



Empowerment in water, sanitation and hygiene index

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ABSTRACT

Water, sanitation and hygiene services are often promoted as critical for women's empowerment and gender equality. Tools for monitoring water, sanitation and hygiene (WASH) have focused largely on technical standards related to public health outcomes, overlooking those related to broader human well-being such as gender and social equality. The Empowerment in Water, Sanitation and Hygiene Index (EWI) is a novel survey-based index designed to measure agency, participation and empowerment in the water and sanitation sector. The EWI can be used to assess gender outcomes of a WASH intervention and to monitor changes over time. Drawing on a multi-level conceptualization of empowerment, the EWI is comprised of a suite of indicators at individual, household, and societal levels. The EWI uses responses collected from a male and female respondent at the same household, and represents the proportion of women and men who are empowered, as well as the level of empowerment. We report the methodological approach and data from this pilot study in Burkina Faso. The findings highlight the importance of better understanding household- and community-level power and gender relations, such as decision-making related to household water or sanitation spending. By enabling measurement of women's empowerment, practitioners and policy-makers can identify and incorporate more targeted strategies that address gender disparities and promote empowerment, and also monitor and evaluate their effectiveness.

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1. Introduction

Access to safe water and sanitation, Sustainable Development Goal (SDG) 6, is necessary for human development, but is seen as particularly critical for women and girls and for making progress towards SDG 5 to 'Achieve gender equality and empower all women and girls.' Prevalent social norms assign the majority of water collection work for domestic purposes to women in many low and middle income countries (Fisher, Cavill, & Reed, 2017). Such division of tasks results in women often bearing more of the burden associated with household water and sanitation insecurity, such as disproportionate health and social burdens including greater exposure to water-related disease, discriminatory taboos, and unrealized economic productivity (Gupta & Obani, 2016).

Water and sanitation infrastructure are often argued to empower women, particularly through pathways associated with reducing the time spent on collecting water. This is particularly

prevalent in NGO materials, with a recent report on water, sanitation and hygiene (WASH) and women's empowerment highlighting the many benefits of WASH with a strong focus on infrastructure (WaterAid, 2017). Similarly, the Water Project states that "With closer water supplies, women have more time in the domestic setting. . . with the added time, women are given more opportunities to work outside of the home to bring in extra income for their families" (Sentlinger, 2019). However, while provision of water and sanitation infrastructure contributes to improved access, it does not address inequalities in control of resources or transform unequal power relations. With less access to power and assets, many women have less say, both within the household and in the community in decision-making processes, such as over management of water resources or investment in a household water connection or sanitation facility that meets their needs (Kayser, Rao, Jose, & Raj, 2019; Routray, Torondel, Clasen, & Schmidt, 2017). This is further reinforced in water-related policy making and planning at higher levels which are often perceived as masculine occupations (Alda-Vidal, Rusca, Zwarteveen, Schwartz, & Pouw, 2017).

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Empowerment is commonly viewed as the process of achieving gender and other social equality outcomes. The concept is defined in many different ways, often drawing on concepts of agency, choice, opportunities, resources, and power (Alsop & Heinsohn, 2005; Ibrahim & Alkire, 2007; Malhotra, Schuler, & Boender, 2002; Rowlands, 1998; Sen, 1999). A commonly used definition from Kabeer describes empowerment as the “processes by which those who have been denied the ability to make choices acquire such an ability” (Kabeer, 2005: 13). This definition views empowerment as a dynamic concept, that involves a change over time, and comprised of dimensions of resources, agency, and achievements. Kabeer defines agency as not only decision-making, but ways that an individual or group can pursue their own goals, even in the face of opposition from others. Alsop & Heinsohn (2005) describe empowerment as the interaction between agency and the institutional context or ‘opportunity structure’ which determines how one converts assets into effective realization of options. Focusing more on the role of the state and civil society institutions, Narayan describes empowerment as the “expansion of assets and capabilities of poor people to participate in, negotiate with, influence, control, and hold accountable institutions that affect their lives” (Narayan, 2005: 5).

Drawing on these concepts offers the potential to provide a broader perspective on how WASH programming can contribute to women’s empowerment beyond the provision of infrastructure. This emphasizes the importance of dual aims of empowerment for achieving gender equality and social justice, as well as a means to an end to achieve improved WASH public health outcomes (e.g. latrine construction, improved menstrual hygiene management), although there is a dearth of evidence on these connections compared to other development outcomes (Taukobong et al., 2016). Despite recognition of gendered disparities related to poor water and sanitation, and repeated statements that WASH increases empowerment, there is a dearth of research focusing on measuring empowerment in the water and sanitation sector (Kayser et al., 2019). This is a critical gap, as without robust evidence on empowerment, achieving gender outcomes will not be prioritized within policy and practice in the WASH sector. This is not the case in all sectors, as a large body of evidence has sought to link empowerment and agency to a range of outcomes including socio-economic (e.g. Mahmud et al., 2012; Mishra & Sam, 2016; Weber & Ahmad, 2014) and health and wellbeing, such as maternal and reproductive health, physical violence and nutrition (e.g. Ahmed et al., 2010; Do and Kurimoto, 2012; Jennings et al., 2014; Kwagala et al., 2013; Mishra and Sam, 2016; Msuya et al., 2014; Shimamoto and Gipson, 2015; Upadhyay and Karasek, 2012; Wekwete et al., 2014).

2. Measuring empowerment

The importance of women’s empowerment for development has led to the creation of a range of approaches and tools to measure empowerment. Aggregate national indices have been developed to capture global gender disparities, including tools such as the Gender Empowerment Measure (GEM) that measures participation in economic and political life (United Nations, 2010), and the Gender Development Index (GDI) that assesses gender differences in human development (Asaolu et al., 2018). In addition, several tools focusing on Sub-Saharan Africa have been developed, including the African Gender and Development Index (AGDI) that assesses social power, economic power and political power, and the Survey-Based Women’s Empowerment (SWPER) Index that comprises attitudes to violence, social independence, and decision making (Ewerling et al., 2017; Miedema, Haardörfer, Girard, & Yount, 2018; UNECA, 2011).

A weakness of these tools is their limited ability to directly measure individual empowerment, and community- and household-level power and social configurations, which are central to understanding women’s empowerment (O’Hara & Clement, 2018). In addition, some researchers argue that these measures cannot be decomposed by characteristics at the individual level such as age or other social identities, and do not account for context specificities (Alkire et al., 2013). Further, measures that utilize Demographic and Health Survey (DHS) data may be constrained by a limited choice of indicators (Seymour & Peterman, 2017). In the agricultural sector, the Women Empowerment in Agriculture Index (WEAI) was developed to measure empowerment of men and women using individual-level data to address some of these limitations (Alkire et al., 2013). The tool generates empowerment profiles of men and women within the same household that reflect achievement in five major domains: agricultural production, ownership of resources, income and control over resources, leadership, and time use. The tool has been used for monitoring agricultural projects in Nepal (Malapit, Kadiyala, Quisumbing, Cunningham, & Tyagi, 2015), Bangladesh (Sraboni, Malapit, Quisumbing, & Ahmed, 2013), Kenya (Diirro, Seymour, Kassie, Muricho, & Muriithi, 2018), Niger (Wouterse, 2016), and Ghana (Malapit & Quisumbing, 2015) and a large number of other countries. The WEAI is now used to design interventions to promote empowerment, and informed Ethiopia’s National Nutrition Policy, prioritizing group membership and speaking in public (Feed the Future and IFPRI, 2018; Stern, Jones-Renaud, & Hillesland, 2016).

This pilot study sought to address the lack of tools to measure empowerment in the WASH sector. In WASH, tools typically focus on measuring access to WASH facilities and quality of services. The lack of measurement tools in the water sector has implications for evidence-based gender mainstreaming and measuring and monitoring these outcomes of interventions. A barrier is that empowerment is a complex and contextual concept that is not easily simplified into a quantitative framework. However, without a quantitative approach it will not be measured routinely by donors and implementers. We present the development of a novel Empowerment in WASH Index (EWI) tool to start a conversation on how to measure and improve empowerment for women in the context of WASH. The rest of paper describes the construction of the EWI tool using a suite of indicators, its application to a pilot case study in Banfora, Burkina Faso, and a discussion of these pilot findings and opportunities for further application of the EWI. The focus of this paper is on its application to women’s empowerment, to illustrate how the tool provides information on gender-based disparities.

3. Overview of the Empowerment in WASH Index (EWI)

The Empowerment in WASH index (EWI), was developed as a novel tool to measure agency, participation and empowerment in the water and sanitation sector. The EWI conceptual framework shown in Fig. 1 describes a multidimensional process of empowerment that centres on an interaction between WASH-related agency and opportunity that leads to human wellbeing outcomes, adapted from frameworks of Kabeer (1999) and Alsop and Heinsohn (2005). Opportunity describes enabling factors including an individual’s rights, opportunities and resources to secure WASH, which interact closely with WASH service providers and systems. Dimensions of agency comprise decision-making, participation and voice at different levels. Together agency and opportunity mean that an individual is empowered to use water and sanitation in ways that they value, going beyond simplistic descriptions of access. This process of empowerment in turn contributes to human health and wellbeing,

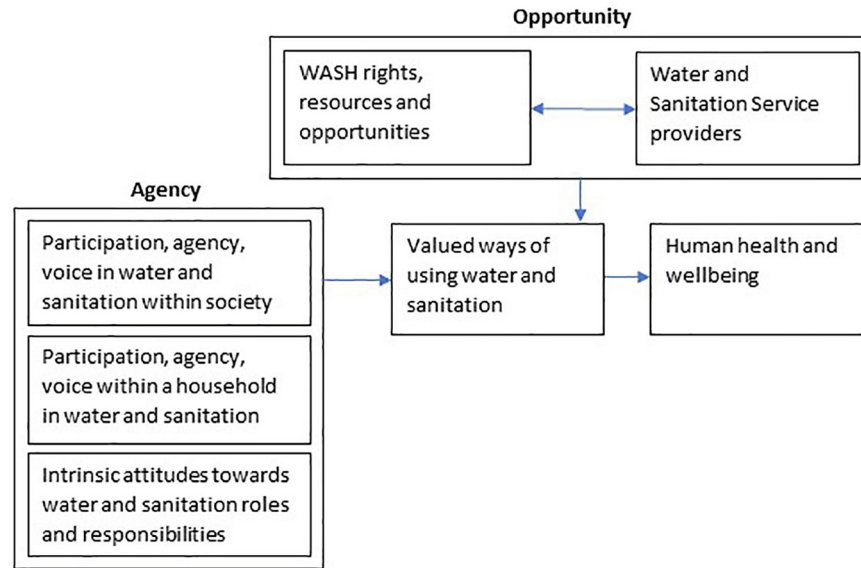


Fig. 1. Conceptual framework of empowerment in WASH centred on an interaction between agency and opportunity (Adapted from empowerment frameworks developed by Kabeer (1999) and Alsop and Heinsohn (2005) to a WASH context).

linking valued ways of using water and sanitation to human wellbeing (Jepson et al., 2017; Mehta, 2014).

The EWI comprises indicators that are combined to assess empowerment across multiple levels and dimensions (Table 1). An index approach provides a straightforward way of illustrating and communicating complex information, allowing monitoring and prioritization to lower scoring indicators. Indicators include

information specific to WASH roles and responsibilities within the household, community and in relation to local service providers, as well as broader indicators of societal empowerment. The individual-, household- and societal-level indicators used in the EWI are described in more detail below. Indicators draw on existing empowerment literature adapted to a WASH context (Dery, Bisung, Dickin, & Dyer, 2020), as well as consultations with WASH

Table 1
Description of indicators included in the EWI.

Level	Indicator	Description	
Individual	Intrinsic attitudes about WASH roles and responsibilities	Reports beliefs about whether the respondent could make their own personal decisions about participation in WASH decisions and activities if they wanted to, regardless of who makes decisions in the household in the current situation.	
Household	Input into decisions about WASH roles and responsibilities	Assesses whether the respondent participates in decisions about collection of water, managing water use inside the household, and maintenance of household toilet or hygiene facilities.	
	Input into decisions about WASH expenditures	Assesses input decisions about WASH expenditures, divided into household expenditure related to water (fees, containers, etc.), and household expenditures related to sanitation (building facilities, emptying pits, maintaining facilities, etc.).	
	Input into decisions about involvement in community WASH activities	Assesses input into decisions made in the household about who should participate in community WASH activities (e.g. planning of water facilities or resolution of problems).	
	Ownership and control over household assets	Assesses sole or joint ownership of household resources, such as water or sanitation facilities (water or toilet infrastructure), household durables and electronics (e.g. furniture, cell phone), land, a house or other structure, and means of transportation.	
	Work balance	Assesses time used for work including unpaid (collecting water, childcare, cleaning activities, travel, etc.) and paid work (agricultural activities, salaried or other income-generating work), compared to leisure or rest.	
	Time for water collection	Assesses on time used specifically for water collection. The indicator uses 30 min as a threshold obtained from the SDG target 6.1 indicator for safely managed water services.	
	Access to and sharing of WASH practice information	Assesses access to and sharing of WASH practices information within the household (e.g. safe storage of water).	
Societal	Community	Access to and sharing of information on WASH rights and responsibilities	Assesses access to and sharing of information about WASH rights and responsibilities of service providers within the household (e.g. right to water and sanitation, standards for water or sanitation service providers).
		Group membership	Reports whether the respondent is actively involved community associations, including water user associations or other economic and social groups (e.g. agricultural producers groups, savings or microfinance group).
	Local WASH institutions and authorities	Leadership in WASH implementation	Reports whether the respondent feels comfortable speaking up in public to help decide on water implementation (like small wells, water supplies being built) and or sanitation project, such as in a community meeting.
		Leadership in WASH accountability	Addresses whether the respondent feels comfortable speaking up in public to complain or raise problems with water services (like break-downs, inadequate service, poor quality) in the community, or in making a complaint to community leaders or local authority about water services.

stakeholders in Burkina Faso and Ghana on how empowerment is conceptualized in the sector that were conducted together with WASH authorities and IRC, an international WASH NGO (Bisung & Dickin, 2019). Some indicators and thresholds were adapted from the WEAI to a WASH context, while others emerged as specific to the WASH sector from the consultations and literature review. Testing these thresholds across different contexts is a next step in the further development of the EWI. Detailed information about how the indicator data are collected using survey questions are provided in Supplementary data 1.

Individual level: This level of empowerment focuses on intrinsic agency, which refers to the power within individuals to develop critical consciousness of their own aspirations and capabilities (Rowlands, 1995). Prior work suggests that intrinsic agency is a meaningful cross-cultural measure of women's empowerment (Miedema et al., 2018). This indicator reports beliefs about whether a respondent could make their own personal decisions about participation in WASH decisions and activities if they wanted to, regardless of who makes decisions in the household in the current situation, focusing in domestic water collection and management, expenditures and participation in WASH activities outside the household.

Household level: Empowerment at the household level includes indicators focused on instrumental agency, relating to power to make decisions regarding WASH roles and responsibilities and participation in community activities. The household level also includes indicators on resources including WASH-related information, ownership and control of household assets, and time use.

Women's influence in household decisions, such as about earnings, purchases, seeking health care, and participating in social activities has been shown to be a valid measure of instrumental agency in prior research (Cheong, Yount, & Crandall, 2017; Miedema et al., 2018; Seymour & Peterman, 2017) and emerged as an important dimension in a WASH context in stakeholder consultations. The first three indicators at the household level address instrumental agency in decision-making in different categories: the first indicator reports whether the respondent participates in decisions about collection of water, managing water use inside the household, and maintenance of household toilet or hygiene facilities. The second indicator reports input decisions about WASH expenditures, divided into household expenditure related to water (fees, containers, etc.), and household expenditures related to sanitation (building facilities, emptying pits, maintaining, facilities, etc.). The third indicator relates to input into decisions made in the household about who should participate in community WASH activities (e.g. planning of water facilities or resolution of problems).

Resources related to ownership and control of assets within the household and workload influence the ability to make choices that lead to desired outcomes. These indicators are based on the WEAI methodology (Alkire et al., 2013), as well as results from stakeholder consultations. The indicator addressing ownership and control over assets assesses sole or joint ownership of household resources, such as water or sanitation facilities (water collection, toilet infrastructure), household durables and electronics (e.g. furniture, cell phone), land, a house or other structure, and means of transportation. The indicator addressing workload comprises assessment of time used for domestic tasks such as collecting water, childcare, cleaning activities, etc.), productive work (agricultural activities, salaried or other income-generating work), compared to leisure or rest. An indicator is also focused specifically on time used for water collection. In this case 30 min is used as a threshold obtained from the SDG target 6.1 indicator for safely managed water services.

The final household indicators address information access, and sharing of that information within the household. In our stake-

holder consultations, access to information for making informed choices about WASH issues was reported as a key dimension of empowerment in WASH. Here an indicator assesses access to and sharing of WASH practices information within the household (e.g. safe storage of water), and another assesses access to and sharing of information about WASH rights and responsibilities of service providers within the household (e.g. right to water and sanitation, standards for water or sanitation service providers).

Community level: As water and sanitation interventions are often planned, implemented and managed at a community level, participation and having one's voice heard in these activities is important to influence their outcomes. The first indicator at this level is group membership, which reports whether the respondent is actively involved in community associations, including water user associations or other economic and social groups (e.g. agricultural producers groups, savings or microfinance group). Active involvement in community groups provides information on social capital, and opportunity and comfort in participating in public life.

The following indicator at this level measures leadership in the community in relation to WASH planning or implementation activities. This indicator addresses whether the respondent feels comfortable speaking up in public to give input on implementation of water (like small wells, water supplies being built) and or sanitation projects, such as in a community meeting. The final indicator at this level deals with leadership in the community in relation to WASH accountability. This indicator addresses whether the respondent feels comfortable speaking up in public to complain or raise problems with water services (like break-downs, inadequate service, poor quality), or by making a complaint to community leaders or local authorities about water services. This indicator addresses the respondent's voice in holding community representative and service providers accountable. For both of these indicators, being able to comfortably speak up indicates empowerment at the community level.

4. Methodology

This section first provides a summary of the EWI construction, followed by a description of the data collection and analysis approach used to pilot the tool in Banfora, Burkina Faso.

4.1. Construction of the Empowerment in WASH Index

Construction of the EWI is adapted from the WEAI, and utilizes the Alkire-Foster method developed for assessing multi-dimensional poverty in the analysis (Alkire et al., 2013). For each of the 12 indicators, a respondent 'achieves' a particular indicator if she or he reaches a certain threshold (e.g. a respondent has a certain amount of input into a decision). Respondents' level of achievement is used to calculate the EWI. Empowered individuals are identified as those achieving at least 75% of the indicators, which applies the threshold used in the project-level WEAI (Malapit et al., 2019). The threshold is subjective, and is designed to ensure that not everyone will be empowered (which would indicate that limited work was needed) or disempowered (excluding too many participants) to allow comparisons across different cases or over time (Gupta, Vemireddy, Singh, & Pingali, 2019). The scores for men and women within the household are also compared to create an intra-household parity index (IHPI). The construction of the EWI and IHPI are described in more detail below.

4.1.1. Empowerment ratio ER

The empowerment ratio ER is the first component of the EWI. It is calculated as the number of respondents achieving 75% of indi-

cators $N_{empowered}$, over the total population surveyed N . The disempowerment ratio, DR , is thus $1 - ER$.

$$ER = \frac{N_{empowered}}{N}$$

4.1.2. Level of achievement LA

LA reports the average level of achievement of indicators noted p that were achieved for the disempowered respondents.

$$LA = \frac{\sum P_{disempowered}}{N_{disempowered}}$$

4.1.3. Empowerment in WASH index

EWI is obtained by a simple calculation using these components:

$$EWI = ER + (DR * LA)$$

4.1.4. Identifying gaps in empowerment

A key feature of the approach is that one can identify which indicators contribute most to disempowerment. This is valuable for diagnosing key areas to target with specific actions. To break-down by indicator, the proportion of disempowered respondents who do not achieve a particular indicator, noted as i , is calculated.

$$DR_i = \frac{N_{disempowered \text{ not achieving } i}}{N}$$

4.1.5. Calculating the Intra-Household Parity Index (IHPI)

The IHPI is a relative measure that reflects the inequality within dual adult households. Each dual adult household is classified as having or lacking parity. To calculate the IHPI a hypothesis is needed about which group of respondents is thought to be systematically less empowered relative to the other group of respondents (e.g. women compared to men, younger women compared to older women). The IHPI combines two pieces of information:

- The percentage of respondents in the 'lower empowerment' group who lack parity relative to their household counterparts in the 'higher empowerment' group
- The extent of inequality in empowerment between the higher and lower empowerment group household members

4.1.5.1. Proportion of parity inadequate households (PIH). The first IHPI component corresponds to the proportion of parity inadequate households PIH . A household is considered to lack parity if the lower empowerment household member is both disempowered, and has a higher % of unachieved indicators compared to the higher empowerment respondent from the same household.

Then, the PIH is calculated as:

$$PIH = \frac{\text{Total number of households lacking parity}}{\text{Total number of households}}$$

4.1.5.2. Average empowerment gap (AEG). The second component of the IHPI is the average percentage gap between the achievement levels of the two respondents living in households that lack parity. For this step, information from the households that achieved parity are not taken into account.

For this step, p is used as the level of achievement. However, p is set to 0.75 for all empowered respondents, regardless of their level of achievement. This limits the influence of changes in the score of these respondents who are in the higher empowerment group on progress that would move lower empowerment respondents towards empowerment. In our pilot, men were assumed to be

the higher scoring group compared to women, and thus the average percentage gap between the p levels within the household is obtained by:

$$\frac{p(\text{man}) - p(\text{woman})}{p(\text{man})}$$

Then, the AEG is calculated by:

$$AEG = \frac{\sum \left(\frac{p(\text{man}) - p(\text{woman})}{p(\text{man})} \right)}{\text{Total number of households lacking parity}}$$

4.1.6. Intra-Household Parity Index

Finally, the IHPI is simply computed by: $IHPI = 1 - (PIH * AEG)$.

The EWI and IHPI can be combined, drawing on the WEAI weighting approach (Alkire et al., 2013). Their weights are then respectively 90% and 10% which is then calculated as:

$$\text{Combined Empowerment in WASH Index} = 0.9EWI * 0.1IHPI$$

4.2. Applying the EWI to a case study in Banfora, Burkina Faso

The EWI was piloted in Banfora in South-West Burkina Faso. Based on the SDG service levels (WHO & UNICEF, 2017), access to safely managed water services is 0%, while access to basic water services is 69%, and the remainder of residents have unimproved or no services (Commune de Banfora, 2018). Access to safely managed sanitation services is 0%, while access to basic sanitation services is 28%, and the remainder of residents use limited or unimproved services (60%) or practice open defecation (8%) (Commune de Banfora, 2018).

This case study site was chosen as it is a 'commune' (an administrative area part of Comoé province, which is part of Cascades region) where IRC, a global WASH NGO, is supporting the local government in the development and implementation of a master plan for water and sanitation service delivery for 2030 (Commune de Banfora, 2018).

The Banfora master plan will form the basis for annual action plans. Banfora is also a reference commune for the rest of the country in terms of water and sanitation practices, as it within the top ten communes in terms of water and sanitation access. This means it is an example to other communes so that lessons can be transferred. However, as the master plan did not involve gender analysis or gender specific indicators, the results from the EWI are relevant to ensuring that action plans address gender inequalities, with the potential to transfer lessons to other communes in Burkina Faso. Findings from this pilot study were presented and discussed with commune and regional WASH actors in order to develop potential activities in the action plan to strengthen consideration of inequalities throughout the WASH system, such as in strategic planning, financial and institutional arrangements, service delivery, accountability and ongoing monitoring and evaluation (Figea & Dickin, 2019).

4.3. Data collection and analysis

The EWI uses individual-level survey data collected from a male and female respondent from the same household. A team of local enumerators were trained to conduct the survey using Qualtrics, a mobile phone application. Mobile phones were used to reduce time needed to conduct the survey, and with the aim that the survey module could be included in future data collection carried out by local or global WASH actors interested in adapting the EWI for their own research or evaluation purposes. The enumerator team conducted field-testing of the survey to revise questions for clarity with respondents. Surveys were carried out targeting respondents

who self-identified as the primary two members responsible for decision-making, both social and economic, within the household. This may have been a husband and wife, or other members as long as there was one male and one female adult. Surveyors used the EPI random path method to randomly select and direction and first household to survey (Milligan, Njie, & Bennett, 2004). Twenty villages and sectors were selected using a probability proportional to population size (PPS) methodology. The survey targeted rural and peri-urban communities, so sectors with more than 5,000 residents were excluded from the sampling procedure. The survey team targeted 15 households in each community, working in teams of male and female surveyor pairs. Field testing and data collection was carried out over the course of 2 months in April and May 2018. The surveyors were instructed to conduct interviews alone where possible, and to note other people present (e.g. other adults or children). Data collected with the mobile technology was uploaded a minimum of once a day. This data was then downloaded for cleaning and analysis.

Data were analysed using SAS University Edition, using the methodology described above to calculate the EWI. To investigate associations between empowerment and other variables the Pearson's chi-squared test was conducted with age, education level, and housing material variables (as a socio-economic proxy). This was also carried out to investigate associations with level of access to water and sanitation facilities. Logistic regressions were performed to predict the empowerment of women based on their type of access to water and sanitation. These analyses controlled for age, education level, spouse's level of empowerment, and location (rural or peri-urban area). Results are presented as adjusted ORs along with associated 95% CIs ($P < 0.05$).

5. Results

Descriptive characteristics of the respondents are included in Tables 2 and 3. The results of the EWI pilot in Banfora, Burkina Faso, indicated that male respondents were more empowered than female respondents in WASH, as the percentage of empowered respondents (those that met at least 75% of the indicators) was 63% and 26% respectively, and indicating most female respondents were disempowered in WASH. Among the disempowered respondents, the Level of Achievement (LA) was higher for men (57%) compared with women respondents (48%). This indicates that

women also have further to go to become empowered. The resulting EWI score was 0.62 for women and 0.84 for men (Table 4), which is scored between 0 and 1.

Disaggregating these findings by indicator highlights where the largest gaps in empowerment exist. Fig. 2 shows the contribution of indicators at individual, household and community level to disempowerment in WASH for men and women respondents. Each level contributed more to disempowerment for women than for men. Fig. 3 shows the proportion of disempowered women and men respondents not achieving each indicator, indicating which indicators are contributing more to disempowerment. The top indicators contributing to disempowerment for women were input into household decisions on expenditures for water and sanitation, input into household decisions to participate in community WASH activities, workload, and comfort in interactions with WASH authorities or local institutions to make complaints about services. In addition, time spent collecting water contributed to disempowerment for women but not men.

For men respondents, the top indicators contributing to disempowerment were input into decisions on WASH roles and responsibilities within the household, group membership, and comfort in interactions with WASH authorities or local institutions during implementation or to make complaints about WASH services.

To assess intra-household parity, men were assumed to have higher empowerment than women. Comparing empowerment for men and women respondents in the same household indicated that 67% of households had a gap in score between men and women respondents, with men 31% more empowered than women respondents. Using these results, the Intra-Household Parity Index (IHPI) is 0.79, indicating that many households do not have gender parity in terms of empowerment in WASH in their households.

5.1. Association with other factors

Although empowerment is a cross-cutting concept, the EWI focuses on empowerment within roles and activities related to water, sanitation and hygiene. This facilitates analyses of associations with other factors, such as types of water or sanitation facilities, and socio-demographic and socio-economic information. The links between provision of safe water and sanitation services and women's empowerment have often been promoted, and the EWI allows more in-depth analysis of these associations. The Pearson's

Table 2
Descriptive characteristics of respondents.

Respondent characteristics	N	Frequency (%)	Mean
Ethnic group	Goun	215	35.83
	Gurunsi	4	0.67
	Lobi	8	1.33
	Mossi	26	4.33
	Sentufu	17	2.83
	Karaboro	154	25.67
	Turka	79	13.17
	Other	97	16.17
Religion	Christian	65	10.83
	Muslim	417	69.50
	Traditional/Animist	104	17.33
	Other	14	2.33
Marital status	Married	314	52.33
	Married polygamous	238	39.67
	Separated	5	0.83
	Never married	25	4.17
	Widowed	18	3.00
Household size	Children 0 – 4		2.17
	Children 5–17		4.20
	Adults 18 – 59		4.78
	Adults 60 +		1.05
	Total		12.21

Table 3
Descriptive characteristics of respondents by sex.

Respondent characteristics		N female respondents	Frequency female respondents (%)	N male respondents	Frequency male respondents (%)
Literacy	Yes	82	27.33	132	44.00
	No	218	72.67	168	56.00
Levels of education achieved if literate	Literate	17	5.67	15	5.00
	Primary education	38	12.67	66	22.00
	Secondary education	25	8.33	39	13.00
	University or college	1	0.3	9	3.00
	Other	1	0.3	3	1.00
Principal activity	No Literacy	218	72.67	168	56.00
	Artisan	9	3.00	7	2.33
	Salesperson	42	14.00	12	4.00
	Farmer	155	51.67	187	62.33
	Raising livestock	2	0.67	6	2.00
	No employment	67	22.33	7	2.33
	Other	25	8.33	81	27.00
Age	15–25	44	14.67	21	7.00
	26–45	179	59.67	132	44.00
	46–55	47	15.67	70	23.33
	56–65	16	5.33	51	17.00
	>65	14	4.67	26	8.67

Table 4
EWI scores in Banfora, Burkina Faso for women and men respondents.

	Women	Men
Disempowerment ratio	74.0%	37.3%
Empowerment ratio	26.0%	62.7%
Level of achievement of disempowered respondents	48%	57%
EWI	0.62	0.84
Households without parity between men and women	67.3%	
Average empowerment gap between men and women in a household	31.3%	
Intra-Household Parity Index	0.79	
Combined EWI (EWI and IHPI)	0.73	

chi-squared test was conducted with age, education level, and housing material (as a socio-economic proxy) (Table 5). This was also conducted with level of access to water and sanitation facilities to evaluate these associations (Table 6).

Associations between empowerment and the above listed indicators varied for men and women respondents. For women, empowerment was associated with housing type, type of water and sanitation access, and type of payment arrangement for water access. For men, empowerment was associated with age and type of water access. There were no significant associations in empowerment for either women or men when comparing rural and peri-urban communities or for level of education.

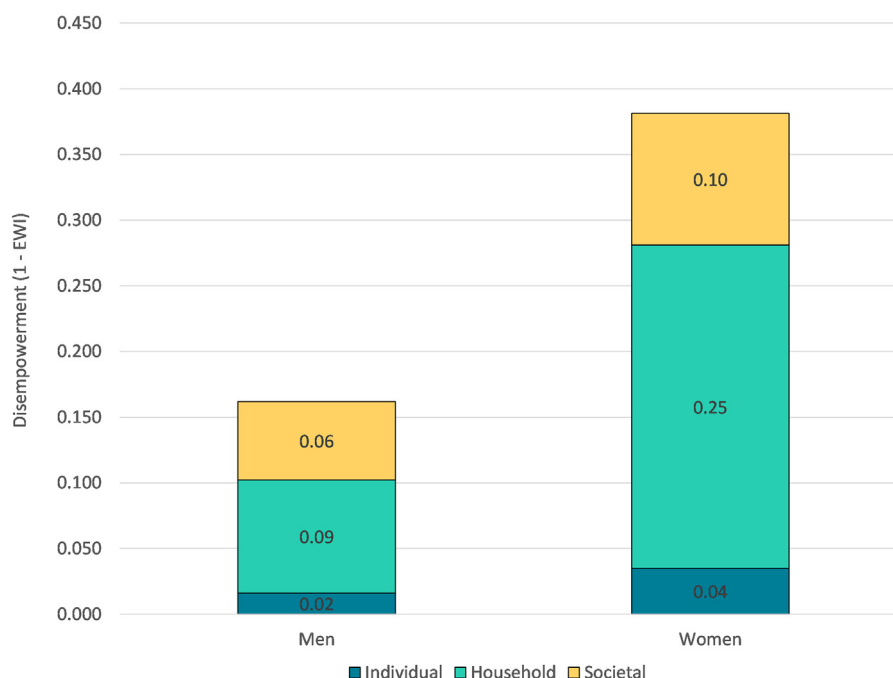


Fig. 2. Comparison of contribution of indicators at each level to disempowerment in WASH for men and women respondents. A larger bar indicates greater contribution to disempowerment.

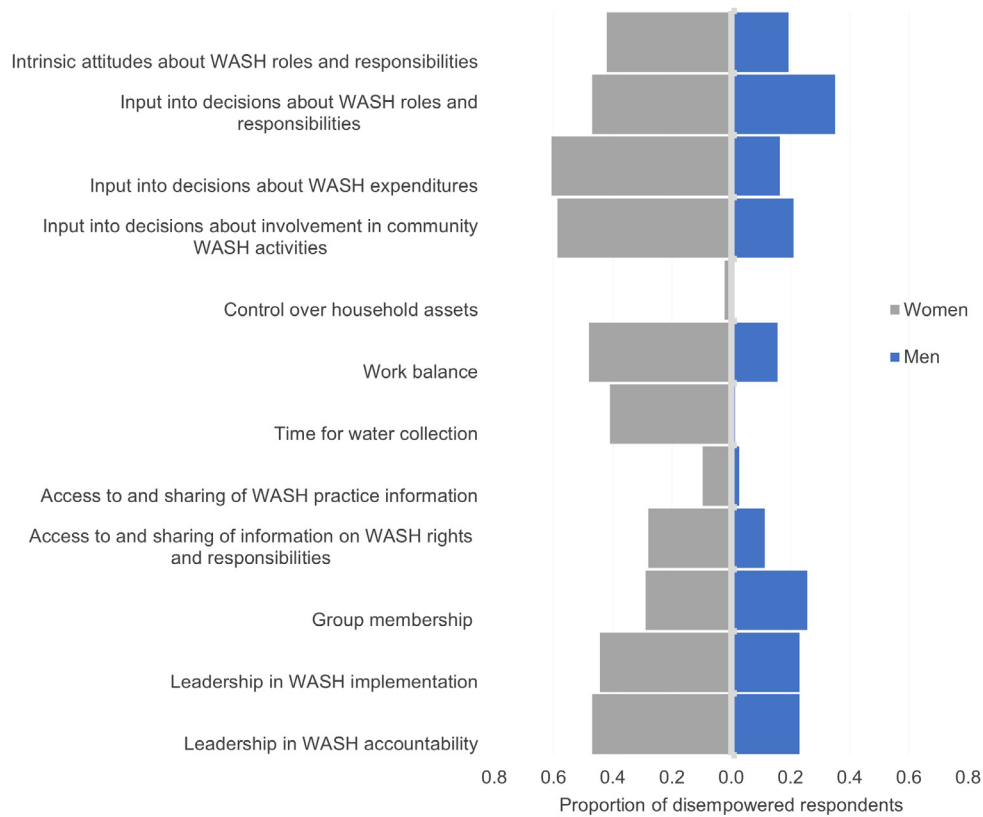


Fig. 3. Proportion of disempowered respondents not achieving each indicator.

Table 5

Association with empowerment (based on *p*, achievement score) and individual and household's characteristics.

Characteristics	Women Empowered				Men Empowered			
	Yes	%	No	%	Yes	%	No	%
<i>Age group</i>								
16–25	5	11.6	38	88.4	4	19.0	17	81.0
26–45	46	25.7	133	74.3	85	64.4	47	35.6
46–55	15	31.9	32	68.1	51	72.9	19	27.1
56–65	6	37.5	10	62.5	34	66.7	17	33.3
>65	6	42.9	8	57.1	14	53.8	12	46.2
Total	78		221		188		112	
Pearson chi2 (statistic and <i>p</i> -value)	8.63				21.57			
			0.071				0.0002	
<i>Education</i>								
Illiterate	59	27.1	159	72.9	108	64.3	60	35.7
Literate	4	23.5	13	76.5	10	66.7	5	33.3
Primary	5	13.2	33	86.8	38	57.6	28	42.4
Secondary or above	8	32.0	17	68.0	21	53.8	18	46.2
Total	76		222		177		111	
Pearson chi2 (statistic and <i>p</i> -value)	3.92				2.11			
			0.27				0.55	
<i>Housing type</i>								
Banco (mudbrick construction)	34	20.4	133	79.6	99	58.6	70	41.4
Brick (cement, baked, mudbrick stabilized with other materials)	39	33.6	77	66.4	82	69.5	36	34.0
Total	73		210		181		106	
Pearson chi2 (statistic and <i>p</i> -value)	6.29				3.55			
			0.01				0.06	

The results of logistic regression analysis highlighted relationships between WASH access and empowerment of women respondents, although as this is a pilot study further research is

required to verify them at scale (Data shown in Supplementary data 2). Women who paid an annual fee for water use (e.g. water on premises or boreholes) were almost 3 times as likely to be

Table 6

Association with empowerment and household water and sanitation facilities and payment arrangement.

Characteristics	Women Empowered				Men Empowered			
	Yes	%	No	%	Yes	%	No	%
<i>Type of water source used for drinking</i>								
Tap on premises	14	37.8	23	62.2	27	75.0	9	25.0
Borehole	46	30.5	105	69.5	99	66.9	49	33.1
Public tap	12	12.9	81	87.1	51	54.8	42	45.2
Unprotected well or surface water	6	31.6	13	68.4	7	36.8	12	63.2
Total	78		222		184		112	
Pearson chi2 (statistic and <i>p</i> -value)	12.9		0.005		11.2		0.011	
<i>Type of sanitation facility</i>								
Open defecation	10	25.6	29	74.4	25	65.8	13	34.2
Unimproved*	16	16.5	81	83.5	60	63.2	35	36.8
Improved traditional latrine	22	23.7	71	76.3	49	52.7	44	47.3
Improved latrine (e.g. VIP, saniplat)	30	42.2	41	57.8	50	71.43	20	28.6
Total	78		222		184		112	
Pearson chi2 (statistic and <i>p</i> -value)	14.57		0.002		6.36		0.096	
<i>Type of payment arrangement for water access</i>								
Annual fee	35	40.2	52	59.8	55	64.0	31	36.0
No fee	10	26.3	28	73.7	19	50.0	19	50.0
Payment by container	11	17.7	51	82.3	41	66.1	21	33.9
Payment upon break-down	19	18.1	86	81.9	63	61.2	40	38.8
Total	75		217		178		111	
Pearson chi2 (statistic and <i>p</i> -value)	14.9		0.002		2.91		0.41	

*Unimproved latrines refer to 'traditional latrines' in Burkina Faso, which are made from local materials.

empowered compared to those paying only when there was a break-down (e.g. public tap or borehole) (AOR: 2.83, 95%CI 1.26 to 6.36). Women who used unimproved sanitation in their household had 0.28 times the odds of being empowered compared to those with improved sanitation (AOR: 0.28, 95%CI 0.13 to 0.61).

6. Discussion

While many links have been made between WASH services and positive changes in women's empowerment and gender equality, limited tools have been developed to measure and monitor these outcomes. As this information has not been directly collected in a quantifiable way, achievements often receive less attention than more measurable outcomes, such as technical standards for improved water sources. This constrains our understanding of who benefits more from improved services due to social and power relations, and who is left behind, whether within households or in communities with similar availability of facilities (Gimelli, Bos, & Rogers, 2018). The novel Empowerment in WASH Index presented in this paper provides a way to monitor and evaluate gender and social equality outcomes in an intervention, and to determine the effectiveness of gender mainstreaming activities. Collecting this information can improve understanding of processes of empowerment in relation to WASH, which have been under-researched (Taukobong et al., 2016).

The findings of the EWI application in Banfora, Burkina Faso, highlight a difference in empowerment between men and women respondents. Entrenched gender roles for women, such as collection of water for domestic uses, as well as social norms over who controls household spending decisions or women's ability to interact with local authorities when a break-down in services occurs, contribute to an overall lower empowerment in WASH. Importantly, women have lower empowerment in WASH despite roles that define them as primarily responsible for WASH-related work. Although such factors are well known (Jansz & Wilbur, 2013), the

EWI approach quantifies the relative importance of these factors and highlights issues that have received less attention. In addition, the tool allows exploration of household- and community-level power and gender relations, whose role has often been overlooked in evaluating outcomes in a WASH context. In Banfora, indicators at the household level contributed more than twice as much to disempowerment for women compared to men, emphasizing the importance of household dynamics in determining WASH-related gender outcomes. For instance, in Banfora, women respondents, on average, were less involved with decisions on spending for water and sanitation relative to men. This implies that strategies to promote household connections to reduce water collection time and health risks may be limited if they do not consider these gendered implications. Similar findings have been reported in some other studies exploring decision-making related to water and sanitation. For example, a study in Odisha, India, found that decisions on construction of household level sanitation facilities were made exclusively by the male head in 80% of households (Routray et al., 2017). Routray and colleagues also found that involvement of women in more general household decision-making did not impact this. Aleixo et al. (2019) reported continued practice of collecting water and using fecally contaminated water following the construction of a water supply system in North-east Brazil, particularly by male-headed households that were more likely to use poorer quality water than households with female household heads. They suggest this may be due to greater decision-making power with respect to type of source for female-headed households to choose safe sources for drinking and food preparation.

In Banfora, women were less comfortable reporting service problems to local authorities and providers, which contributed to their disempowerment, despite these challenges having a larger impact on their daily activities. This is relevant for a growing focus on developing citizen and service-user accountability processes in the WASH sector, where such gender considerations will need to be incorporated. Among disempowered men, lack of involvement

in WASH decisions in the household was the top factor, indicating that such gender norms can also constrain men's opportunities, despite the negative impact of women conducting the large majority of unpaid water collection and management work. These findings were presented in a workshop that generated recommendations by regional WASH stakeholders for improving gender considerations in the Banfora master plan and annual action plan, including reviewing how to include gender considerations in planning and monitoring activities, creating more effective channels for men and women to give input or make complaints to service providers, and promoting and sharing examples of women playing leadership roles in WASH (Figea & Dickin, 2019).

The findings indicated an association between women's empowerment and type of water and sanitation facilities. For instance, a greater proportion of empowered women relative to disempowered women used a water source on premises or an improved sanitation facility, compared to those using lower service levels. There was also an association with payment type, as more disempowered women relative to empowered women paid by container for water or when there was a break-down, compared with other arrangements such as annual fees. In particular, women who paid an annual fee for water use (e.g. most often the case with water on premises or boreholes) were almost 3 times as likely to be empowered compared to those paying only when there was a break-down (e.g. most often the case using a public tap or borehole). This may indicate that more empowered women are able to use their resources, such as access to information about safe sanitation or financial resources to obtain connections to on premises water or reliable boreholes, compared to a more precarious arrangement of paying per container or when there is a break-down. More women using unprotected sources were empowered compared to women using public taps, which is unexpected. One possible explanation is that women in this group had lower comprehension of the survey questions, as this group had the highest level of illiteracy (78%) compared with other groups. This indicates the value of conducting cognitive validity testing with groups with differing educational attainment in future research. As this pilot study involved cross-sectional data, we cannot establish causality to determine whether certain water services and payment arrangements empower women, or whether more empowered women are able to command resources needed to use preferred services, or whether there are bi-directional pathways. More research is needed to understand such causal relationships in the WASH sector, and their direction, although it may be challenging to attribute any results to a specific intervention (O'Hara & Clement, 2018, [Taukobong et al., 2016](#)).

This EWI pilot was conducted as a diagnostic analysis to generate an understanding of levels of empowerment in Banfora, however the EWI could be adapted depending on desired aims or requirements of a project. For instance, the EWI can be used to assess and monitor gender outcomes at the beginning and throughout WASH programmes, in order to shape them accordingly. It is particularly important to better monitor gender outcomes as negative or unexpected changes in gender disparities may also occur following certain interventions. A focus on individual respondents means that further dis-aggregation of data can be conducted to assess intersectional disparities related to WASH. Understanding how other social identities such as age and ethnicity intersect with gender to influence empowerment is an important area for further research. In addition, research in other cultural contexts is needed to assess the EWI validity in different settings as a tool for cross-cultural comparisons of empowerment in WASH. Furthermore, sensitivity analysis should be conducted to test varying thresholds for level of achievement in different contexts, or to adjust the contribution of the Intra-Household Parity Index to the 'Combined EWI' score ([Gupta et al., 2019](#)).

7. Conclusions

Despite a frequent narrative emphasizing the importance of WASH services to address women's empowerment and gender disparities, the complexity of defining and measuring empowerment has limited its previous applications in WASH. Together with a lack of sex-disaggregated data ([Miletto, Pangare, & Thuy, 2019](#)), gaps in understanding of interactions between gender and empowerment outcomes and WASH outcomes limit the development of evidence-based gender-sensitive interventions and policy options. With the global uptake of the SDGs, the synergistic interactions between goals, such as between SDG 6 for clean water and sanitation and SDG 5 and 10 to reduce gender and other inequalities, have increasingly been promoted ([Fisher et al., 2017](#)). Monitoring progress in these areas requires tools that go beyond service ladders for water and sanitation infrastructure. The EWI is a novel tool that can measure agency, participation, and empowerment in the WASH sector. This can be used as a diagnostic, or as a monitoring tool over time to evaluate effectiveness of gender-mainstreaming approaches. Piloting of the EWI in a case study in Banfora, Burkina Faso indicated that the tool can provide concrete evidence of which respondents are most disempowered, which can facilitate targeting of actions within sector development plans. The findings indicated the importance of community and household level dynamics in contributing to empowerment, such as household decision-making, which have often been overlooked in WASH interventions despite their importance in influencing outcomes, and their recognition in other sectors ([Hirai, Graham, & Sandberg, 2016](#)). More robust understanding of empowerment contributes to a broader evidence-base indicating how WASH services are critical not just for their foundational public health role, but also in meeting goals to address gender and other social inequalities. This will support the push for decision-makers to prioritize investments in, and practitioners to implement, inclusive WASH service delivery.

CRedit authorship contribution statement

Sarah Dickin: Conceptualization, Methodology, Formal analysis, Writing - original draft. **Elijah Bisung:** Conceptualization, Methodology, Writing - original draft. **Juste Nansi:** Methodology, Writing - review & editing. **Katrina Charles:** Methodology, Writing - review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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