Quantifying Water, Sanitation, and Hygiene Challenges in Conflict Zones: Applying the WASH Insecurity Analysis (WIA) Model in Syria

A thesis submitted by

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I. Abstract

This study assesses the Water, Sanitation, and Hygiene (WASH) conditions in Syria's governorates post-civil war, utilizing recent, local data at Admin level 1 for a detailed analysis that surpasses the often-generalized national data (Admin level 0). Developed through consultations with UNICEF, the WASH Insecurity Analysis (WIA) model employs 42 and 34 indicators to evaluate WASH systems, health and environmental stressors, and vulnerabilities across each governorate. This research is integral to a broader UNICEF project analyzing WASH in seven countries. The indicators are rated on a scale from 1 to 5, where 1 indicates optimal conditions and 5 indicates a critical need for improvement. By integrating these scores using a specialized Excel-based WASH analysis system and Python for mapping, the study visually depicts the severity of WASH deterioration, with most governorates scoring above 3.0, and some as high as 4.4. These findings underscore the urgent need for comprehensive WASH reforms across Syria to ensure safe water and sanitation practices, highlighting the study's contribution to improving localized data utilization in humanitarian WASH assessments.

II. Acknowledgements

First and foremost, I want to express my deepest gratitude to my advisor, Dr. Daniele Lantagne, for her invaluable guidance throughout my research journey. Working under her mentorship at Tufts has been an enriching experience, and her profound knowledge, support, and encouragement have been crucial to my development and success.

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Finally, I must express my profound appreciation to my family. To my parents who have mastered the art of long-distance cheering and patience throughout these two years, and to Todd who has been an incredible pillar of practical help and calm, making everyday life smoother and simpler.

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1 Introduction

Water, sanitation, and hygiene (WASH). WASH is a multi-faceted sector which aims to provide essential services in water supply, sanitation, and hygiene, and enables critical determinants of public health, socio-economic development, and quality of life (WASH. UNICEF). WASH essential services contribute to protecting both human health and dignity, and thus the human right to water and sanitation is a prerequisite for the realization of other human rights (Russell, F., & Azzopardi, P.).

Humanitarian emergencies, including natural disasters, disease outbreaks, and complex emergencies, are occurring at increasing rates globally (Yates,T.). Complex emergencies, as defined by the United Nations, are situations characterized by disrupted livelihoods and threats to life due to warfare, civil disturbances, and large-scale movements of people. In such contexts, ensuring WASH access becomes even more critical (Latta, S.).

Global response to humanitarian emergencies relies heavily on readily available data. The WASH Insecurity Analysis (WIA) project, initiated by UNICEF, aims to provide a standardized, user-friendly methodology for quantifying WASH-related risks (Global WASH Cluster.). The WIA model is envisioned as a data-based solution, providing a robust methodology that can bring together diverse stakeholders, empower coordination platforms, and enhance advocacy efforts at the grassroots level. However, the potential of the WIA is greatly reduced if the provided data is out of date, lacking detail, or not readily available.

This research focuses on Syria, a region grappling with multifaceted WASH challenges exacerbated by prolonged conflict (Sikder, Mustafa, et al.). In nations such as Syria, where a decade-long conflict has led to infrastructural and societal disruption, the central importance of

WASH becomes even more pronounced. and aims to test and validate the WIA model is a current point of issue.

1.1 Objectives of the Research

The objectives of this thesis are twofold:

1. The first objective was to help refine the WIA Model by working with UNICEF and Lantagne Group members. In my work, I focused on gathering easily available, admin level 0, international-level data to assist in fine-tuning the initial WIA models. This work is described in Chapter 2 of this thesis.
2. The second objective is to bridge the gap between international and local data sources to enhance the accuracy of the WIA model in the specific context of Syria. In Chapter 3 I describe the specific context of Syria and compare WIA scores derived from internationally-available data with locally-available data.

The goal of the WIA, and this work, is to provide improved information by finding deficiencies and areas of concern to assist in responding to humanitarian crises.

2 The WASH Insecurity Analysis Model

The absence of a standardized framework to transform complex data into actionable information has become a bottleneck in decision-making processes for the WASH sector. The aim of the WIA is to provide a common approach to classifying the severity of WASH-related risks faced by people in a given geographic area.

UNICEF, in collaboration with Tufts and experts, is developing this WIA model to inform planning and decision-making, and to support resource allocation and advocacy efforts in both humanitarian and development contexts. The WIA is intended to be both a tool and a robust, comparable methodology that can bring together diverse stakeholders, including those working in the development, and humanitarian nexus. Ultimately, the WIA will enable stakeholders to better understand and address WASH-related risks and needs, promoting more effective and efficient interventions.

2.1 Measuring by Risk

The WIA measures insecurity by measuring risk. Risk is defined as the possibility that a person, family or community will experience some kind of negative outcome such as loss, injury, or illness. Risk considers both the scale and likelihood of each outcome. The WIA measures risk as a function of exposure, hazard, and vulnerability, using the common equation:

Risk = function (Exposure, Hazard, Vulnerability)

The WIA takes a multi-hazard approach to quantify the overall level of risk faced by populations in a specific area at a specific current time. The 1 to 5 scale of the WIA reflects the overall level of risk populations face based on their vulnerabilities relative to WASH service levels and exposure to hazards (Figure 1). Thus, WASH related risks may be associated with people's health (e.g., WASH-related disease outbreaks) or their well-being (e.g., experiencing gender-based violence).

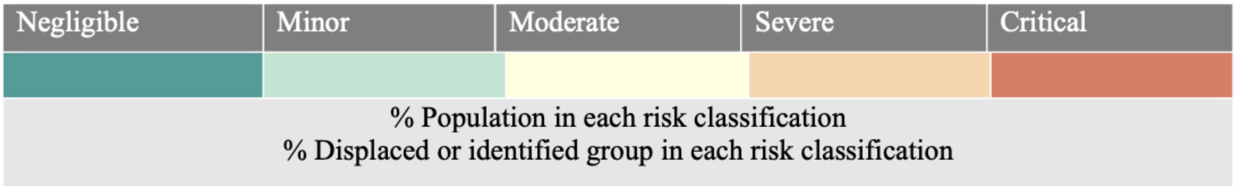


Figure 1: WIA 1-5 Risk Scale

The list of WASH-related risks is extensive, and includes, for example:

- Negative health outcomes linked to WASH-related diseases.
- Inability to fully realize the right to a life of equality and dignity.
- Limited economic or educational opportunities linked to inadequate WASH services.
- The possibility of physical or psychological harm caused by violence or abuse linked to the use of inadequate or inappropriate WASH services.

2.2 Geographic Target for WIA

The WIA focuses on the present risk to people living in a defined geographic area.

Present:

The WIA characterizes the current risk, based on information available at the time. While it may be used to understand trends over time, the WIA is not designed as a predictive model.

People:

The risk level is centered around the risks faced by individuals, families, or communities. Risks to infrastructure, systems, or resources are considered only indirectly when they impact people.

Defined geographic area:

The WIA provides a risk score at the 'Admin 1' level. This is the highest-level subnational administration unit in a country (commonly referred to as 'state', 'district' or 'province'). There is no reason the model could not also be used at lower levels than Admin 1, but WIA piloting was at Admin 1.

2.3 Specifications for WIA

Based on the above guiding principles, the WIA model incorporates a Base Score that is globally comparable. The Base Score would:

- Have a human rights-based focus.
- Be globally comparable, using consistent indicators.
- Use available data, not unavailable ideal data.
- Focus on providing comparability within-country that informs where to respond.
- Not distinguish between development and humanitarian sectors.
- Be UNICEF-embedded with links to JMP and other UNICEF programs.
- Be robust, yet simple and easy-to-use.
- Focus initially on Admin Level 1 in countries, with ability to use at other Admin levels.
- Be transparent in methodology.
- Include quantitative and qualitative (expert) data that meet quality requirements.
- Provide information to other initiatives (including geo-spatial ones), but not be geo-spatial.

- Not be predictive but would be able to be routinely completed and integrate seasonal/historical risks, integrate data from other relevant early warning systems or forecasts, and be simple and replicable to enable measures over time (monitoring).

2.4 WASH SDG Definitions - The JMP Service Ladders

The WHO/UNICEF Joint Monitoring Program for Water Supply, Sanitation, and Hygiene (JMP) has reported country, regional, and global estimates of progress on drinking water, sanitation, and hygiene (WASH) since 1990 (Water, sanitation, and hygiene (WASH). UNICEF). The JMP definitions of basic water, sanitation, and hygiene (as described below) were selected for use in the WIA and associated derivatives.

2.4.1 Drinking Water JMP Service Ladder

Drinking water services encompass ease of access, availability, and the quality of the primary water source utilized by households for activities such as drinking, cooking, personal hygiene, and various domestic needs (Figure 2).

Improved drinking water sources are characterized by their design and construction, ensuring the delivery of safe water. The JMP (Joint Monitoring Program) categorizes the population relying on improved sources into three distinct groups based on the level of service provided. These groups are comprised of "safely managed", "basic," and "limited" (as shown in Figure 2).

The final two categories are unimproved sources, where individuals access water from unprotected dug wells or springs, as well as the lowest level of water service, which is defined as the consumption of surface water collected directly from a river, dam, lake, stream, or irrigation canal. For the WIA, safely managed and basic are considered the least risky. (Drinking water | JMP. (n.d))

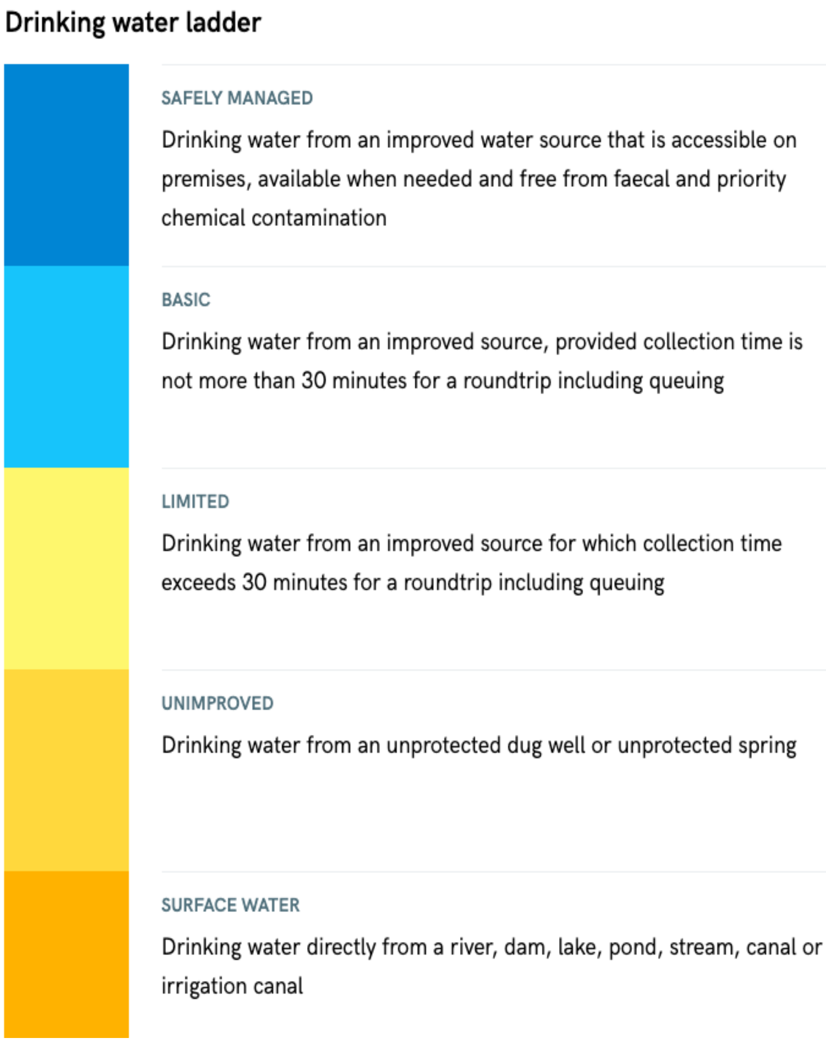


Figure 2: JMP Drinking Water Ladder Drinking water (Drinking water | JMP. (n.d.).)

2.4.2 Sanitation JMP Service Ladder

Safely managed sanitation services include the use of improved sanitation facilities which are not shared with other households, and the excreta produced should either be treated in-situ or off-site (Figure 3). If the excreta from improved sanitation facilities is not safely managed, then people using those facilities are classed as having a basic sanitation service. (Drinking water | JMP. (n.d))

People using improved facilities shared with other households are classified as having a limited service. Unimproved sanitation is present if the population uses unimproved services or practies open defecation. For WIA scoring, safely managed and basic sources are considered the least risky. (Drinking water | JMP. (n.d))

Figure 3: JMP Sanitation Ladder Drinking water (Drinking water | JMP. (n.d))

2.4.3 Hygiene JMP Service Ladder

The presence of a handwashing facility with soap and water on-premises is the main indicator of sufficient hygiene (Figure 4). Households with a handwashing facility with soap and water available meet the criteria for a basic hygiene service rating. Households that have a facility for handwashing, but no water or soap are given a rating of limited service. In some cultures, other materials, such as ash are used for handwashing, but are less effective and are dubbed as limited hygiene services. (Drinking water | JMP. (n.d))

Figure 4. JMP Handwashing Ladder Drinking water (Drinking water | JMP. (n.d.).)

2.5 WIA Dimensions, Themes, Macro-Indicators, and Indicators

The dimensions in a Risk model include exposure, hazards, and vulnerabilities (Figure 5). For development of the WIA, it is created in a risk-based insecurity framework, specific to WASH, including the development of WASH dimensions, themes, macro-indicators, and indicators (described below).

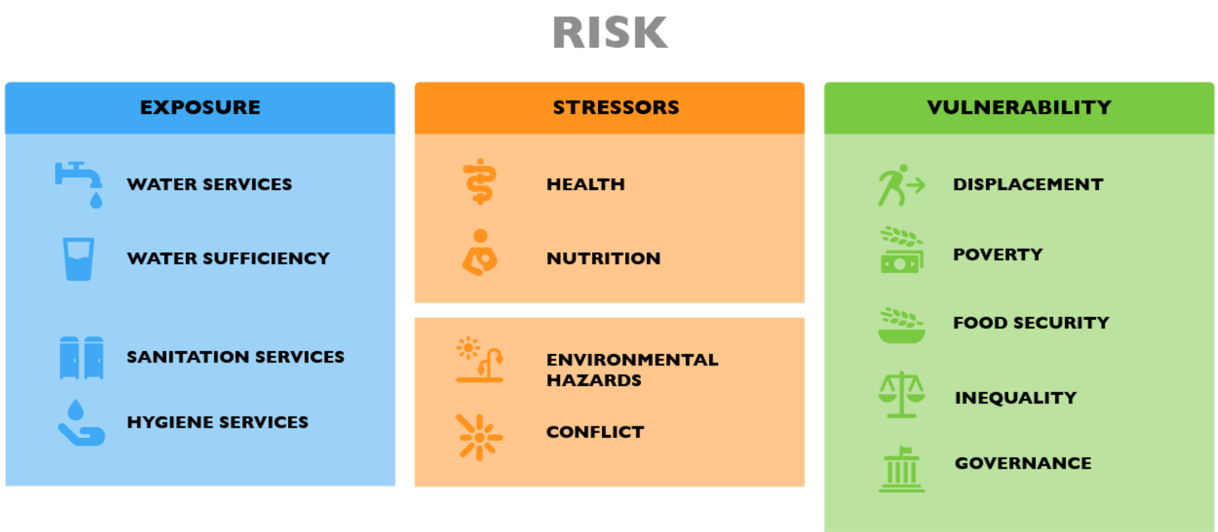


Figure 5: Exposure, Stressors, and Vulnerability Themes of WIA

Exposure (dimension) = WASH (theme).

The WIA uses data on the ratio of population without access to a minimum level of WASH services to estimate the population exposed in a given area, based on the JMP indicators describe above. Exposure is expressed in the percentage of the population in a given area who are exposed based on lack of access to WASH services.

Hazard (dimension) = Stressors - Health (theme) and Stressors - Environment (theme)

Only WASH-related hazards are considered in the framework, including hazards that may impact the delivery of WASH services; or those that may be mediated by utilization of improved WASH services (Table 2). WASH Program activities may address exposure to hazards (for example, by providing WASH services, or by strengthening the systems that underpin these services).

Vulnerabilities (dimension) = Vulnerability - Context (theme)

Similarly to the hazards, vulnerabilities were included that may impact the delivery of WASH services or be mediated by WASH services (Table 1).

Table 1: Environmental Hazards Included and Not Included in the WIA

Hazards that may impact the functionality of WASH services	Hazards where impact is mitigated by improved WASH services
Earthquake	Malnutrition
Drought	Endemic diseases
Flooding	Epidemic diseases
Cyclone / Hurricane	Severe heat
	Conflict

Three dimensions, four themes, and 16 macro-indicators, are shown on the next page in Table 2.

Table 2: Dimensions, Themes, and Macro-indicators of the WIA

Dimensions	Themes	Macro-indicators
Exposure	WASH	Access to water services
		Access to sufficient water
		Access to sanitation services
		Access to hygiene services
Stresssors	Health	Malnutrition
		Endemic infections
		Epidemic infections
	Environmental	Flooding
		Drought / Heat
		Earthquake / Cylone
		Conflict
Vulnerability	Vulnerabilities	Displacement
		Poverty
		Food insecurity
		Gender
		Governance

2.6 WIA Indicators

During an iterative process with UNICEF and Tufts and Advisory Committee members, indicators were selected for each macro-indicator. The goal of each indicator was to be:

- Available and accessible currently at Admin 1 level worldwide.
- Reliable and using high quality data.
- Related to the Themes and Macro Indicators described above.
- Not composite themselves – the goal was to limit composite indicators in the model to prevent collinearity.

Overall, 58 indicators were selected for inclusion in the WIA pilot testing framework.

2.7 Winnowing the Indicators

Once this list of 58 indicators (within the dimensions, themes, macro-indicators framework) were selected, a process to winnow those indicators was needed. This process included gathering actual data on a maximum set of 58 indicators from the three pilot countries and four data countries.

As part of the overall design process, seven countries were selected as data countries (where international data would be obtained), and three of these countries were also selected to pilot the WIA model with in-person visits (Figure 6). The seven countries were Afghanistan, Bangladesh, Kenya, Syria, and Lebanon, Mali, and South Sudan. The in-person countries were selected because of their representativeness across humanitarian and development contexts, and the strength of, and interest in the WIA, of the country staff, being Lebanon, Mali, and Kenya. The goal of the site visits was to obtain as many of these remaining indicators as possible, with local data.

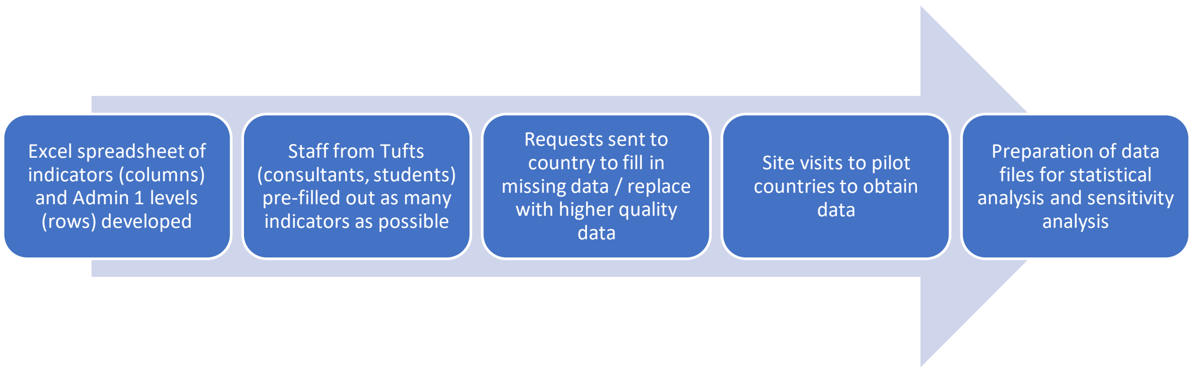


Figure 6: Process for Obtaining Data from Pilot Countries

My involvement in this project entailed the establishment of an initial framework for the model. Recognizing the Sustainable Development Goals (SDGs) as a foundational reference, I extracted a list of relevant indicators from the SDG database. This initial step was critical in setting the direction for the model's development. I then begun the meticulous process of data collection, aiming to gather comprehensive information for each indicator across the first administrative division level for five initial countries: Afghanistan, Kenya, Syria, South Sudan, and Bangladesh. This endeavor involved sifting through various sources, including academic papers, UNICEF reports, and other reliable publications, to compile a preliminary dataset that would be input into the model.

However, it quickly became evident that efficiency and consistency in data sourcing were extremely important. The uneven quality of the initial data sources posed significant challenges in comparability and integration. This prompted a strategic shift towards identifying platforms capable of providing consolidated data sets. My efforts led to the discovery of resources such as the Global Facility for Disaster Reduction and Recovery (GFDRR) for environmental stressor indicators, JMP data for WASH indicators, the Integrated Food Security Phase Classification (IPC) for acute food insecurity, and additional WASH-related data from ReliefWeb. These sources provided comprehensive and administratively detailed data essential for refining the model's accuracy.

Engagement with the Methodological Working Group (MWG) marked a critical phase in the model's development. The MWG, comprising experts from various departments within UNICEF, JMP, and other organizations, played a pivotal role in evaluating and enhancing the model. My participation in these meetings allowed me to observe and integrate feedback directly from field experts, ensuring the model's indicators were not only scientifically sound but also practically relevant. This collaborative process was instrumental in finalizing the indicators and setting a clear trajectory for the project's advancement.

With the model's framework and indicators established, my focus shifted to the application and validation of the model using data from Syria. This phase involved a comparative analysis of globally sourced data and newly acquired "locally available data" from within the target countries. My responsibility was to demonstrate the model's utility in determining WASH insecurity levels and to highlight the disparities between old and new data sets. This analysis not only showed the significance of the model in providing nuanced insights into WASH conditions but also showcased its potential in guiding interventions and policy formulations.

Based on the data gathering pross (at the international and local level) the indicators were reduced from 58 to 42 and 33(34), and the overall model is presented as Figure 8. Reasons for removing each indicator in both the 42 and 33(34) models can be seen in Table 3, Table 4, and Table 5, below. In the end, two models were developed: a 42-indicator model based on winnowing from the statistics only, and a 33(34)-indicator model based on winnowing from the statistics and expert judgement of the Tufts statistics team.

Table 3: Indicators Removed Before Data Gathering

Indicator Number	Indicator Name	Reason to Drop
30	Under five mortality rate (%)	Too general and not WASH specific
31	Evidence of increasing/projected increasing prevalence of endemic micronutrient deficiencies (Vitamin A, Iron, Iodine…) and / or Emergence of cases of micronutrient deficiency diseases (beriberi, pellagra, scurvy, riboflavin)	No data expected from countries on this indicator
32	Evidence of disrupted access and/or utilization of health care services for case management of acute malnutrition	Too subjective
33	Evidence of disruption of routine vaccination services	Too subjective
34	Evidence of disruption / inadequate surveillance system	Too subjective
43	Average Population Affected by Disasters in The Last 5 Years	Not an accurately collected number/ risk of poor quality data
49	Average Population Killed in Conflicts in The Last 5 Years	Not an accurately collected number and likely to be correlated to conflict current

Table 4: Indicators Removed After Data Gathering

Indicator Number	Indicator Name	Reason to Drop
3	% of population taking drinking water from a limited source (defined as: drinking water from an improved source for which collection time exceeds 30 minutes for a roundtrip including queuing)	Collinearity so include as a general rule but do not include in scoring
9	% of population using limited facilities (defined as: use of improved facilities shared between two or more households)	Collinearity so include as a general rule but do not include in scoring
13	% of population with a handwashing facility on premises without soap and water available (defined as a limited facility)	Collinearity so include as a general rule but do not include in scoring
17	Evidence of increasing prevalence / caseload of acute malnutrition in children 6-59m, compared to locally expected levels	Only 1 country able to answer
18	Evidence of increasing/high prevalence estimates of acute malnutrition among pregnant and lactating women (PLW)	No country able to answer
21	Evidence of increasing malaria incidence (all ages), compared to expected levels	No country able to answer
22	Evidence of increasing incidence of NTDs (e.g. specific neglected tropical diseases of local importance), compared to expected levels	No country able to answer

Table 5: Indicators Recommended to Drop by Tufts Statistics Team

Indicator Number	Indicator Name	Reason to Drop
#26	Confirmed acute diarrheal disease outbreak (within the last month)	These are qualitative binary current health hazards, that are difficult to assess (#26), rare (#29), or vague (#27). It is felt risk is adequately captured with other indicators in the model. While they are hazards in the areas of operation, there was no perceived additional risk from these outbreaks that is not captured among the other indicators. Additionally, the data for these indicators was limited during the pilots and the team felt that these indicators would likely not be captured in future due to the unavailable or unreliable country data sources.
#27	Confirmed other outbreak e.g. Hep E, typhoid, Ebola, other (within the last month)	
#29	Confirmed polio outbreak (within the last month)	
#39	Evidence that area is currently affected by potentially damaging and/or life-threatening flooding (within the last month)	These are qualitative binary current environmental hazards, that are already accounted for in the model. While they are hazards in the areas of operation, there was no perceived additional risk from these outbreaks that is not captured among the other indicators. Additionally, the data for these indicators was limited during the pilots and the team felt that these indicators would likely not be captured in future due to the unavailable or unreliable country data sources.
#42	Evidence that population are experiencing increased water scarcity (defined as reduced water availability compared to water demand), compared to expected levels	
#45	Evidence that area is currently experiencing potentially damaging earthquake shaking (within the last month)	
#47	Evidence that area is currently experiencing potentially damaging cyclones/hurricanes/typhoons (within the last month)	
#48	Volatility & Risk Predictability Index (number of events in last 6 months)	This indicator was noted by UNICEF to be "controversial" to measure conflict. Rather, it was preferred to use a binary indicator of if there is local conflict (#49) instead. However, at present we have retained this indicator due to unavailable local data on presence of conflict.
#57	CPIA policies for social inclusion/equity cluster average (1=low to 6=high)	This indicator provided no additional information to the WIA. As it is a national metric, it was superfluous to the WIA calculation, and the team felt that this could be dropped from the list.

2.8 Thresholds

It was determined to use established thresholds for each indicator used in the WIA. For example, when an indicator is selected from inclusion into the WIA, the thresholds used for that indicator will also be used to assign the Risk Score in the WIA. As shown in Figure 7, the percentage of a threshold meeting a quality or higher relates to a threshold score. These scores are used in calculating a macro-indicator's risk level.

Because a risk level of 1-5 is assigned at the level of each indicator, it is not possible for overall WIA risk to be calculated as a multiplicative score. Rather, risk in the WIA is calculated as an average (a sum divided by the number of indicators) across indicators in each macro-indicator section. And then again across each of the theme sections, to realize the WIA score.

Figure 7: Threshold Scoring Method

Threshold	Water % of people with safely managed/basic	Sanitation % of people with safely managed/basic	Hygiene % of people with basic or limited
1	90% or greater	85% of greater	85% of greater
2	80-<90%	70<85%	70<85%
3	70-<80%	55-<70%	55-<70%
4	60-<70%	40-<55%	40-<55%
5	<60%	<40%	<40%

2.9 Calculation/Methodology

Using the data from the three pilot countries, and the four international data countries, a WIA calculation model was completed (in Excel).

- The data for all indicators for the seven countries was collated in a "Data" spreadsheet.
- Each individual indicator is converted to a 1-5 risk scale using the thresholds.
- The WIA Scores are calculated in the "WIA-Scoring-Imputation-42" (and 33(34)) spreadsheets, using the 42 and 33(34) variable models.
    - Indicator thresholds are averaged to create macro-indicator thresholds.
    - Macro-indicator thresholds are weighted at three weighting models determined by the Tufts Statistics team, to create an overall WIA score. In this calculation, three weighting systems were used across the themes (Table 6).

Table 6: Weighting Models Used for Theme to WIA Score (three models)

	WASH	Stressors – Health	Stressors – Environmental	Vulnerabilities
Weighting	40	20	20	20
	60	15	15	10
	70	10	10	10

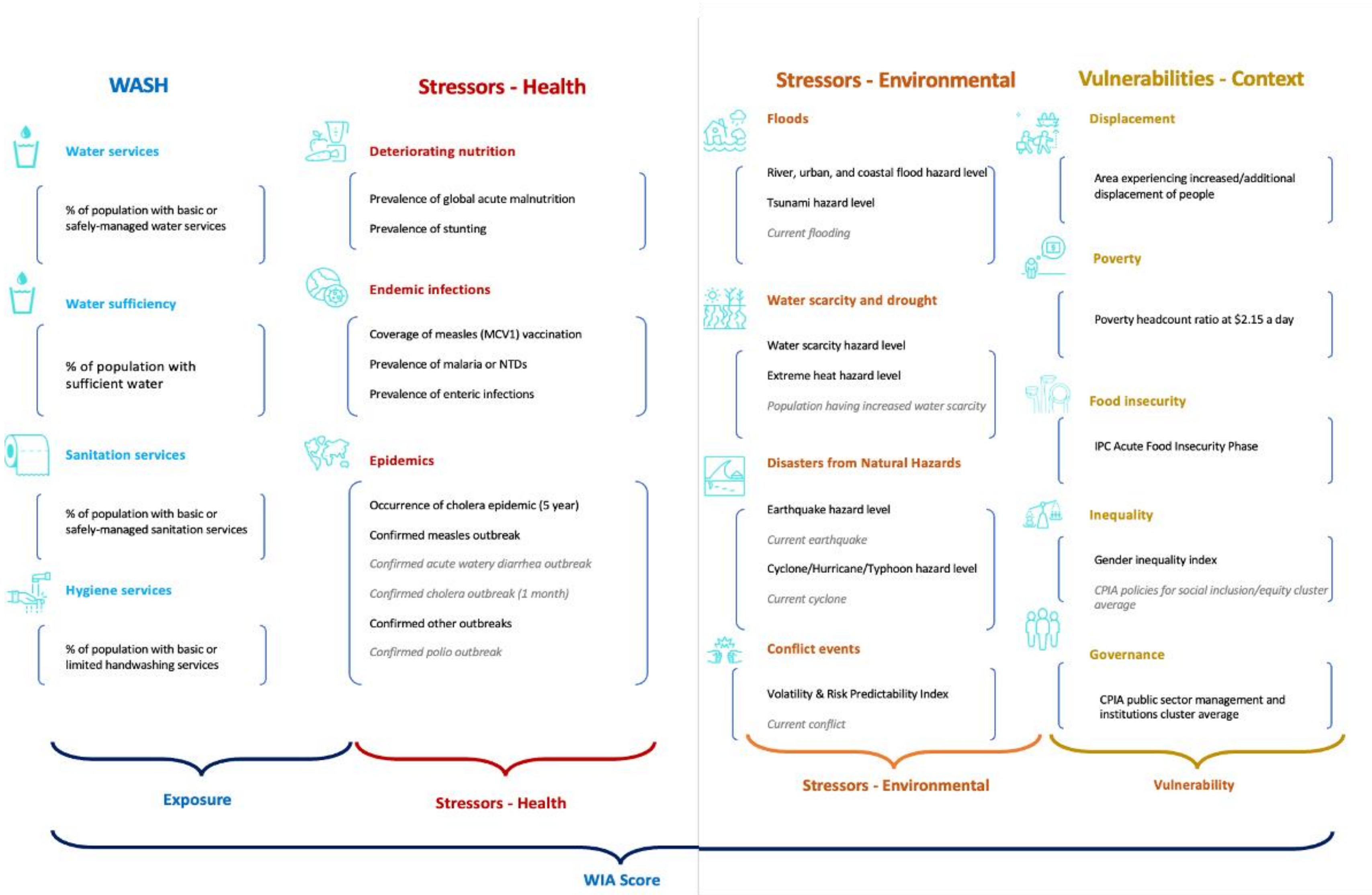


Figure 8: Overall WIA Model Visualization

2.10 Model Results

Thus, for each country, there are six WIA scores calculated, with two different number of indicators and three different weightings.

Overall, the models worked well, demonstrating that results:

- Seem to vary appropriately to experts both within and across countries.
- Show better results and scores in countries with more data and are flattened in countries with less data availability.
- Show incorrect results in countries with poor data availability.
- Show little variability across the different models, with the two indicator sets and three weightings that were used to calculate final results.

These results show that the model as designed is well fit to the data available. Further tuning of the model can be completed after more data – especially at the local level is obtained.

3 WIA Analysis in Syria

3.1 Background on Syria Conflict

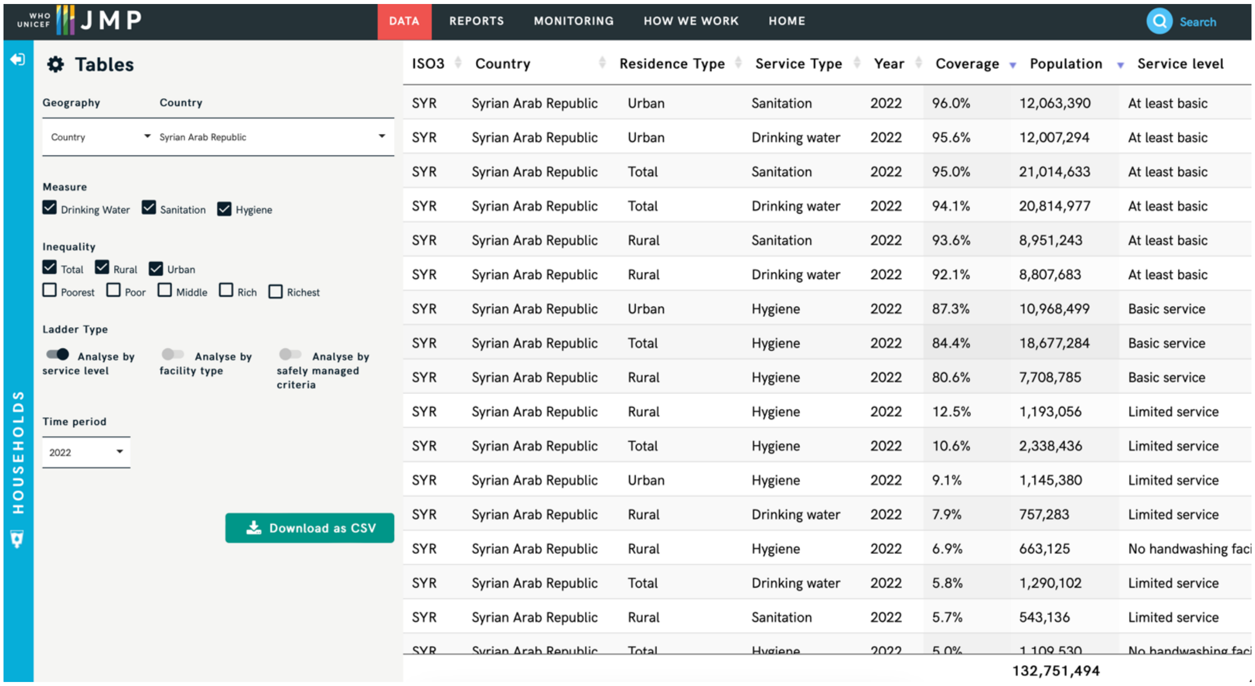
Syria's conflict commencing in 2011 has engendered profound disruptions. Millions have fled to surrounding countries attempting to flee the war (Lamb, Jenny, 2015). In addition, as of 2015, over 10 million Syrians within the country require humanitarian assistance, and 3 million are registered as refugees with the United Nation High Commission of Refugees (Lamb, Jenny, 2015). Recently, Syria has experienced increased turmoil with an earthquake in February of 2023, inflation, and over 50% of Syrians experiencing food insecurity. The Food and Agriculture Organization of the United Nations has noted that over $100 million is required to help Syrians obtain secure food sources (Syrian Arab Republic: Humanitarian Needs and Response Plan 2024.). In addition, continued human rights violations, a worsening water crisis, and military conflict have left the population vulnerable and in desperate need of basis services (Syrian Arab Republic: 2024 Humanitarian Needs Overview).

Urban centers, once symbols of historical continuity and modernity, have been profoundly affected. The ramifications of this conflict affect people greatly, particularly in the WASH sector. Specifically, Aleppo, a region in northern Syria experiences the greatest WASH difficulties, with 91% of residents unable to access the public water network, and many spending high percentages of their income to purchase unsafe water for consumption (Saghir, Abdullah.). To make matters worse, in 2022, a Cholera outbreak of 132,782 suspected cases occurred in the Syrian governorates of Idlib and Aleppo, with data pointing towards poor WASH conditions as the cause (Hmaideh, Ahmad, et al.).

Before the onset of the conflict in 2011, over 90% of Syrians had access to improved drinking water (Sikder et al., 2018). By 2016 and 2017, the reliance on piped water as the main water source had declined from 22.0% to 15.3% (Sikder, Mustafa, et al., 2018). During such destruction, water infrastructure has been purposely targeted, exacerbating the scarcity of safe water (Haar, Rohini, et al.). This has led to an increase in water-based diseases over time (Tabor, Ruby, et al.). The disruption has led many households to turn to private water trucking networks. While these networks have been effective in providing water, they come at a high cost, with households spending approximately 20% of their income on water (Sikder, Mustafa, et al., 2018). Furthermore, the quality of this water remains uncertain.

3.2 International and Local Data in Syria

The most recent data from the JMP website (the international-available data) was only available for all of Syria (divided by rural and urban, which is not well defined). Admin level 0 data is not accurate enough for WIA analysis, which is why newer data was gathered at Admin level 1. While Admin level 0 data provides a broad overview, Admin level 1 data offers the detailed insights necessary for nuanced analysis and informed decision-making. This granularity is crucial for understanding local conditions, formulating effective policies, and implementing targeted interventions, particularly in diverse and complex countries like Syria. An example of Admin level 0 data can be seen below in Figure 9.



ISO3	Country	Residence Type	Service Type	Year	Coverage	Population	Service level
SYR	Syrian Arab Republic	Urban	Sanitation	2022	96.0%	12,063,390	At least basic
SYR	Syrian Arab Republic	Urban	Drinking water	2022	95.6%	12,007,294	At least basic
SYR	Syrian Arab Republic	Total	Sanitation	2022	95.0%	21,014,633	At least basic
SYR	Syrian Arab Republic	Total	Drinking water	2022	94.1%	20,814,977	At least basic
SYR	Syrian Arab Republic	Rural	Sanitation	2022	93.6%	8,951,243	At least basic
SYR	Syrian Arab Republic	Rural	Drinking water	2022	92.1%	8,807,683	At least basic
SYR	Syrian Arab Republic	Urban	Hygiene	2022	87.3%	10,968,499	Basic service
SYR	Syrian Arab Republic	Total	Hygiene	2022	84.4%	18,677,284	Basic service
SYR	Syrian Arab Republic	Rural	Hygiene	2022	80.6%	7,708,785	Basic service
SYR	Syrian Arab Republic	Rural	Hygiene	2022	12.5%	1,193,056	Limited service
SYR	Syrian Arab Republic	Total	Hygiene	2022	10.6%	2,338,436	Limited service
SYR	Syrian Arab Republic	Urban	Hygiene	2022	9.1%	1,145,380	Limited service
SYR	Syrian Arab Republic	Rural	Drinking water	2022	7.9%	757,283	Limited service
SYR	Syrian Arab Republic	Rural	Hygiene	2022	6.9%	663,125	No handwashing faci
SYR	Syrian Arab Republic	Total	Drinking water	2022	5.8%	1,290,102	Limited service
SYR	Syrian Arab Republic	Rural	Sanitation	2022	5.7%	543,136	Limited service
SYR	Syrian Arab Republic	Total	Hygiene	2022	5.0%	1,109,530	No handwashing faci
						132,751,494	

Figure 9: Admin Level 0 Syria Data from JMP

This led to flat WIA scores, as there was no gradation of the WASH indicators across governorates (the Admin 1 unit in Syria). However, the WASH Cluster in Syria (supported by UNICEF) had locally available data. We obtained this data and analyzed it, to make the WIA more specific. The locally-available Syria data proved to be more robust than the data that was readily and internationally- available. It provided 98 columns of data, encompassing all governorates in Syria at the Admin 1 level. These 98 columns ranged from WASH data, household information, geographic location, spending habits, and more.

However, it is imperative to note that the questions asked to participants and categorized throughout the 98 columns do not have a perfect one-to-one equivalent to the described WASH categories. Therefore, some questions' answers had to be combined or multiple questions were used to reference one WIA indicator.

Utilizing the Excel function Pivot Table, multiple responses were filtered and totaled from each question. For example, to total the number of responses in Aleppo that stated a closed well network as their main drinking water source or the total number of responses in Damascus that have both soap and water for handwashing. This dynamic table was used to filter between governorates and count the total number of responses, as well as individual responses for each governorate which was then used to get percentage values for the WIA model.

This process continued for every survey response, with one option taking the number of responses meeting the requirements in a COUNTIFS statement to calculate water insufficiency in each governorate. If it was more convenient to remove only one response and consider all others as a “positive” answer (e.g. multiple types of yes responses to “Did your household spend 2 consecutive days or more without water in the last 30 days?”), the remaining, non-positive number would be taken from the total responses in a governorate. With the total number of responses calculated for each individual indicator in every governorate, the raw totals were converted to percentages over the total number of responses in each governorate. This is because the WIA model utilizes household percentages when interacting with data.

Below, in the sub-sections, please find how I collated data into the water, sanitation, and hygiene WIA Indicators.

3.2.1 Water Category

Starting with water consumption quality, the new Syria data has 7 responses as opposed to the 5 that are included in water micro-indicator, not including the insufficiency measurement. These 7 responses are types of water sources and are described as the following: bottled water, closed well individual water source, closed well network water source, network water source, open water source, springs, and water trucking source.

Open-well water sources are considered unimproved in the WIA model, since they are not covered or protected.

Closed-well network water sources, closed-well individual water sources, natural springs, bottled water, and water trucking are all placed in the basic water source WASH category. The distinction between basic and safely managed water sources is the acquisition times. Because the locally-available Syria data does not indicate how long it takes to acquire water, it is assumed that the network is efficient and takes less than 30 minutes to gather water.

Network water sources are of the highest quality and considered a safely managed water source under the WASH system.

Insufficient water data was pulled directly from 2 separate columns of data from the locally-available Syria source. The questions used in reference here inquire if the individual had sufficient water in the past 30 days or if they experience 2 or more days without water. All responses not indicating sufficient water in 30 days or noting 2 or more days without water were counted as "insufficient water" under the WASH definition. (Drinking water | JMP. (n.d.).)

3.2.2 Sanitation Category

The locally-available Syria data provided 4 survey answers for sanitation quality. Out of these 4 responses, 3 of them were categorized under limited sanitation, and the remainder was categorized as basic. The categories public toilet, shared family, and communal toilet were categories as limited sanitation facilities. This is because shared sanitization facilities cannot be categorized higher than limited, no matter the quality of the facility itself. In addition, there is no quality data describing how good or poor the facilities are and therefore lack sufficient data to comfortably assign them below limited. (Sanitation | JMP. (n.d.).)

The remaining category from the locally-available Syria data are lavatories that are not shared with other households. In contrast to the previously mentioned facilities, individual household facilities are assumed to be of good quality and are placed under basic with these assumptions. (Sanitation | JMP. (n.d.).)

3.2.3 Hygiene Category

The locally-available Syria data has 5 categories that comfortably fit within WASH's 3 categories. The locally-available Syria data categories are, 1. No handwashing facility, 2. Facilities without water and soap, 3. Facilities with only water, 4. Facilities with only soap, and 5. Handwashing facilities with both water and soap. No handwashing facility links up with WASH's definition of no hygiene facilities. (Hygiene | JMP. (n.d.).)

Furthermore, facilities without adequate soap and/or water line up with WASH's definition of limited facilities and are categorized as such on the WIA model. Handwashing facilities with both soap and water fall under WASH's basic hygiene definition. (Hygiene | JMP. (n.d.).)

3.3 WIA Scoring

Once adequately connected to WASH definitions, the locally-available Syria data was organized by governorate and categorized by response totals. Each governorate had a different number or responses. The highest response region, Aleppo, provided 3,971 responses to each question, while the lowest response region, Damascus, provided 96 responses. The response total was converted to percentages relative to the total responses in each region.

After being placed under the internationally-available Syria data on sheet 1(data) of the WIA model, the data was used to calculate thresholds of each region for each WASH category, drinking water quality, sanitation, and hygiene.

3.4 Comparison of Two Syria Data Sets

Comparing the threshold scores between the two sets of WASH Syria data, the internationally available, and more “birds-eye-view" data received a high rating of 1 for all governorates in terms of basic drinking water. This means that every governorate has 90% of its population consuming safely managed water. However, every data point for each governorate is the exact same, as the data is admin level 0; data which encompasses an entire country, as opposed to a governorate, state, or province. Here, the data being used is outdated country-level data for drinking water safety. In contrast, the 2022 locally-available Syria data all received a low score of 5 on the WIA Scoring sheet. This is because the more detailed data is largely categorized under “limited” or “unimproved” which are just below basic drinking water safety.

As for drinking water sufficiency threshold scores, the internationally-available Syria data did not have any data regarding this measurement, and therefore does not have an assigned threshold rating. The locally-available Syria data obtains a range of threshold ratings ranging from 1 to 5, thanks to the detailed governorate data provided.

For sanitation threshold scores, the more general, internationally-available Syria data received a score of 5 throughout all 14 governorates, for the same reason as previous, being that the data is country wide. The locally-available gathered data for Syria has large differences, with some governorates having the vast majority (90%+) of respondents reporting safely managed sanitation services, while other governorates have the same percentage of respondents reporting limited sanitation services. For this reason, the threshold ratings are mostly a high grade of 1.

Hygiene, the final WASH category, has surprisingly similar threshold grades for both Syria data sets. Although the internationally-available Syria data is admin level 0, hygiene quality levels are still very high with a threshold grade of 1. Locally-available Syria data depicts a more distressing story, with all governorates receiving a rating of 5.0, showing that hygiene quality is insufficient throughout the country.

Utilizing the 42-indicator and 34(33)-indicator model, the top set of WIA scores for the 4 themes comes from the international data set, while the lower scores come from the local data in Table 8 and Table 9, respectively. The Stressors-Health, Stressors-Environmental, and Vulnerabilities thresholds do not have any variance in data and therefore depict the same WIA score between the two data sets. The WASH threshold has very different data, which can be seen as the local data scores have greater individuality and variance.

Table 7: Indicator Scoring Color Gradient

Color gradient	Score Range
1.0	1
2.0	1 to 2
3.0	2 to 3
4.0	3 to 4
5.0	4 to 5

Table 8: 42-Indicator WIA Model Syrian Theme Scores from International and Local Data Sources

			Theme	WASH	Stressors - Health	Stressors - Environmental	Vulnerabilities
		Macro-indicator		11 variables	11 variables	14 variables	6 variables
				4 macro-indicators	3 macro-indicators	4 macro-indicators	5 macro-indicators
SYR	Syria	SYR01	Aleppo (U)	2.2	3.5	3.8	2.3
SYR	Syria	SYR02	Damascus (U)	2.2	3.5	3.6	2.3
SYR	Syria	SYR03	Daraa (U)	2.2	3.5	2.9	2.3
SYR	Syria	SYR04	Deir ez-Zor (R)	2.2	3.5	3.1	2.3
SYR	Syria	SYR05	Hama (U)	2.2	3.5	3.1	2.3
SYR	Syria	SYR06	Al-Hasakah (R)	2.2	3.5	3.1	2.3
SYR	Syria	SYR07	Homs (R)	2.2	3.5	2.9	2.3
SYR	Syria	SYR08	Idlib (U)	2.2	3.5	2.8	2.3
SYR	Syria	SYR09	Latakia (U)	2.2	3.5	3.1	2.3
SYR	Syria	SYR10	Quneitra (R)	2.2	3.5	2.6	2.3
SYR	Syria	SYR11	Raqqa (R)	2.2	3.5	3.1	2.3
SYR	Syria	SYR12	Rif Dimashq (U)	2.2	3.5	3.1	2.3
SYR	Syria	SYR13	As-Suwayda (R)	2.2	3.5	2.4	2.3
SYR	Syria	SYR14	Tartus (U)	2.2	3.5	3.7	2.3
Local_SYR	Syria	SYR01	Aleppo (U)	5.0	3.5	3.8	2.3
Local_SYR	Syria	SYR02	Damascus (U)	5.0	3.5	3.6	2.3
Local_SYR	Syria	SYR03	Daraa (U)	5.0	3.5	2.9	2.3
Local_SYR	Syria	SYR04	Deir ez-Zor (R)	5.0	3.5	3.1	2.3
Local_SYR	Syria	SYR05	Hama (U)	5.0	3.5	3.1	2.3
Local_SYR	Syria	SYR06	Al-Hasakah (R)	5.0	3.5	3.1	2.3
Local_SYR	Syria	SYR07	Homs (R)	5.0	3.5	2.9	2.3
Local_SYR	Syria	SYR08	Idlib (U)	5.0	3.5	2.8	2.3
Local_SYR	Syria	SYR09	Latakia (U)	5.0	3.5	3.1	2.3
Local_SYR	Syria	SYR10	Quneitra (R)	5.0	3.5	2.6	2.3
Local_SYR	Syria	SYR11	Raqqa (R)	5.0	3.5	3.1	2.3
Local_SYR	Syria	SYR12	Rif Dimashq (U)	5.0	3.5	3.1	2.3
Local_SYR	Syria	SYR13	As-Suwayda (R)	5.0	3.5	2.4	2.3
Local_SYR	Syria	SYR14	Tartus (U)	5.0	3.5	3.7	2.3

Table 9: 34(33)-Indicator Syrian Theme Scores from International and Local Data Sources

		Theme		WASH	Stressors - Health	Stressors - Environmental	Vulnerabilities
	Macro-indicator			11 variables	8 variables	10 variables	5 variables
				4 macro-indicators	3 macro-indicators	4 macro-indicators	5 macro-indicators
SYR	Syria	SYR01	Aleppo (U)	2.0	3.5	3.8	2.3
SYR	Syria	SYR02	Damascus (U)	2.0	3.5	3.6	2.3
SYR	Syria	SYR03	Daraa (U)	2.0	3.5	2.9	2.3
SYR	Syria	SYR04	Deir ez-Zor (R)	2.0	3.5	3.1	2.3
SYR	Syria	SYR05	Hama (U)	2.0	3.5	3.1	2.3
SYR	Syria	SYR06	Al-Hasakah (R)	2.0	3.5	3.1	2.3
SYR	Syria	SYR07	Homs (R)	2.0	3.5	2.9	2.3
SYR	Syria	SYR08	Idlib (U)	2.0	3.5	2.8	2.3
SYR	Syria	SYR09	Latakia (U)	2.0	3.5	3.1	2.3
SYR	Syria	SYR10	Quneitra (R)	2.0	3.5	2.6	2.3
SYR	Syria	SYR11	Raqqa (R)	2.0	3.5	3.1	2.3
SYR	Syria	SYR12	Rif Dimashq (U)	2.0	3.5	3.0	2.3
SYR	Syria	SYR13	As-Suwayda (R)	2.0	3.5	2.4	2.3
SYR	Syria	SYR14	Tartus (U)	2.0	3.5	3.7	2.3
Local_SYR	Syria	SYR01	Aleppo (U)	4.0	3.5	3.8	2.3
Local_SYR	Syria	SYR02	Damascus (U)	4.0	3.5	3.6	2.3
Local_SYR	Syria	SYR03	Daraa (U)	4.0	3.5	2.9	2.3
Local_SYR	Syria	SYR04	Deir ez-Zor (R)	4.0	3.5	3.1	2.3
Local_SYR	Syria	SYR05	Hama (U)	4.0	3.5	3.1	2.3
Local_SYR	Syria	SYR06	Al-Hasakah (R)	4.0	3.5	3.1	2.3
Local_SYR	Syria	SYR07	Homs (R)	4.0	3.5	2.9	2.3
Local_SYR	Syria	SYR08	Idlib (U)	4.0	3.5	2.8	2.3
Local_SYR	Syria	SYR09	Latakia (U)	4.0	3.5	3.1	2.3
Local_SYR	Syria	SYR10	Quneitra (R)	4.0	3.5	2.6	2.3
Local_SYR	Syria	SYR11	Raqqa (R)	4.0	3.5	3.1	2.3
Local_SYR	Syria	SYR12	Rif Dimashq (U)	4.0	3.5	3.0	2.3
Local_SYR	Syria	SYR13	As-Suwayda (R)	4.0	3.5	2.4	2.3
Local_SYR	Syria	SYR14	Tartus (U)	4.0	3.5	3.7	2.3

The same pattern of local data being more refined is seen with the final WIA model, using the three-weightings used to generate the final score (Table 10 and Table 11). As the weighting further emphasizes the WASH theme score over others, the local Syria data receives lower, more concerning WIA scores, in both 42-indicator and 33(34)-indicator models. In contrast, the admin level 0 international Syria data is more even throughout all weightings, with slight fluctuations. The reason that the local Syria data receives better scores in the 33(34)-indicator model is because the removed indicators under the two stressors and risk themes negatively impacted the scoring in the 42-indicator model. With these poor scores removed, the final WIA score improves slightly. In both WIA scoring systems, emphasis on the weighting of WASH data results in a worse score. This indicates that the WASH theme has a significantly worse result than the other three themes

Table 10: 42-Indicator WIA Model Scores, across 3 weightings, International and Local Data Sources

		Theme		WIA Score	WIA Score	WIA Score
	Macro-indicator			40/20/20/20	60/15/15/10	70/10/10/10
SYR	Syria	SYR01	Aleppo (U)	2.8	2.0	2.5
SYR	Syria	SYR02	Damascus (U)	2.8	2.0	2.5
SYR	Syria	SYR03	Daraa (U)	2.6	1.9	2.4
SYR	Syria	SYR04	Deir ez-Zor (R)	2.7	2.0	2.4
SYR	Syria	SYR05	Hama (U)	2.7	2.0	2.4
SYR	Syria	SYR06	Al-Hasakah (R)	2.7	2.0	2.4
SYR	Syria	SYR07	Homs (R)	2.6	1.9	2.4
SYR	Syria	SYR08	Idlib (U)	2.6	1.9	2.4
SYR	Syria	SYR09	Latakia (U)	2.7	2.0	2.4
SYR	Syria	SYR10	Quneitra (R)	2.6	1.9	2.4
SYR	Syria	SYR11	Raqqa (R)	2.7	2.0	2.4
SYR	Syria	SYR12	Rif Dimashq (U)	2.7	2.0	2.4
SYR	Syria	SYR13	As-Suwayda (R)	2.5	1.9	2.4
SYR	Syria	SYR14	Tartus (U)	2.8	2.0	2.5
Local_SYR	Syria	SYR01	Aleppo (U)	3.9	3.7	4.5
Local_SYR	Syria	SYR02	Damascus (U)	3.9	3.6	4.4
Local_SYR	Syria	SYR03	Daraa (U)	3.8	3.6	4.4
Local_SYR	Syria	SYR04	Deir ez-Zor (R)	3.8	3.6	4.4
Local_SYR	Syria	SYR05	Hama (U)	3.8	3.6	4.4
Local_SYR	Syria	SYR06	Al-Hasakah (R)	3.8	3.6	4.4
Local_SYR	Syria	SYR07	Homs (R)	3.8	3.6	4.4
Local_SYR	Syria	SYR08	Idlib (U)	3.7	3.6	4.4
Local_SYR	Syria	SYR09	Latakia (U)	3.8	3.6	4.4
Local_SYR	Syria	SYR10	Quneitra (R)	3.7	3.6	4.3
Local_SYR	Syria	SYR11	Raqqa (R)	3.8	3.6	4.4
Local_SYR	Syria	SYR12	Rif Dimashq (U)	3.8	3.6	4.4
Local_SYR	Syria	SYR13	As-Suwayda (R)	3.6	3.6	4.3
Local_SYR	Syria	SYR14	Tartus (U)	3.9	3.7	4.5

Table 11: 34(33)-Indicator WIA Model Scores, across 3 weightings, International and Local Data Sources

		Theme		WIA Score	WIA Score	WIA Score
	Macro-indicator			40/20/20/20	60/15/15/10	70/10/10/10
SYR	Syria	SYR01	Aleppo (U)	2.7	1.9	2.4
SYR	Syria	SYR02	Damascus (U)	2.7	1.8	2.3
SYR	Syria	SYR03	Daraa (U)	2.6	1.8	2.3
SYR	Syria	SYR04	Deir ez-Zor (R)	2.6	1.8	2.3
SYR	Syria	SYR05	Hama (U)	2.6	1.8	2.3
SYR	Syria	SYR06	Al-Hasakah (R)	2.6	1.8	2.3
SYR	Syria	SYR07	Homs (R)	2.6	1.8	2.3
SYR	Syria	SYR08	Idlib (U)	2.5	1.8	2.3
SYR	Syria	SYR09	Latakia (U)	2.6	1.8	2.3
SYR	Syria	SYR10	Quneitra (R)	2.5	1.8	2.2
SYR	Syria	SYR11	Raqqa (R)	2.6	1.8	2.3
SYR	Syria	SYR12	Rif Dimashq (U)	2.6	1.8	2.3
SYR	Syria	SYR13	As-Suwayda (R)	2.4	1.8	2.2
SYR	Syria	SYR14	Tartus (U)	2.7	1.9	2.4
Local_SYR	Syria	SYR01	Aleppo (U)	3.5	3.1	3.8
Local_SYR	Syria	SYR02	Damascus (U)	3.5	3.0	3.7
Local_SYR	Syria	SYR03	Daraa (U)	3.4	3.0	3.7
Local_SYR	Syria	SYR04	Deir ez-Zor (R)	3.4	3.0	3.7
Local_SYR	Syria	SYR05	Hama (U)	3.4	3.0	3.7
Local_SYR	Syria	SYR06	Al-Hasakah (R)	3.4	3.0	3.7
Local_SYR	Syria	SYR07	Homs (R)	3.4	3.0	3.7
Local_SYR	Syria	SYR08	Idlib (U)	3.3	3.0	3.7
Local_SYR	Syria	SYR09	Latakia (U)	3.4	3.0	3.7
Local_SYR	Syria	SYR10	Quneitra (R)	3.3	3.0	3.6
Local_SYR	Syria	SYR11	Raqqa (R)	3.4	3.0	3.7
Local_SYR	Syria	SYR12	Rif Dimashq (U)	3.4	3.0	3.7
Local_SYR	Syria	SYR13	As-Suwayda (R)	3.2	3.0	3.6
Local_SYR	Syria	SYR14	Tartus (U)	3.5	3.1	3.8

This is also seen in GIS images, with the locally-available data more refined and granular than the international data (Figure 10 and Figure 11). Three maps under three weighting system for WIA internationally-available scores depict the scores on a color scale attached to each Syrian province. Using the older, data, the Syrian maps are homogenous across all three weighting styles. This fails to show the different challenges each region faces. Similarly to what was shown in Tables 7 and 8, Figures 9 and 10 show the stark contrast between the internationally-available admin 0 data and the local admin 1 data.

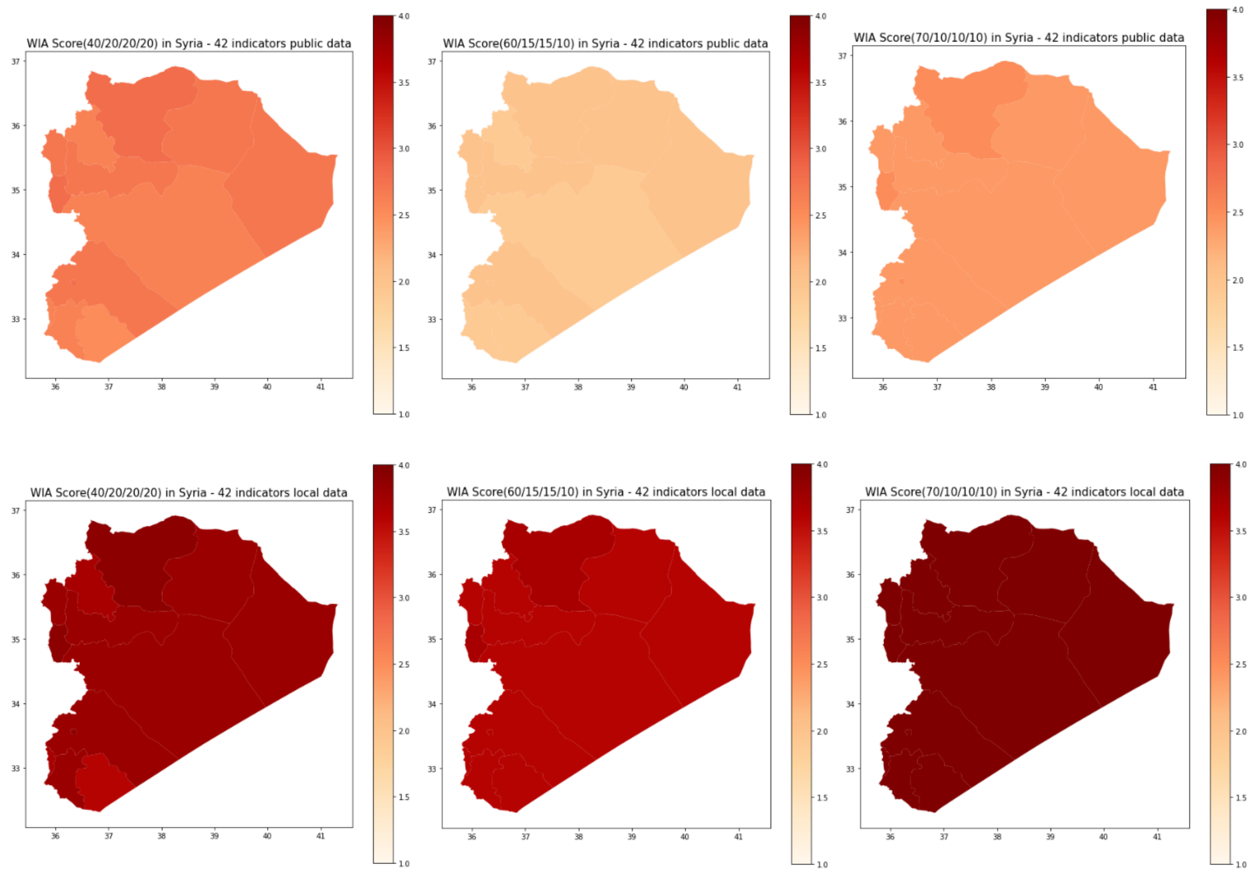


Figure 10: 42-Indicator WIA Scores (with three weightings) comparing International-level data (top) to locally-available data

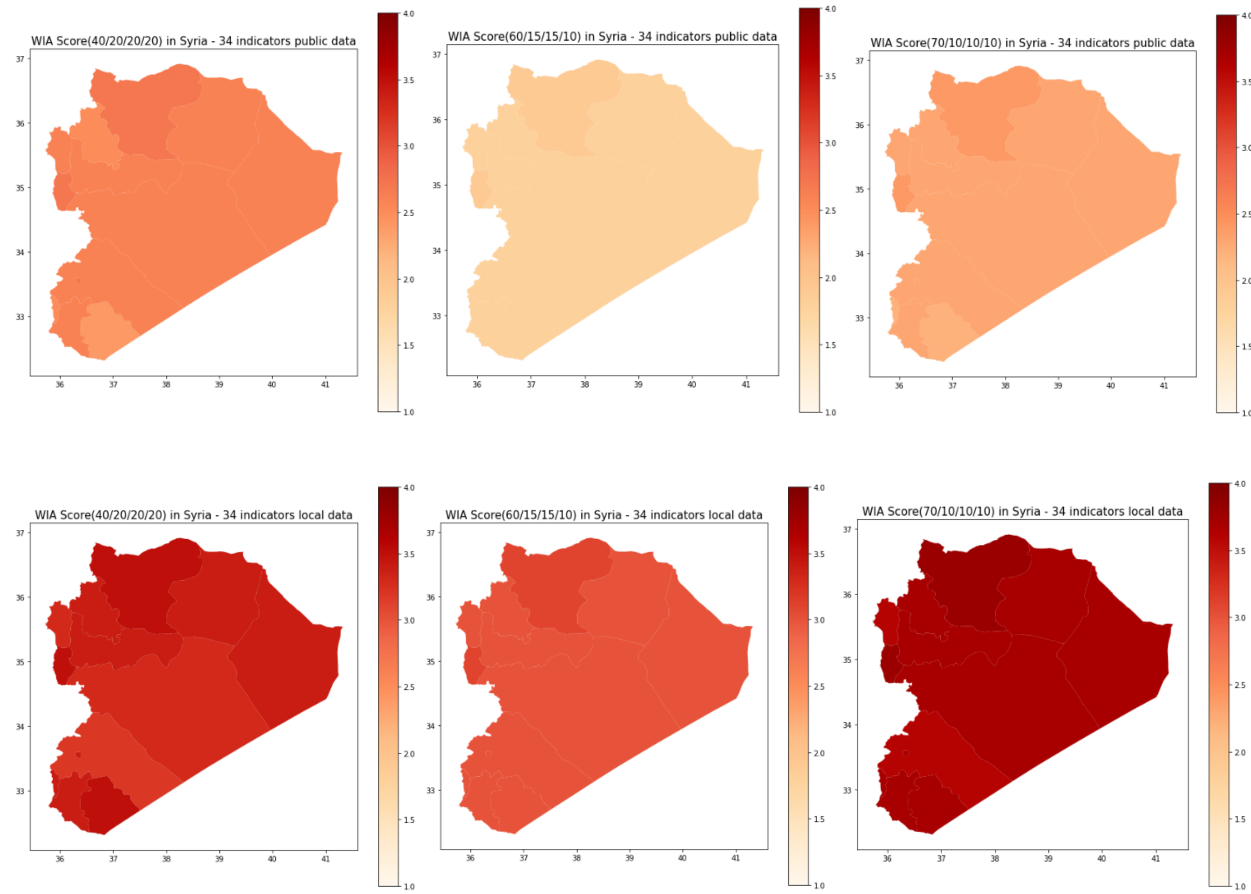


Figure 11: 34(33)-Indicator WIA Scores (with three weightings) comparing International-level data (top) to locally available data

Comparing the locally available Syria data between the two indicator models, the WASH indicators are the only unaffected, with the other three indicator categories having noticeable differences. With these changes from 42 indicators to 33(34) indicators, all WIA grades have a higher rating (a lower number) than previously mentioned. In contrast to a range of 3.6 to 3.9 on the 42-indicator sheet, the 33(34) indicator WIA measurement has a better rating for the locally available Syria data, with a range of 3.2 to 3.5. The second WIA measurement shows similar results, with the 33(34)-indicator having slight variation, ranging from 3.0 to 3.1. The last WIA measurement, with the greatest emphasis on WASH, ranges from 3.6 to 3.8 on the 33(34)-indicator sheet. Comparing across the Figures 9 and 10, it is evident that the difference between the 42 and 33(34) indicator models is that the 33(34) have a slightly better WIA score. Still, the poor WASH scores in the local data bring the overall WIA score down significantly.

Through the comparison of both data sets in Syria, it was evident that the locally available data was more useful in terms of detail, quality, and time of research. Being limited to Admin 0 level data which is over a decade old proved to be inefficient in judging the state of WASH quality in each Syrian governate. The admin 0 level, internationally available data, while painting a more positive picture of Syria's current predicament, is outdated and extremely general. The governorate-specific, detailed Admin 1 level data shows the dire situation Syria is currently in, showing consistently worse measurements throughout all indicator and weight combinations when compared to the admin 0 data. The individually shaded Syrian maps depict this scenario as well, with the internationally-available data being orange hues, while the more recent and detailed local data shows Syria engulfed in a dark red.

4 Conclusion

In this thesis, I applied the WASH Insecurity Analysis (WIA) model to the context of Syria, a country deeply scarred by conflict which exerted a profound impact on the water, sanitation, and hygiene sector. The main findings from this study underscore a significant variance in WASH-related risks across different Syrian governorates, as highlighted by the more recent and detailed locally available data. This data, contrasted with older, internationally available information, paints a vivid picture of the deteriorating WASH situation in Syria, with many areas exhibiting high WIA scores indicating severe insecurity.

The significance of this work lies in its potential to guide targeted interventions in Syria's WASH sector. By offering a granular view of the WASH landscape, the model facilitates informed decision-making, enabling stakeholders to prioritize resources and efforts in areas most in need. This research contributes to a nuanced understanding of water and sanitation insecurity in a conflict-ridden setting, offering a critical tool for humanitarian and development agencies operating in such challenging environments.

Moreover, the real-world applications of these findings are substantial. The detailed WIA scores, especially those derived from the 33(34)-indicator set, offer a more optimistic yet still cautious view of the situation, suggesting potential areas of intervention. By focusing on specific governorates with higher WIA scores, policymakers, and aid organizations can develop more effective strategies to mitigate WASH-related risks, thereby significantly impacting the health and well-being of the Syrian population.

For governments and policymakers, this research offers data-driven insights to inform policies and allocate resources effectively. It underscores the need for strategies that not only improve WASH infrastructure but also consider the social dynamics, including gender-specific needs and the rights of vulnerable populations. International organizations and NGOs can leverage these findings to advocate for human rights and gender equity, using the data to highlight the disproportionate impact of WASH insecurity on women and girls. This advocacy is vital in raising public awareness and garnering support for initiatives aimed at improving WASH conditions in conflict zones. With proper awareness and readily available data, WASH infrastructure rebuilding can be properly planned for, despite the politicization of necessities and disease outbreaks (Tarnas, M.C.). Water resource management has already been known as difficult to perform in Syria with poor data, even for precipitation data in the Barada Basin (Alsilibe, F.). Cholera outbreaks and an estimated 12 million people in need of drinking water in Syria acutely show the need for accurate, up-to-date data so that detailed plans can be executed (Eneh, S. C). Moreover, this research calls for increased public awareness and advocacy. Educating the public about the critical link between WASH, human rights, and gender equity is essential in building a collective consciousness that supports and sustains efforts in these areas. Public awareness campaigns, informed by this research, can amplify the message, encouraging broader community involvement and support.

Looking ahead, there are several avenues for further enhancing this research. One key area involves refining the WIA model to account for rapid changes in conflict situations, ensuring the data remains current and relevant. Expanding the data sources to include more recent and comprehensive information could also provide a more accurate picture of the WASH sector in Syria. Additionally, exploring different scenarios through the model, such as the impact of potential infrastructure development or the consequences of prolonged conflict, could offer valuable insights for future planning and response strategies.

In conclusion, this research not only contributes to the critical field of WASH security in conflict zones but also stands as a testament to the potential of data-driven models. The application of the

WIA model in Syria serves as an important step in addressing the complex challenges of WASH insecurity, highlighting the need for continued efforts and innovation in this domain. However, the path forward requires a concerted effort from all stakeholders. This collaborative approach is fundamental in advocating for sustainable, equitable, and rights-based WASH services, which are integral to the health, dignity, and overall well-being of communities. As this research shows, the challenges are substantial, but the opportunities for positive change, driven by informed, collaborative efforts, are even greater. The findings and methodologies presented herein offer a framework that can be adapted and applied to other conflict-affected regions, reinforcing the importance of such research in the global pursuit of sustainable and equitable access to water and sanitation.

5 Recommendations for Future Development

As the WIA model in this thesis uses outdated data for the non-WASH data points, I would really like to see and play around with a full, detailed dataset and see how it changes WIA scoring. Currently, we can see through the local Syria data that Syria is doing poorly in terms of safe drinking water, hygiene, and sanitation. However, the sufficiency of water is quite good throughout the country. At the very best, scoring 1s in all categories, the local Syria WIA scores range from 2.3 to 1.2 throughout all weights. In addition, having access to the other 3 macro-indicator sets of data would provide insight into whether the WIA model held any bias towards a specific area, and if so, how it can be adjusted. In addition, adding some of the previously removed indicators would allow for more nuance and perhaps more accurate WIA scoring of countries and regions. However, securing reliable, unbiased data on the removed indicators has already proven to be difficult. Researching other possible missed indicators and adding them to the model may also be a future path for development.

Currently, the Syria data must be formatted into percentages to work with the WIA model. This means that the local Syria data provided had to manually be manipulated to determine the total number of responses to each question, as well as the percentage of responses for each answer. Once that task was completed, the data was organized by governorate rows and indicator columns in the Excel tab titled “1. Data ->”. This data tab was then fed into the next tab, “2. Thresholds ->”, where the results were filtered into threshold scores as previously described in Figure 7. The scores were shown on this second tab organized by governorate and macro-indicator threshold score. These scores were then transferred to two tabs, for 42 and 33(34) indicators respectively. On those same tabs, the macro-indicator threshold scores were then averaged under each theme. The theme scores were then weighted at three ratios, as seen in Table 6.

As for next steps of development, the WIA model would benefit from being used with data from the other countries originally mentioned in this article in both modern and historical settings. I think it would be beneficial to see the accuracy and shortcomings of the WIA model by comparing results with data that is known to be showing various levels of concern, a.k.a. easily definable threshold and WIA scores. The countries used to further test the model should also be under different situations and reasons for WASH struggles. In addition, testing each macro-indicator against other data points that do not change, such as in this thesis where WASH data was compared while stressors and vulnerabilities data were not changed, would add further insight on the validity of the WIA model. Once issues are identified and fixed, the improved WIA model may prove to be useful in identifying various issues countries face at an admin 1 level.

Another possible road would be to see if even more detailed data, e.g. at admin level 2, would be possible to input into the WIA model. Obviously, the more precise the data the more specific assistance and be provided to vulnerable populations. Comparison between admin 0, 1, and 2 data within the same country would be interesting to analyze. It is currently assumed that more granular data would be the most helpful in determining next steps, but does the outcome of admin level 2 analysis outweigh the effort it takes to obtain the data? Finally, it would be intriguing to see how theoretical planning would differ based on different admin-level WIA scores, perhaps in a blind comparison where the two or three parties are unaware of other data.

Future users of the WIA model are researchers, members of international assistance groups such as UNICEF, and governments that wish to pinpoint geographic locations and indicators that need to be addressed. The WIA model provides key information that enables parties to mobilize assistance efforts in specific geographic areas suffering specific issues. It is a powerful tool that can improve planning and execution. I am very excited to see how the WIA model evolves and is implemented internationally to help populations in need.

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