

Closing the measurement gap: The Water Security for Health and Livelihoods (WaSHeL) indicator for standardizing the integrated measurement of household water security

Key messages

- **Household water insecurity is multidimensional but poorly measured in practice.** While widely cited definitions recognize water security as encompassing health, livelihoods, risk, governance, and ecosystems, most existing indicators and survey instruments capture only fragments of this reality, with a particular focus on domestic water access.
- **Current experiential water insecurity scales leave major gaps.** Experiential scales, including the Household Water InSecurity Experiences Scale (HWISE) and the Individual Water InSecurity Experiences Scale (IWISE), focus primarily on domestic water access, use, and reliability. Meanwhile emerging livelihood-oriented tools such as the Agricultural Water Insecurity Experiences Scale (AgWISE) assess productive water use separately. This division limits their ability to capture the full spectrum of water insecurity. Across these approaches, critical dimensions such as governance processes, climate risks, and adaptation experiences remain insufficiently represented.
- **Households and economies depend on water for both domestic well-being and productive activities.** In both rural and urban contexts, water supports drinking, hygiene, and a wide range of livelihood and economic activities, such as agriculture, industry, and services. Measurement approaches that separate these domains fail to capture their interdependence, thereby misrepresenting lived realities and underestimating vulnerability.
- **The WaSHeL indicator closes a critical measurement gap.** The Water Security for Health and Livelihoods (WaSHeL) indicator is a concise 13-item, experiential household instrument that integrates domestic and productive water insecurity while also capturing social consequences, governance exclusion, seasonal migration, and climatic uncertainty.
- **WaSHeL is survey-ready and available for wide adoption.** Designed for rapid implementation with binary responses and a 12-month recall period consistent with the framework of the Food Insecurity Experience Scale (FIES), WaSHeL has been embedded in the 2025 Ghana Living Standards Survey (GLSS), providing the first nationally representative experiential measure of integrated household water security in Ghana. The instrument is available for integration into household surveys in other country contexts.
- **WaSHeL supports coherent and targeted policy and investment.** By identifying both system-wide and dimension-specific threats to water security, WaSHeL enables policymakers to design more coherent policies and investments that jointly target water, sanitation, and hygiene (WASH), agricultural water management, and climate adaptation interventions.



A community borehole in the Upper East Region of Ghana supports domestic and productive water uses, while the surrounding dry farmland highlights the challenges of seasonal water scarcity and climate change. Photo by Joseph Salmawobil

Introduction and background

Water insecurity remains a major global challenge. As of 2024, 2.2 billion people still lack access to safely managed drinking water, and nearly 4 billion experience severe water scarcity for at least one month each year, with impacts concentrated in low- and middle-income countries (WHO and UNICEF 2025; UN-Water 2025). These pressures are especially acute in rural sub-Saharan Africa, where households rely on water not only for drinking and hygiene but also for agriculture, livestock, and small-scale enterprises amid strong seasonality and climate variability (UN-Water 2025). Despite growing recognition that water insecurity spans multiple domains of household life, existing measurement systems fail to adequately capture how it is experienced and how it shapes welfare and livelihood decisions.

Advances in remote sensing, digital twins, and artificial intelligence (AI)-driven analytics have expanded the capacity to characterize water-related risks at scale, enabling near real-time monitoring of drought, groundwater depletion, and hydrological variability. However, these tools operate at spatial resolutions that cannot reach the household level, and they are not designed to capture the social and economic dimensions of water insecurity. Spatial data can identify where water stress is concentrated but cannot explain why outcomes differ across households within the same geographic area, nor what shapes household-level coping strategies, technology adoption decisions, or livelihood adjustments in response to water-related shocks. These questions require micro-level data collected through standardized, validated survey instruments. Standardization matters not only for internal validity but also for comparability: instruments applied consistently across contexts allow researchers to track change over time, benchmark across countries, and accumulate the evidence base needed to inform investment decisions at scale.

Measuring household water insecurity requires instruments that capture the full range of dimensions through which water affects welfare and livelihoods. Widely cited definitions of water security (Grey and Sadoff 2007; UN-Water 2013) encompass quantity, quality, accessibility, affordability, productive use, risk and resilience, governance, and ecosystem dimensions. None of these dimensions can be adequately represented by a single indicator. Over the past decade, experiential scales such as the Household Water InSecurity Experiences Scale (HWISE; Young et al. 2019) and the Individual Water InSecurity Experiences Scale (IWISE; Young et al. 2021) have advanced measurement beyond infrastructure-based proxies by capturing the lived impacts of unreliable or insufficient water on health and well-being (Jepson et al. 2017; Young et al. 2019). However, when assessed against a comprehensive water security framework, existing tools leave significant dimensions unaddressed:

productive water uses for agriculture and non-farm enterprises, governance and exclusion experiences, adaptation responses such as seasonal migration, and uncertainty related to climate variability are largely absent from standard modules (Octavianti and Staddon 2021; Sarker et al. 2024). This fragmentation limits researchers' and policymakers' ability to assess the full scope of household water vulnerability and to design appropriately targeted interventions.

To address these gaps, the Water Security for Health and Livelihoods (WaShEL) indicator has been developed as a concise 13-item experiential instrument that integrates domestic and productive water insecurity alongside social consequences, governance exclusion, migration as an adaptation strategy, and climate-related uncertainty. WaShEL has been embedded in the 2025 Ghana Living Standards Survey (GLSS), providing the first nationally representative experiential measure of household water security spanning both welfare and livelihoods. The instrument can be integrated into household surveys across different country contexts.

This brief outlines the conceptual foundation of WaShEL, situates it within the broader water security measurement literature, reviews how existing experiential tools map onto key water security dimensions, and presents the instrument's structure, scoring approach, and intended applications for monitoring, evaluation, and policy use.

Conceptual framework

Defining water security

Two definitions dominate the water security literature. Grey and Sadoff (2007) define water security as the availability of an acceptable quantity and quality of water for health, livelihoods, ecosystems, and production, coupled with an acceptable level of water-related risks to people, environments, and economies. UN-Water (2013) subsequently broadened this definition to encompass "the capacity of a population to safeguard sustainable access to adequate quantities of acceptable-quality water for sustaining livelihoods, human well-being, and socio-economic development, for ensuring protection against waterborne pollution and water-related disasters, and for preserving ecosystems in a climate of peace and political stability."

Together, these definitions establish that water security is inherently multidimensional and cannot be adequately captured by any single indicator. A household may have physical access to water but be unable to afford it; a basin may have abundant resources but lack the governance structures to distribute them equitably; a farming community may have sufficient water in an average year but remain highly exposed to drought under climate variability. Effective measurement must reflect this complexity.

Dimensions of water security

Building on the definitions posited by Grey and Sadoff (2007) and UN-Water (2013), as well as recent literature on water security measurement frameworks (Garrick and Hall 2014; Grey and Sadoff 2007; Octavianti and Staddon 2021), this brief

identifies eight analytical dimensions that together constitute a comprehensive measurement framework. Each dimension encompasses a set of sub-dimensions (Table 1), which serve as the analytical lens through which existing measurement tools are assessed.

Table 1. Eight dimensions of water security: analytical framework with key sub-dimensions and indicators.

Dimension	Key sub-dimensions and indicators
1. Quantity & Availability	Concerns about water availability Experience of water scarcity Frequency and duration of water shortages
2. Quality & Safety	Concerns about water quality and safety Sensory experience (taste, smell, color) of water quality Need for water treatment (boiling, filtering) before use
3. Accessibility & Affordability	Time and effort needed to access water Financial affordability of water
4. Risk & Resilience	Exposure to water-related shocks (droughts, floods, etc.) Capacity to cope with and adapt to water-related shocks
5. Water for the Environment	Observed changes in vegetation, landscape, or wildlife patterns Concerns about long-term environmental sustainability
6. Health & Well-Being	Psychosocial stress, anxiety, shame, and mental fatigue caused by water issues Inability to perform WASH activities due to a problem with water Inability to prepare proper meals due to water scarcity or quality issues
7. Socioeconomic & Livelihood Support	Economic activities affected by water issues Intensity of the impact of water issues on economic activities Impact of water issues on planning, investment, and future aspirations
8. Governance & Management	Level of trust in water authorities and institutions Experience of exclusion or discrimination in water-related decision-making Experience of conflict over water

Note: WASH - Water, sanitation and hygiene

Existing measurement tools: A review against our conceptual framework

Over the past decade, experiential water insecurity scales have shifted measurement beyond infrastructure access to capture the lived impacts of unreliable, insufficient, or unsafe water—including concerns, disruptions to daily activities, and psychosocial stress (Jepson et al. 2017; Young et al. 2019). Table 2 assesses five established instruments against the eight-dimension framework presented in the previous section: HWISE, a 12-item scale validated across 23 low- and middle-income countries; IWISE, an individual-level adaptation of HWISE; the Water Insecurity Scale for Nutrition Outcomes (WATINE; Nounkeu et al. 2021), developed to link water insecurity with nutritional outcomes; the Household Water Insecurity scale (HHWI-20; Boateng et al. 2018), a 20-item instrument capturing a broader range of domestic insecurity experiences; and

AgWISE (Sarker et al. 2024), designed to capture productive agricultural water insecurity.

Although these instruments represent important advances in experiential measurement, assessment against the proposed framework reveals that they still provide incomplete coverage of the combined domestic-productive realities and broader structural drivers of water insecurity common in rural, mixed-economy households.

Key gaps in existing experiential scales

- **Split coverage of domestic and productive water use:** Most tools focus on household domestic water needs (e.g., HWISE and IWISE), while AgWISE focuses on agricultural water use. Few instruments integrate both domains within a single concise module (Sarker et al. 2024; Young et al. 2019).

- **Limited coverage of diverse livelihoods:** Even where productive water use is considered, non-agricultural water-dependent enterprises and mixed livelihood activities are rarely captured (Octavianti and Staddon 2021).
- **Limited attention to governance experiences:** Existing scales rarely measure exclusion from water-related decision-making, perceptions of fairness, or accountability in water allocation (Jepson et al. 2017; Octavianti and Staddon 2021).
- **Underrepresentation of risk, climate variability, and concerns regarding extreme-events:** Experiences of uncertainty related to droughts, floods, and climate extremes are largely absent from standard experiential modules (Garrick and Hall 2014; Octavianti and Staddon 2021).

- **Limited measurement of adaptation responses:** Coping and adaptation strategies, such as temporary migration or production adjustments in response to shocks affecting water security, are not routinely incorporated into experiential indicators (Hadley and Freeman 2016; Sarker et al. 2024).

Table 2 shows that existing scales provide strong coverage of domestic water insecurity, particularly in terms of the dimensions of quantity, availability, and psychosocial well-being. Water quality, accessibility, and affordability are only partially represented, with affordability receiving particularly limited attention. Critical gaps persist in the dimensions of risk and resilience, water for the environment, and governance, which are largely absent or only minimally covered. Socioeconomic and livelihood impacts are better addressed in AgWISE and WaSHeL, but most scales remain centered on domestic experiences. WaSHeL advances a more integrated approach by combining productive, governance, and climate dimensions with domestic water use.

Table 2. Coverage of water security dimensions in major experiential water insecurity scales

Dimension	Sub-dimension	HWISE	IWISE	WATINE	HHWI-20	AgWISE	WaSHeL
1. Quantity & Availability	Concerns about water availability	●	●	●	●	●	●
	Experience of water scarcity	●	●	●	●	●	●
	Frequency and duration of water shortages	●	●	—	●	—	—
2. Quality & Safety	Concerns about water quality and safety	—	—	●	●	●	●
	Sensory experience of water quality	—	—	●	●	—	—
	Need for water treatment before use	—	—	●	●	—	—
3. Accessibility & Affordability	Time and effort to access water	—	—	●	●	—	—
	Financial affordability of water	—	—	—	●	—	—
4. Risk & Resilience	Exposure to water-related shocks	—	—	—	—	●	●
	Capacity to cope with and adapt to shocks	—	—	—	—	—	●
5. Water for the Environment	Observed changes in vegetation/landscape	—	—	—	—	—	—
	Long-term environmental sustainability	—	—	—	—	—	—
6. Health & Well-Being	Psychosocial stress and mental fatigue	●	●	●	●	●	●
	Inability to conduct WASH activities	●	●	●	●	—	●
	Inability to prepare proper meals	●	●	●	●	●	●
7. Socioeconomic & Livelihood Support	Economic activities affected	—	—	●	●	●	●
	Intensity of the impact on economic activities	—	—	—	—	—	●
	Impact on planning, investment, aspirations	—	—	—	—	—	—
8. Governance & Management	Level of trust in water authorities	—	—	—	—	—	—
	Exclusion from water-related decisions	—	—	—	—	●	●
	Experience of conflict over water	—	—	●	—	—	●

Note: Green fill (●) = covered by at least one item in the instrument; — = not covered. HWISE = Household Water Insecurity Experiences Scale (Young et al. 2019); IWISE = Individual Water Insecurity Experiences Scale (Young et al. 2021); WATINE = Water Insecurity Scale for Nutrition Outcomes (Nounkeu et al. 2021); HHWI-20 = Household Hydro-Insecurity Experiences Scale (Boateng et al. 2018); AgWISE = Agricultural Water Insecurity Experiences Scale (Sarker et al. 2024); WaSHeL = Water Security for Health and Livelihoods. WASH - Water, sanitation and hygiene.

The WaSheL indicator: A 13-item water security instrument

WaSheL was developed to fill the measurement gap identified in the preceding review. It is designed as a short, survey-ready module that captures household-level domestic and productive water insecurity, along with downstream consequences, governance dimensions, and climate-related water anxiety.

Design rationale

The module is structured around two innovations relative to existing experience-based tools. First, by incorporating a productive dimension (Q6–Q8) alongside the domestic dimension (Q1–Q5), WaSheL captures the full scope of water security as defined by Grey and Sadoff (2007) and UN-Water (2013), extending measurement beyond health and hygiene to include water’s role in livelihoods and economic production.

Second, by including questions on consequences and adaptation responses (migration, constrained agricultural decisions), governance experiences (exclusion from water-related decision-making), and climate uncertainty (worry about climatic events), WaSheL moves beyond immediate experiences of insecurity to capture the systemic and structural dimensions that shape household vulnerability.

The 12-month reference period is consistent with the Food Insecurity Experience Scale (FIES; FAO 2016) framework and captures seasonal water insecurity—a critical feature given that water availability is highly seasonal. The binary response format minimizes respondent burden and enumerator training requirements.

Module questions

Table 3 presents the full text of the 13 questions included in the WaSheL module.

Table 3. The Water Security for Health and Livelihoods (WaSheL) module: question text, response codes, sectors, and insecurity domains

#	Question (12-month recall)	Response codes	Sector	Insecurity domain
DOMESTIC DIMENSION				
Q1	During the last 12 months, was there a time when you or others in your household were worried you would not have enough water (in quantity and quality) for all your household DOMESTIC needs? (drinking, cooking, cleaning, washing, bathing, etc.)	0=No 1=Yes	Domestic	Worry
Q2	During the last 12 months, was there a time when you or others in your household were thirsty but did not drink because of a problem with water (unavailable, too far, dirty, unsafe, expensive)?	0=No 1=Yes	Domestic	Insecurity experience —Drinking
Q3	During the last 12 months, was there a time when you or others in your household had to restrict the use of water for cooking (cleaning of vegetables, soaking of rice, etc.) because of a problem with water (unavailable, too far, dirty, unsafe, expensive)?	0=No 1=Yes	Domestic	Insecurity experience —Cooking
Q4	During the last 12 months, was there a time when you or others in your household had to go without washing their hands, faces, or bodies because of a problem with water (unavailable, too far, dirty, unsafe, expensive)?	0=No 1=Yes	Domestic	Insecurity experience —Washing
Q5	During the last 12 months, was there a time when you or others in your household had to go without cleaning (floor, dishes, clothes, household linen, etc.) because of a problem with water (unavailable, too far, dirty, unsafe, expensive)?	0=No 1=Yes	Domestic	Insecurity experience —Cleaning
PRODUCTIVE DIMENSION				
Q6	During the last 12 months, have you or anyone in your household worried that you would not have enough water (in quantity and quality) for all your household PRODUCTIVE needs? (crop farming, fish farming, livestock keeping, agricultural processing, other businesses)	0=No 1=Yes	Productive	Worry
Q7	During the last 12 months, has your household’s agricultural production (crop, livestock, or fish farming) suffered because of problems with water (unavailable, too far, dirty, unsafe, expensive)?	0=No 1=Yes	Productive	Insecurity experience —Agriculture
Q8	During the last 12 months, has your household’s non-agricultural economic activity suffered because of problems with water (unavailable, too far, dirty, unsafe, expensive)?	0=No 1=Yes	Productive	Insecurity experience —Non-agriculture

#	Question (12-month recall)	Response codes	Sector	Insecurity domain
CONSEQUENCES, ADAPTATION, & GOVERNANCE				
Q9	During the last 12 months, has anyone in your household had to temporarily migrate to another region or place (for at least one month) because of a problem with water (e.g., dry season migration)?	0=No 1=Yes	Combined	Consequence/adaptation — Migration
Q10	During the last 12 months, were your household's decisions with respect to agriculture (type of crop, area) and livestock (type of animal, number of head) restricted by problems with water (unavailable, too far, dirty, unsafe, expensive)?	0=No 1=Yes	Combined	Consequence/adaptation — Decision-making
Q11	During the last 12 months, was there a time when you or others in your household had any conflict or felt social relations were deteriorating with neighbors or community members because of problems with water related to domestic or productive uses?	0=No 1=Yes	Combined	Conflict, social consequences
Q12	During the last 12 months, have you or anyone in your household felt excluded from decisions related to water access for domestic or productive use?	0=No 1=Yes	Combined	Governance
Q13	During the last 12 months, have you or anyone in your household worried about climatic events (drought, floods, cyclone, heat wave, etc.) impacting your access to water (in quantity and quality) for domestic or productive use?	0=No 1=Yes	Combined	Climatic uncertainty

Index construction

Each of the 13 items is reverse-coded so that responses indicating water insecurity are assigned a value of 0, while responses indicating absence of insecurity are assigned a value of 1. For example, reporting worry about water access is coded as 0, reflecting lower water security. The WaSheL indicator is calculated by summing the recoded item scores and normalizing the total score as a percentage:

$$\text{WaSheL} = \left(\frac{\sum_{i=1}^{13} \text{item}_i}{13} \right) \times 100$$

Higher values indicate greater water security, with a score of 100% representing full water security across all measured dimensions. Sub-indices are calculated using the same approach:

- **WaSheL-D** (Domestic; Q1–Q5): sum of five domestic items divided by 5;
- **WaSheL-P** (Productive; Q6–Q10): sum of five productive items divided by 5;
- **WaSheL-GC** (Governance and Climate; Q11–Q13): sum of three items divided by 3.

Each sub-index is expressed as a percentage, enabling direct comparison across households, dimensions, and survey rounds and facilitating clear communication of results for policy and presentation purposes. At this stage, the WaSheL indicator is treated as a continuous measure of water security; severity scores and categorical thresholds will be defined in future work, informed by empirical validation using the data collected across different survey rounds and geographical settings.

The current scoring assigns equal weight to all 13 items. As a result, the domestic and productive dimensions each contribute 5/13 of the composite score, while the governance and climate dimensions contribute 3/13. This weighting structure reflects the measurement gap identified in the literature review, specifically, the under-representation of productive, governance, and climate dimensions in existing instruments, rather than a prior assumption about the relative welfare importance of each domain. Equal item weighting is a standard starting point in the development of composite experiential scales (cf. Young et al. 2019; Cafiero et al. 2018) and facilitates reproducibility. The appropriateness of this weighting structure relative to alternative approaches, including dimension-level weighting or empirically derived weights based on item response theory, will be examined through sensitivity analyses as survey data accumulate and through subsequent applications.

Intended and current applications

WaSheL is designed to serve two broad functions: (1) informing policy and investment decisions, and (2) supporting monitoring, evaluation, learning, and impact assessment (MELIA).

Policy targeting and coherence. The composite indicator and its three sub-indices (WaSheL-D, WaSheL-P, and WaSheL-GC) provide a structured basis for identifying the dimensions of water insecurity that are most constraining for a given population and for specific demographic groups within that population. A household scoring low on WaSheL-P but adequately on WaSheL-D signals that productive water constraints are the primary limitation, suggesting the need for agricultural water management rather than improvements in water, sanitation and hygiene (WASH) infrastructure. Where WaSheL-GC scores are low, institutional responses targeting

water governance or climate resilience must take priority. This diagnostic function is particularly relevant in contexts where WASH, agricultural water management, and climate adaptation are financed through separate channels despite serving the same households. By capturing all three domains within a single instrument, WaSheL provides an empirical basis for cross-sectoral policy coherence and for aligning investments with integrated water security targets across multiple Sustainable Development Goals (SDGs)—notably SDG 2 (zero hunger), SDG 6 (clean water and sanitation), SDG 8 (decent work and economic growth), SDG 13 (climate action), and SDG 16 (peace, justice, and strong institutions).

MELIA. The standardized 12-month recall period and binary response format make WaSheL suitable for repeated measurement across survey rounds. Changes in scores over time, at composite or sub-index level, provide a tractable outcome indicator for program evaluations targeting water security, agricultural livelihoods, or climate resilience. The sub-index structure is particularly useful for impact assessment: when an intervention targets a specific dimension, the corresponding sub-index provides a theoretically grounded primary outcome measure, while the remaining sub-indices help detect spillover or unintended effects across domains.

Current and future applications. The WaSheL module has been embedded in the 2025 Ghana Living Standards Survey (GLSS) as a novel component, providing, for the first time, a nationally representative measure of household water security that covers both personal and productive uses. Focused group discussions conducted across Northern Ghana were used to inform item development and ensure relevance to local lived experiences of water security. Integration of the module into household surveys in additional country contexts is actively sought, with the dual purpose of expanding the evidence base on integrated water security and enabling cross-country comparisons over time.

Conclusion

WaSheL addresses a documented gap in the measurement of household water security by integrating the dimensions of domestic and productive water insecurity, governance and exclusion experiences, adaptation responses, and climate-related uncertainty into a single, concise survey module. The instrument was developed through a systematic review of existing water security scales and qualitative fieldwork in Northern Ghana, and is grounded in an eight-dimension water security framework drawing on established definitions (Grey and Sadoff 2007; UN-Water 2013). It was embedded in the 2025 GLSS as the first nationally representative application of an integrated household water security measure in Ghana.

WaSheL is available for immediate integration into household surveys in other country and program contexts. The standardized binary response format and 12-month recall period facilitate low-burden implementation across diverse settings, and the sub-index structure (WaSheL-D, WaSheL-P, and WaSheL-GC) supports both composite and dimension-specific analysis. Researchers, national statistics officers, and program evaluators seeking to adopt the module are invited to contact the authors.

Ongoing work will refine the instrument as data from the GLSS and subsequent survey rounds accumulate. Priority validation tasks include convergent validity testing against HWISE and other established scales, calibration of severity thresholds, sensitivity analysis of the equal-weighting assumption, and development of an extended module for dimension-specific severity measurement. These activities will inform future iterations of the instrument and its scoring guidance without limiting its current applicability.

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