputs
and behavioural changes, and thus encompasses a variety of measures that not only influence health but consider many other aspects.

The results suggest that measuring the health impact of water and sanitation rarely produces reliable estimates, which seriously hampers the drawing of conclusions. Moreover, interpretation of epidemiological studies is not straightforward; and in terms of policy-making, they hardly detect operational deficiencies or suggest improvements. In all, it appears that health impact evaluations are not sound tools for monitoring purposes or fine-tuning of interventions. Rather, a focus on identifying the most efficient means for achieving such impact may be more useful. And there is little doubt about the potential of water, sanitation and hygiene in this regard.

At the global level, the JMP has emerged as a consistent approach to report on WASH sector status and trends. Its major strength, and the root of its success, is the simplicity of having a few relatively well-defined and easy-to-measure indicators, which produce reasonable estimates of coverage across different contexts. However, JMP measures access through technology-based proxies, and it does not provide information on the quality of the water, the continuity of the water service, the sanitary conditions of the toilet facility, or whether economic, institutional, social or environmental reasons jeopardize the ability of households to access the services. Therefore, the simplicity of the monitoring framework is also its core limitation, and it is necessary to gain an insight into wider issues that relate to sector performance. The index approach attempts to overcome this weakness. It combines data of different nature and then helps differentiate the multifaceted situation at the dwelling in relation to water, sanitation and hygiene. In the end, both the JMP and the index approaches are complementary to meet different needs at different levels. Consistent reporting of coverage is essential, and a more comprehensive evaluation system would probably be too difficult to implement and therefore counter-productive. The JMP's indicators are adequate to harmonize the monitoring mechanisms and produce quality basic estimates of the type of drinking water sources and sanitation infrastructure people use. Nevertheless, they do not by themselves give insight into
the real picture of the context in which service delivery is taking place. This requires a monitoring framework that takes into account a broader view of service level and human rights criteria. In this regard, the index approach proves especially useful for decision-makers and planners as a rapid appraisal instrument. If routinely assessed, the composite sheds light on whether the intervention strategy needs fine-tuning and how it can be improved, which is precisely the aim of operational monitoring.

It is noteworthy, however, that any monitoring and evaluation tool should be ultimately developed to respond to the informational needs of policymakers, and therefore feed into decisions on resource allocations, targeting of services, and prioritization of interventions. To accomplish this elusive challenge, equity would be one major driver, and data should be disaggregated to show at a glance spatial inequalities and socio-economic disparities. Monitoring and evaluation may otherwise degenerate into a rationale for inconsistent planning, undermining the imperative need for efficiency and effectiveness.

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