# Research Methodology Note

## Area of Knowledge Severity Index (AoK SI) Guidance Note

## Global

**February 2025**
**v1**

REACH Informing more effective humanitarian action

## 1. Executive Summary

| | | | | | | |
|---|---|---|---|---|---|---|
| **Country of intervention** | *[Global (Guidance Note): This standard Methodology Note can be used by country teams as a basis for a country-level Methodology Note containing the final methodology as used at country-level, by completing, adjusting or deleting text as relevant and removing unecessay annexes. This global standard version has been pre-validated by IMPACT HQ. Highlighting changes made to this standard version when submitting for review to IMPACT HQ will allow for efficient review and validation.]* | | | | | |
| **Type of Emergency** | x | Natural disaster | X | Conflict | □ | Other *(specify)* |
| **Type of Crisis** | x | Sudden onset | X | Slow onset | X | Protracted |
| **Mandating Body/ Agency** | *N/A* | | | | | |
| **IMPACT Project Code** | *N/A* | | | | | |
| **Overall Research Timeframe** *(from research design to final outputs / M&E)* | *N/A* | | | | | |
| **Research Timeframe** *Add planned deadlines (for first cycle if more than 1)* | 1. Pilot/ training: _ _/_ _/_ _ _ _ | | | 6. Preliminary presentation: _ _/_ _/_ _ _ _ | | |
| | 2. Start collect data: _ _/_ _/_ _ _ _ | | | 7. Outputs sent for validation: _ _/_ _/_ _ _ _ | | |
| | 3. Data collected: _ _/_ _/_ _ _ _ | | | 8. Outputs published: _ _/_ _/_ _ _ _ | | |
| | 4. Data analysed: _ _/_ _/_ _ _ _ | | | 9. Final presentation: _ _/_ _/_ _ _ _ | | |
| | 5. Data sent for validation: _ _/_ _/_ _ _ _ | | | | | |
| **Number of assessments** | □ | Single assessment (one cycle) | | | | |
| | x | Multi assessment (more than one cycle)<br>*[Describe here the frequency of the cycle]* | | | | |
| **Humanitarian milestones** *Specify **what** will the assessment inform and **when** e.g. The shelter cluster will use this data to draft its Revised Flash Appeal;* | **Milestone** | | | **Deadline (can be tentative)** | | |
| | □ | Donor plan/strategy | | _ _/_ _/_ _ _ _ | | |
| | □ | Inter-cluster plan/strategy | | _ _/_ _/_ _ _ _ | | |
| | □ | Cluster plan/strategy | | _ _/_ _/_ _ _ _ | | |
| | □ | NGO platform plan/strategy | | _ _/_ _/_ _ _ _ | | |
| | x | Other (Specify): global development of an internal methodology to provide a standardized and efficient approach to summarising and interpreting AoK data into meaningful & actionable analysis. | | N/A | | |

| | | | | |
|---|---|---|---|---|
| **Audience Type & Dissemination** *Specify **who** will the assessment inform and **how** you will disseminate to inform the audience* | **Audience type** | | **Dissemination** | |
| | □ Strategic<br>□ Programmatic<br>□ Operational<br>x [Other, Specify] producers and users of information based on AoK data | | □ General Product Mailing (e.g. mail to NGO consortium; HCT participants; Donors)<br>□ Cluster Mailing (Education, Shelter and WASH) and presentation of findings at next cluster meeting<br>□ Presentation of findings (e.g. at HCT meeting; Cluster meeting)<br>□ Website Dissemination (Relief Web & REACH Resource Centre)<br>□ [Other, Specify] | |
| **Stakeholder mapping** *Has a detailed stakeholder mapping been conducted during research design to identify all actors that could **contribute** to and/or **benefit from** the research?* | □ | Yes | x | No |
| **General Objective** | The AoK Severity Index (AoK SI) methodology aims to inform emergency (re)prioritization of humanitarian actions and top-level programming decisions in various contexts (including in sudden onset and protracted crises) by providing an indicative estimate of the likely severity of acute humanitarian needs at community (e.g. settlement) and area (e.g. admin 2) level, based on AoK data. The AoK SI aims to do so by providing a standardized and efficient approach to summarising and interpreting AoK data into meaningful & actionable analysis of the severity of acute multisectoral humanitarian needs, including by identifying hotspots of acute need, based on the IMPACT Acute Needs Analytical Framework (ANF) and other sectoral analytical frameworks of reference. It is designed for use in any Research Cycles making use of the AoK methodogy, including single Rapid Needs Assessments (RNAs) and multi-cycle Humantarian Situation Monitoring (HSM). | | | |
| **Specific Objective(s)** | 1. Estimate the multisectoral severity of humanitarian needs in assessed communities (e.g. settlements) and areas (e.g. admin 2) as reported by key informants (KIs) sampled and interviewed through the AoK methodology, based on the ANF and other sectoral analytical frameworks of reference;<br>2. Identify the reported drivers of acute need (sectors with high severity) in assessed communities across assessed sectors;<br>3. Identify geographic areas with a high concentration of communities reportedly experiencing severe needs (hotspot identification), including across administrative or other divisions.<br>4. Identify trends in the severity of reported needs within assessed communities across time (when used for multiple rounds of monitoring) | | | |
| **Research Questions** | 1. What is the multisectoral severity of acute humanitarian needs in assessed communities (e.g. settlements) as reported by sampled key informants (KIs), based on the ANF and other sectoral analytical frameworks of reference? | | | |

| | |
|---|---|
| | 2. What are the reported drivers of need (sectors with high severity) and barriers to accessing basic needs and services in assessed communities across assessed sectors?<br>3. Which are the geographic areas with a high concentration of communities reportedly experiencing severe needs?<br>4. What are the trends in the severity of reported needs within assessed communities across time (if multiple rounds of data are available)?<br>5. Which sectoral needs are co-occurring? |
| **Geographic Coverage** | *N/A* |
| **Secondary data sources** | *N/A* |

| | | | | |
|---|---|---|---|---|
| **Population(s)**<br>*Select all that apply* | □ | IDPs in camp | □ | IDPs in informal sites |
| | □ | IDPs in host communities | □ | IDPs [Other, Specify] |
| | □ | Refugees in camp | □ | Refugees in informal sites |
| | □ | Refugees in host communities | □ | Refugees [Other, Specify] |
| | □ | Host communities | X | [Other, Specify]: any population assessed through the AoK methodology |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Stratification**<br>*Select type(s) and enter number of strata* | x | Geographical #:_ _ _<br>Population size per strata is known? □ Yes □ No | □ | Group #: _ _ _<br>Population size per strata is known?<br>□ Yes □ No | □ | *[Other Specify]* #: _ _<br>Population size per strata is known?<br>□ Yes □ No |

| | | | | |
|---|---|---|---|---|
| **Data collection tool(s)** | x | Structured (Quantitative) | □ | Semi-structured (Qualitative) |

| | **Sampling method** | **Data collection method** |
|---|---|---|
| **Structured data collection tool # 1**<br>*Select sampling and data collection method and specify target # interviews* | x Purposive<br>□ Probability / Simple random<br>□ Probability / Stratified simple random<br>□ Probability / Cluster sampling<br>□ Probability / Stratified cluster sampling<br>□ [Other, Specify] | x Key informant interview (Target #):_ _ _ _ _<br>□ Group discussion (Target #):_ _ _ _ _<br>□ Household interview (Target #):_ _ _ _ _<br>□ Individual interview (Target #):_ _ _ _ _<br>□ Direct observations (Target #):_ _ _ _ _<br>□ [Other, Specify] (Target #):_ _ _ _ _ |

| | | | | |
|---|---|---|---|---|
| **Disaggregation by gender and age**<br>*Are you planning to conduct sex/age disaggregated analysis?* | Gender | | Age | |
| | □ | Yes (*the methodology allows for potentially filtering results by KI gender – tick Yes if implemented, keeping in mind this is indicative only*) | □ | Yes |
| | □ | No | x | No |
| **Data management platform(s)** | x | IMPACT | □ | UNHCR |
| | □ | [Other, Specify] | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Expected ouput type(s)** | □ | Situation overview #: _ _ | □ | Report #: _ _ | □ | Profile #: _ _ |
| | □ | Presentation (Preliminary findings) #: _ _ | □ | Presentation (Final) #: _ _ | □ | Factsheet #: _ _ |

| | | | | | | |
|---|---|---|---|---|---|---|
| | □ | Interactive dashboard #:_ | □ | Webmap #: _ _ | X | Map #: _ _ |
| | x | [Other, Specify]: dependent on each case, can include formatted datasets, factsheets, interactive dashboards, etc. | | | | |
| **Access** | □ | Public (available on REACH resource center and other humanitarian platforms) | | | | |
| | X | Restricted (bilateral dissemination only upon agreed dissemination list, no publication on REACH or other platforms) | | | | |
| **Visibility** *Specify which* ***logos*** *should be on outputs* | ***REACH*** *[By default unless specified otherwise]* | | | | | |
| | ***Donor:*** *[List logos here as per contract]* | | | | | |
| | ***Coordination Framework:*** *[List logos here as relevant]* | | | | | |
| | ***Partners:*** *[List logos here if outside coordination framework]* | | | | | |

# 2. Rationale

## 2.1 Background

The present methodology note aims to provide a template and guidance for the calculation of a severity index based on the Area of Knowledge (AoK) methodology.

### The Area of Knowledge methodology: definition

The AoK methodology is an indicative structured (and quantitatively aggregated) community[1] key-informant survey methodology developed by REACH. It aims to produce indicative information on humanitarian needs in restrictive environments (e.g. when there is a lack of access, funding, and/or time) to inform humanitarian response actions such as prioritization and top-level planning. AoK is a relatively rapid and efficient data collection and analysis approach which enables the identification of areas experiencing severe needs and the drivers of needs, including in hard-to-reach areas. This makes AoK particularly useful in cases where representative household surveys or other resource-intensive methods cannot be implemented, do not justify the required resources, or are not needed to achieve the intended research objectives. To some extent, AoK also allows to capture community-level phenomena better than household surveys (e.g. availability of basic services at community-level). AoK entails:

1. **Structed (quantitative) Community Key Informant Interviews (KIIs):** Interviewing Key Informants (KIs) about communities which the KIs have declared they have recent knowledge of, through a structured questionnaire. This can be both KIs who are currently present in the communities of interest (aka "direct AoK") or KIs who were recently present in the communities of interest (aka "indirect AoK").[2]
2. **Community-level (e.g. settlement) aggregation:** In cases where multiple KIs were interviewed on the same community (e.g. settlement or administrative division), aggregating responses at community-level to retain a single "consensus" response for each indicator (e.g. "In settlement A, the KI consensus is that the majority of people in the settlement did not have access to an improved water source").
3. **Area-level aggregation:** Aggregating community-level responses further at the relevant levels of analysis/reporting (typically the admin 2 level and at the level of the entire assessed area) to obtain a quantitative summary of community-level responses. This is usually presented as the proportion of communities where KIs reported a certain response out of the total of assessed settlements, e.g. "In 40% (40/100) of assessed settlements in District A, KIs reported that the majority of people did not have access to an improved water source".

[1] For AoK the term "community" is defined simply as a place with a group of people living in it and which has commonly understood boundaries. In most cases, the community used as the unit of analysis is the "settlement", defined simply as a village or town (or potentially a neighborhood within a large urban area) with clearly defined boundaries that are understood by KIs. In some cases however, the community used as the unit of analysis for AoK can be for example an admin division (e.g. admin 4 or 3).

[2] While AoK originally consisted of interviewing KIs having been recently displaced from hard-to-reach areas into accessible areas where they could be interviewed (now referred to as "indirect AoK"), in many cases AoK rather consists of interviewing KIs who are still present in the communities of interest (now referred to as "direct AoK"), for example by phone. This can be done both in hard-to-reach or accessible areas as AoK is useful both when facing access constraints but also when facing resource constraints (i.e. not enough funds, staff or time to use other methods such as representative household surveys). AoK is also the methodology currently used for UNDAC sudden onset assessments (aka Multisectoral Initial Rapid Needs Assessments or MIRAs) and on which the UNDAC KI indicator bank is based (the aim is ultimately to align this bank as much as possible with other AoK tools in IMPACT, and the present AoK SI methodology is intended to also apply to AoK-based UNDAC MIRAs). In short, if conducting structured interviews with KIs reporting on a community (e.g. settlement or admin division), which are then quantitatively summarized, then it is the AoK methodology that is used.

AoK indicators can be hard to interpret when analysed and reported individually, making it difficult to generate useful analysis for humanitarian responses. This especially the case when individual indicators are aggregated at area level (e.g., admin 2), as this loses any insight on how various indicators might reflect a coherent and interconnected set of conditions that reflect the sectoral and multisectoral needs in each assessed community.[3]

The AoK Severity Index (AoK SI) is a composite index methodology that aims to provide a standardized and efficient approach to summarising and interpreting AoK data into meaningful & actionable analysis of acute multisectoral humanitarian needs at community (e.g. settlement) and area (e.g. admin 2) level.[4] It enables the identification of the likely severity[5] of acute needs, the multisectoral and sectoral drivers of need, geographic hotspots of need, and the evolution of needs over time (when used for multiple rounds of monitoring). It thus allows for meaningful comparisons of needs between areas and over time, including across administrative or other boundaries. The AoK SI can be used for any assessments using the AoK methodology, including single assessments (e.g. rapid needs assessments) and recurring monitoring assessments (e.g. HSM).

The AoK SI is based on the IMPACT Acute Needs Analytical Framework (ANF) and other sectoral analytical frameworks of reference (see details below), which underpin the IMPACT AoK Indicator Bank (see section 3.1 for more details).

**Intended impact**

The ultimate objective of the AoK SI is to inform emergency (re)prioritization of humanitarian actions and top-level programming decisions by providing a coherent understanding of multisectoral humanitarian needs and their underlying drivers at the community and area levels, based on AoK data. The AoK SI enhances the utility of AoK data for humanitarian decision-making by providing a robust framework for summarizing multiple AoK indicators into a standardized multisectoral index of needs severity when using the AoK methodology. It enables an indicative understanding of where acute needs are being reported, what those needs are and why, how they compare with other locations, and how they evolve over time.

The specific impacts of the AoK SI will depend on each context. The main use cases include:

[3] For example, basic AoK reporting is typically presented as: "In 70% of assessed settlements in District A, KIs reported that the majority of people were engaging in (e.g.) negative food coping strategies". However, this does not tell us about what is driving the problem, whether other problems are compounding this one, and what the overall situation regarding food security is in each assessed community. Using other individual indicators to analyse this at area-level has limited validity as we cannot know whether they are being reported in the same communities. In short, there is no coherent analysis being done at the community (e.g. settlement) level that enables a wholistic understanding of sectoral and multisectoral needs at community and area levels.

[4] The AoK SI follows a similar rationale to the REACH Multi-Sectoral Needs Index (MSNI) used to provide coherent analysis of representative household surveys in Multi-Sectoral Needs Assessments (MSNAs). There are differences in how these indexes are calculated as they are based on different data sources and have different objectives. The AoK SI "Score Index" is the closest to the MSNI calculation methodology and can serve a similar objective when representative household data is not available.

[5] In the context of the AoK SI, severity is understood as the intensity of needs for individual indicators (e.g. use of surface water is more severe than use of a protected water source) as well as the scope of needs across indicators (i.e. for how many indicators out of the total across all sectors is the intensity of severity high).

- Informing the top-level planning and prioritization of response actions[6] between locations, sectors, programmes, etc. based on single rapid needs assessments, including sudden onset assessments such as AoK based UNDAC Multisectoral Initial Rapid Needs Assessments (MIRA).
- Informing the regular strategic or operational level re-prioritization of response actions between locations, sectors, programmes, etc. based on recurring monitoring assessments (e.g. HSM or integrated monitoring), for example within an Assessment and Analysis Working Group (AAWG) or through an Inter-Cluster Coordination Group (ICCG).

# 3. Methodology

## 3.1 Methodology overview

The AoK SI methodology consists of the following steps:

1. Selecting the indicators (based on the underlying analytical framework)
2. Setting severity thresholds
3. Community (e.g. settlement) level aggregation of the AoK data (if multiple KIs per community)
4. Selecting the Severity Index aggregation methodology (Flag Index or Score Index approach)
5. Computation of the index at sectoral, community (e.g. settlement) and area level (e.g. admin2 or admin3)
6. Sensitivity Analysis
7. Reporting

Analytical framework: IMPACT Acute Needs Analytical Framework (ANF) and global cluster sectoral frameworks

Indicators included in the AoK SI are core indicators from the **IMPACT AoK Indicator Bank**[7] which measure key concepts that drive the severity of needs. This indicator bank (and thus the AoK SI) is grounded in the **IMPACT Acute Needs Analytical Framework (ANF)**[8] and **other global reference analytical frameworks** for sectors not covered by the ANF.[9] These reference frameworks determine which indicators are considered to drive severity, and what severity thresholds should be assigned to indicator values (including based on existing severity classification methodologies associated with these frameworks[10]).

The **ANF** is specifically designed to identify (and monitor) primarily the most acute humanitarian needs, defined as needs that are linked to the risk of preventable loss of life (i.e. life-threatening needs). It provides a theoretical (and empirically backed) framework for understanding how life-threatening humanitarian outcomes (e.g. malnutrition, disease and ultimately mortality) at the individual level are influenced by known contributing (or risk) factors at the household, community and systemic levels. Specifically, the ANF outlines the key factors and

[6] The response actions that can be informed are many, and can potentially include advocacy, fundraising, top-level programming, operational responses, etc. The specific response actions to inform should be determined based on engagement with key response actors in each context to determine information gaps.
[7] Draft available here or on request to the Global Emergencies Unit in IMPACT HQ.
[8] Draft available here or on request to the Global Emergencies Unit in IMPACT HQ.
[9] Sectors not covered by the ANF are those not directly related to public health, for example shelter, protection, education, etc. The frameworks of reference are mentioned for each indicator in the AoK Indicator Bank. They are the reference sectoral frameworks provided by Global Clusters.
[10] For example, the Joint Intersectoral Analysis Framework (JIAF), the WASH Insecurity Analysis, the Shelter Severity Classification, etc.

dimensions of vulnerability (and the relationships between them) which can contribute to negative impacts on physical well-being and ultimately a risk of preventable loss of life. These dimensions can then be measured through needs assessments and the framework can be used structure the analysis of the resulting indicators to estimate the severity of needs.

For this reason, the AoK SI has a particular focus on dimensions that have a direct link with the risk of preventable loss of life (e.g. access to clean water, healthcare, livelihoods, adequate shelter, etc.). This aims to inform the prioritization of humanitarian response actions towards people in the most critical, life-threatening need.

However, other dimensions without a direct link to the risk of preventable loss of life are also included to inform the prioritization of multisectoral response actions more broadly (i.e. indicators not directly related to public health, e.g. broader indicators for shelter, education, protection, etc.). AoK indicators for these non-public health related sectors similarly aim to measure contributing factors to the outcomes of interest for these sectors, guided by **global reference analytical frameworks**.

The AoK SI has indicators across eight sectors or themes: Food Security and Livelihoods; Shelter; Water, Sanitation, and Hygiene (WASH); Health; Protection; Education; Market Functionality; and Shocks.

As AoK data measures indicators at community (e.g. settlement) level, it can only measure the community-level dimensions of the underlying analytical framework (e.g. access to, for example, livelihoods for the majority of people in the community). It does not allow the measuring of household and individual level outcomes (e.g. household food consumption, individual nutrition status, etc.). Instead AoK aims to provide information on dimensions which are known contributing factors to (or potentially proxies for) these household and individual level outcomes. This enables analysis of the likely severity of humanitarian needs in a community based on the identification of community-level contributing factors to household and individual outcomes, without directly having information on these lower-level outcomes. For example, while measuring malnutrition or household food consumption is not possible with AoK, it can still provide information on community-level access to livelihoods, food, clean water, healthcare, shelter conditions, etc. which are known to influence the likelihood of severe levels of low food consumption or malnutrition. For example, if KIs report that the majority of people in a community do not have access to their livelihoods, food, clean water, healthcare, etc. it is reasonable to conclude that household level food consumption and malnutrition in this community will likely be more severe than in a community where the majority of people do have access to all these basic needs and services.

## Constructing the AoK SI

### 3.1.1 Step 1: Selecting the indicators

The list of indicators (and associated thresholds) used in the standard AoK SI is available in the AoK SI indicator and thresholds table[11] which is based on core indicators from the AoK Indicator Bank. If these core indicators were used during data collection, there should be no need to modify this list before proceeding with the index

[11] Available here or on request to the Global Emergencies Unit in IMPACT HQ.

calculation.[12] However, if relevant this list of indicators can be contextualized by adding or modifying indicators to ensure that key drivers of the severity of needs in each context are included.[13]

### 3.1.2 Step 2: Setting severity thresholds

For each selected indicator, severity thresholds are defined based on the analytical frameworks of reference and associated severity classification methodologies (see above). The thresholds for the standard AoK SI are indicated in the AoK SI indicator and thresholds table. In most cases, there should be no need to modify these thresholds before proceeding with the index calculation. However, if relevant thresholds can be contextualized to ensure that the severity of needs is accurately reflected in each context to best inform response actions.

These thresholds indicate the level of severity that an indicator reflects based on its value. For individual indicators, 'severity' signifies the 'intensity' of needs measured by that indicator at the community (e.g. settlement) level, using the following scale[14]:

1. None/minimal: Essential basic sectoral needs are met in the community,
2. Stress: Borderline inability to meet basic sectoral needs in the community,
3. Crisis/Severe: Moderate inability to meet basic sectoral needs in the community, (and moderate risk of preventable loss of life)
4. Emergency/Extreme: Extreme inability to meet basic sectoral needs in the community (and high risk of preventable loss of life),

4+. Extreme Emergency/Catastrophic/Sectoral Collapse: Collapse of basic services and/or total inability to meet basic sectoral needs in the community (and very high risk of preventable loss of life).[15]

The primary guiding principle for setting the thresholds is to assign the highest severity levels (e.g., 4 or 4+) only to indicators with a known link to the risk of preventable loss of life (aka the risk of excess mortality) – based on the ANF mentioned above. In particular, a score of 4+ should only apply to indicators with a direct link to mortality. This includes for example access to critical health services, clean water and food. Lower severity levels (1 to 3) are assigned based on proportional declines in access, availability, or quality of services and to indicators that have no link to mortality. [16]

[12] Indicators in the IMPACT AoK Indicator Bank that are not included in the list of indicators for the AoK SI are not used for the calculation. However, they should still be used as part of the broader analysis of AoK data alongside the AoK SI to present a more comprehensive overview of the situation in the assessed settlements, for example by explaining the drivers of multisectoral and sectoral severity, barriers to accessing needs and basic services, etc.

[13] When contextualizing the indicator table for the AoK SI, only indicators which measure humanitarian outcomes should be included (e.g. access to clean water, food, healthcare, shelter, etc.). Generally, indicators that measure barriers or reasons for these outcomes should not be included in the table as measures of severity because they do not measure the ultimate result, i.e. the outcome.

[14] The terminology for this scale is aligned with the severity scales of the JIAF and Integrated Phase Classification for Food Insecurity (IPC). However, as AoK data only measures proxy outcomes and does not directly measure "hard" outcome data (such as Global Acute Malnutrition, household food and water consumption, etc.), these severity levels are only indicative of likely conditions as measured by AoK based on KI reports and are not equivalent to JIAF and IPC classifications. Further triangulation and confirmation is necessary to increase confidence in such estimates of the severity of needs in assessed areas. The exact term to use for each level of severity can be chosen as relevant in each context.

[15] The score "4+" is preferred instead of "5" to avoid any misinterpretations that this severity score would be equivalent to IPC severity 5, as AoK data only allows to produce indicative information on the likely severity of needs.

[16] A preliminary sensitivity analysis of the standard AoK SI was conducted on AoK data from the South Sudan HSM Research Cycle collected in June 2024. The purpose of this preliminary sensitivity analysis was to develop an approach that ensures severity thresholds align with varying country contexts, ensuring applicability and consistency across different settings. The analysis resulted in an improved

**If relevant only: 3.1.3 Step 3: Aggregating KI-level information at community (e.g. settlement) level**

This step only applies in cases where there are multiple KI interviews for each assessed community (e.g. settlement). It is the standard methodology for the analysis of AoK data.[17] The responses of all KIs reporting on the same locality will be aggregated into a single, triangulated response for the locality for each indicator, to reflect consensus between KIs. See the AoK Guidance Note for more details on this step.

### 3.1.4 Step 4: Selecting the Severity Index aggregation methodology at settlement level

The AoK SI can be calculated based on two different aggregation methodologies (see section 3.1 for details):

- **Flag Index**: to inform prioritisation based on relative estimates of need based on reported problems at community level that cross a single predefined severity threshold (and are thus ”flagged”)
- **Score Index**: to inform prioritisation based on absolute estimates of need based on the aggregation of severity scores attributed to each indicator based on multiple predefined severity thresholds (1 to 4+)

Both aggregation approaches allow for the calculation of a severity index at the following levels:

- **Community level**: in most cases this means at settlement level, but in some cases this can be based on an another unit of analysis (e.g. in some cases KIs can be asked to report on an admin 4 or 3, rather than a settlement)
- **Area level**: in most cases this means at admin 2 or admin 3 levels (the level of analysis should be determined by how the information will be used, e.g. admin 2 to inform prioritization between admin 2s)

The approach to use should be decided based on the objectives of the Research Cycle (see use cases below). The Flag Index approach is recommended by default unless there is a clear case to use the second one. In relevant cases, both approaches can also be used in parallel to serve different objectives:

1. The **Flag Index** methodology

***What it is:*** The basic Flag Index is calculated as the number of indicators that surpass predefined severity thresholds in an assessed community (e.g. settlement). In simple terms, the index sums up the number of indicators which reflect severe needs in an assessed community (as reported by KIs). This method provides a simple and transparent indication of the overall multisectoral severity of needs in assessed communities. When presented as a proportion (see details below), it also allows to some degree an understanding of the severity of needs in absolute (rather than just relative) terms (i.e. how many indicators of severe need are in fact being reported out of all the severe needs that could potentially be reported). However, it provides only a limited understanding of needs in absolute terms as it is based on a simple binary assessment of severity (i.e. whether an indicator crosses the defined severity threshold e.g. 4 or not – without accounting for more nuance in whether an indicator is at severity 1, 2, 3, 4 or 4+).

alignment of indicator severity thresholds with the ANF. It further showed that the Index is well-balanced in terms of number of indicators within a sector, severity thresholds and low severity correlation between indicators within the same sector (which means that the different indicators included measure different things as intended). The analysis became an important step in the construction of the Index and it is recommended to conduct a sensitivity analysis to support in-country adjustment (see section *3.1.4 Sensitivity analysis*).

[17] See aggregation and analysis app for additional explanation and steps: impact-initiatives.shinyapps.io/geuki_analysis_app/

***When it should be used:*** This approach should be used when the objective is to inform the prioritisation of response actions within a crisis based on a **relative** comparison of the severity of needs (i.e. when the question is "In which assessed communities are the needs worst compared with others?"). It shows the difference in severity between assessed communities in a granular way (i.e. with potentially high variance across communities), which is most useful to inform the prioritisation of response actions towards **communities with the most severe needs compared with others**. This approach should be used, for example, when the objective is to inform the prioritization of programmatic or operational responses within a rapidly evolving context. See below for more details on the Flag Index method.

2. The **Score Index** methodology

***What it is:*** The **Score Index** is calculated as the severity score (1 to 4+) achieved or surpassed by all of the top 25% most severe indicator scores across all indicators (based on their values in reference to the defined severity thresholds). This method ranks all assessed indicators by severity (on a 1 to 4+ scale) and determines the severity score at which **at least 25% of indicators** in that unit have an equal or higher severity.

***When it should be used:*** This approach should be used when the objective is to inform the prioritisation of response actions within a crisis or between crises based on an **absolute** comparison of the severity of needs based on a predefined scale, e.g. 1-4+ (i.e. when the question is "How severe are needs in assessed communities on a scale of 1 to 4+?"). Its main limitation is that it may lead to many assessed communities being classified in a similar level of severity (i.e. with little variance across communities), which limits its usefulness for the relative prioritisation of response actions between communities within a crisis. However, it provides an indication of severity which is easier to interpret in absolute terms and accounts for the depth/intensity of severity for each indicator (e.g. severity categories of 1 to 4+, where 4+ is easily understood to represent the worst possible severity and 1 the absence of needs). This provides a stronger basis for estimating the overall severity of needs in a crisis and potentially comparing this with other crises (e.g. using the same reference severity thresholds, the distribution of assessed communities in each severity category 1 to 4+ can be compared between two crises, potentially showing which is experiencing the most severe conditions overall). This approach should be used, for example, when the objective is to inform strategic level processes such as the Joint Intersectoral Analysis Framework (JIAF[18]) or cross-crisis analyses at the global level (e.g. for global needs monitoring). See below for more details on the Score Index method.

### 3.1.5 Step 5: Computing the Severity Index

For detailed guidance on the index calculation (which will depend on the selected aggregation approach), see section *3.3 Data Processing & Analysis*. A standard package of R scripts for the calculation of the index is available here or on request to IMPACT HQ.

### 3.1.6 Sensitivity analysis

After computing the Severity Index based on the data collected, the quality and robustness of the Index should be analyzed through a Sensitivity analysis conducted by country teams to ensure that the Index is fit for purpose at

[18] For example by monitoring the evolution of needs throughout the year specifically against baseline JIAF severity classifications based on annual Multi Sectoral Needs Assessments (MSNAs).

country-level.[19] The methodology for the Sensitivity analysis is presented in detail in Annex 4. The analysis examines the Index by:

1. Analyzing Missing Values: Ensuring missing data does not disproportionately influence severity scores.
2. Indicator Distribution: Evaluating the spread of indicator values to confirm thresholds appropriately capture severity levels and the distribution of severity values matches the conceptual framework.
3. Correlation Analysis: Identifying and addressing instances of high correlation between indicators to avoid implicit double counting of similar indicators in the index calculation.

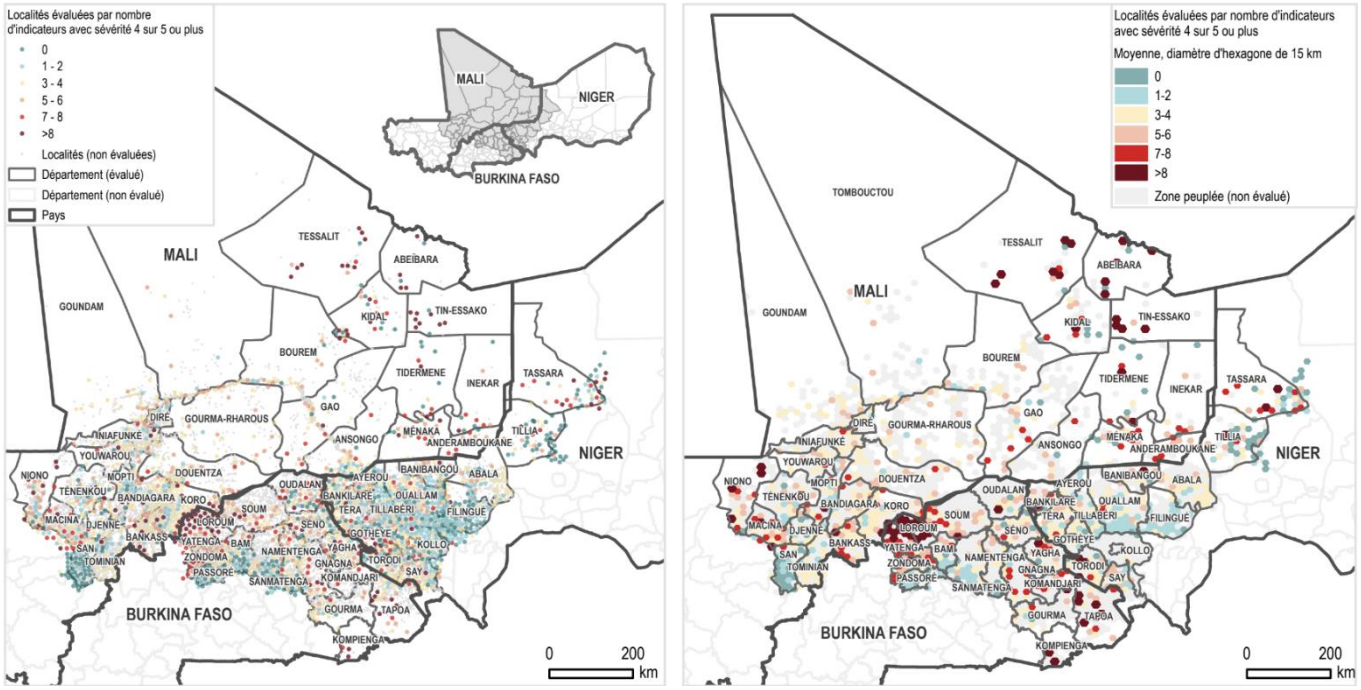
### 3.1.7 Reporting and Visualization

Once the Severity Index is calculated, the results are compiled into a clear and actionable report. This can include visualizations to enhance understanding of severity levels, spatial distribution of needs and trends. Key elements include:

- Tabular Representation: Table output showing the Index for all three thresholds (Crisis, Emergency, Extreme Emergency) for each indicator, per community (e.g. settlement), and per sector.
- Geographical Representation (see *Annex 3: Severity Index Mapping SOP*): maps and charts highlighting the severity of needs at the community (e.g. settlement) and area levels, allowing users to quickly identify areas of highest concern. For community (e.g. settlement) level mapping, it is recommended to use dot maps displaying the index score for individual assessed community (e.g. settlement). Hexagon maps based on the mean index scores of assessed settlements within each hexagon can also be used when the density of assessed settlements leads to excessive overlapping of dots which reduces visual clarity. Such settlement level mapping allows to better visualize the geographic distribution of severity, including across administrative boundaries, and thus the identification of areas of highest concern and notable trends.
- Sectoral Breakdown: Sector-specific visualizations to pinpoint critical drivers of needs in each area.
- Temporal Analysis (if applicable after validation): Line graphs, community (e.g. settlement) level trend mapping, or other tools to illustrate changes in severity levels over time, offering insights into evolving needs.
- Comparison Across Regions: Tables or charts summarizing severity levels by community (e.g. settlement) or region for comparative analysis.

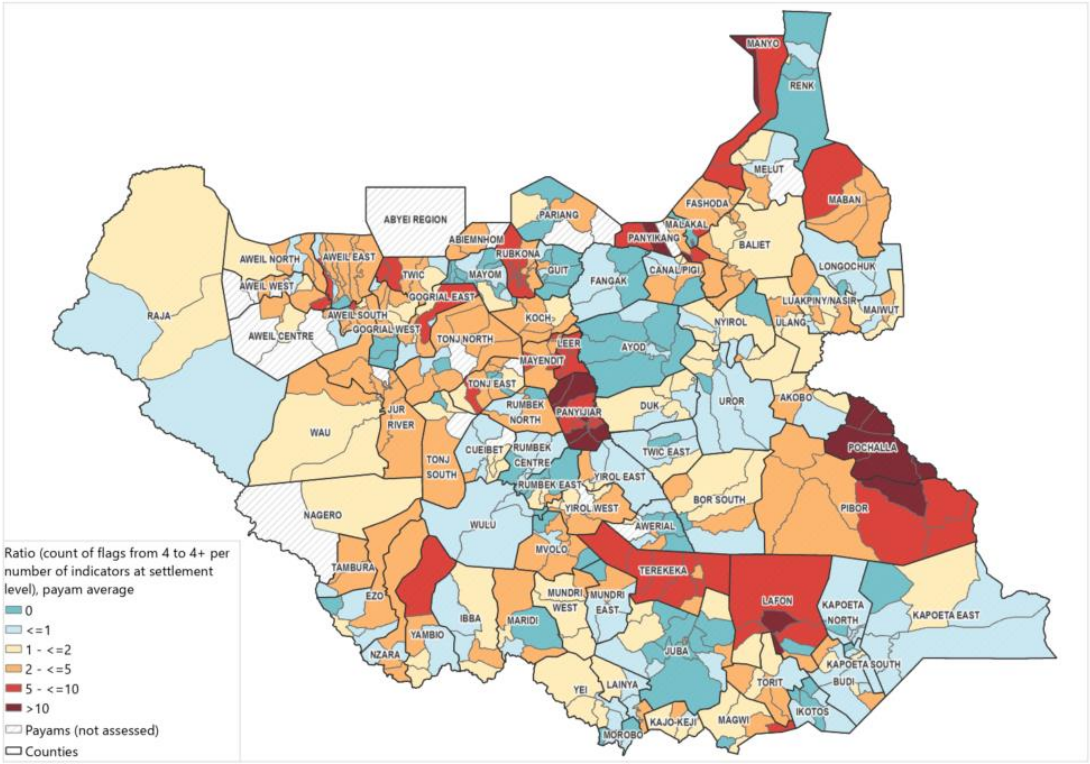
[19] This should be done at least once after the first round of data collection (if several), and ideally after each round to check that the index construction is still fit for purpose and robust across data collection rounds.

*Figure: Example of a dot map and hexagon map of settlement level AoK SI scores (based on a simple Flag Index count approach)*




*The example shows the value of mapping the AoK SI at community (e.g. settlement) level which allows for the analysis of spatial patterns which would be hidden at higher levels of aggregation, including patterns of severity that cut across administrative boundaries and a better accounting for settlement density.*

*Figure: Example of an admin 3 level map: Proportion (ratio) of flagged indicators (4 or 4+) out of total available indicators at admin 3 level, based on average flags across assessed settlement in each admin 3*



### 3.2 Population of interest

The whole population in the assessed area.

### 3.3 Data Processing & Analysis

*Table: count of indicators in the standard AoK SI indicators and thresholds table, by sector and severity level.*

| Sector | # of indicators | Max 3 (Crisis) | Max 4 (Emergency) | Max 4+ (Extreme Emergency) |
|---|---|---|---|---|
| WASH | 9 | 1 | 6 | 2 |
| Shelter | 6 | - | 5 | 1 |
| Health | 6 | - | 3 | 3 |
| Education | 3 | 3 | - | - |
| FSL | 7 | - | - | 7 |
| Protection | 3 | - | 3 | - |
| Cash & Markets | 3 | 3 | - | - |
| Population Movement | 2 | - | 2 | - |
| Total | 39 | 7 | 19 | 13 |

#### 3.3.1 Calculating the Flag Index

I. Basic Flag Index Calculation:
   a. For each unit of analysis (e.g. settlement), the SI is calculated as the count of indicators meeting or exceeding the selected severity threshold defined in the thresholds table. As default we set the severity threshold to 4 and name this the Flag 4 Index[20]. This total number of flagged indicators comprises the severity index at community (e.g. settlement) level based on the Flag Index approach. These indicators are considered "flagged". The "Flag **4** Index" is the default

[20] Threshold 4 is used as the standard because it effectively identifies critical needs while aligning with established frameworks. However, other thresholds can be applied depending on context (e.g. 4+ if the aim is to only prioritise the most severe needs). An interactive dashboard could enable users to filter by thresholds (e.g. 3, 4 and 4+), offering flexibility in exploring the data.

method. It counts all indicators that meet or exceed severity level 4 (as defined in the thresholds table). For comparison between communities (e.g. settlements) the Index can be converted to a proportion.

II. Proportion-Based Representation[21] (recommended):
   a. The basic index (step 1 above) is a very simple and transparent way of indicating the number of severe issues reported by KIs in assessed communities (i.e. "how many severe issues are there in this settlement?"). However, it does not give any indication of severity in an absolute sense (e.g. just how severe is 5 flags or 10 flags?). It also does not account for missing data (an absence of flags might be because of missing data and not necessarily because the situation is not severe). And it does not account for the different numbers of indicators in different sectors. For those reasons it is recommended to present the index as the "proportion of flagged indicators out of total available indicators" (i.e. "out of all the severe issues there could be in the available data, how many are flagged as severe in this community?")
   b. In this proportion (or ratio) based representation, the numerator is the number of flagged indicators, and the denominator is the total number of indicators with available data (e.g., 5 flagged indicators / 10 indicators with data that could potentially be flagged = 50%).
   c. This proportion format accounts for different number of indicators for each sector and the potential variability of the number of indicators for which data is available in different assessed communities.
   d. It also normalizes the index, which makes it easier for everyone to interpret and communicate, especially when comparing across regions or time (e.g. "out of 20 indicators that could be flagged as severe, 10 are in fact flagged").
   e. **The proportion should not be calculated when the number of available indicators for one community (e.g. settlement) is less than half of the total indicators of the** indicator and thresholds table.[22] In that case the absolute Flag Index should be used for the entire area/country. This avoids reporting high proportions in cases where there are few available indicators, which would give the misleading impression of high severity when in fact there is simply little available data.

III. Sectoral Score:
   a. Sector-specific scores can be calculated using the same Flag Index approach but restricted to indicators within each sector. Comparisons between sectors are best made using the proportion format (step 2 above), as it allows to compare balanced proportions, instead of absolute sectors with different number of indicators.

IV. Area-level (e.g. admin 2) representation:
   a. At the **area-level** (e.g., admin 2), the **Flag 4 Index** and **Proportion 4 Index** are aggregated using the **Mean of Flag 4 Index**. It is recommended to use the Mean of the Proportion 4 Index when possible. This method ensures that severity assessments at the settlement level are consistently represented at a broader geographical level while accounting for differences in the number of available indicators per settlement.

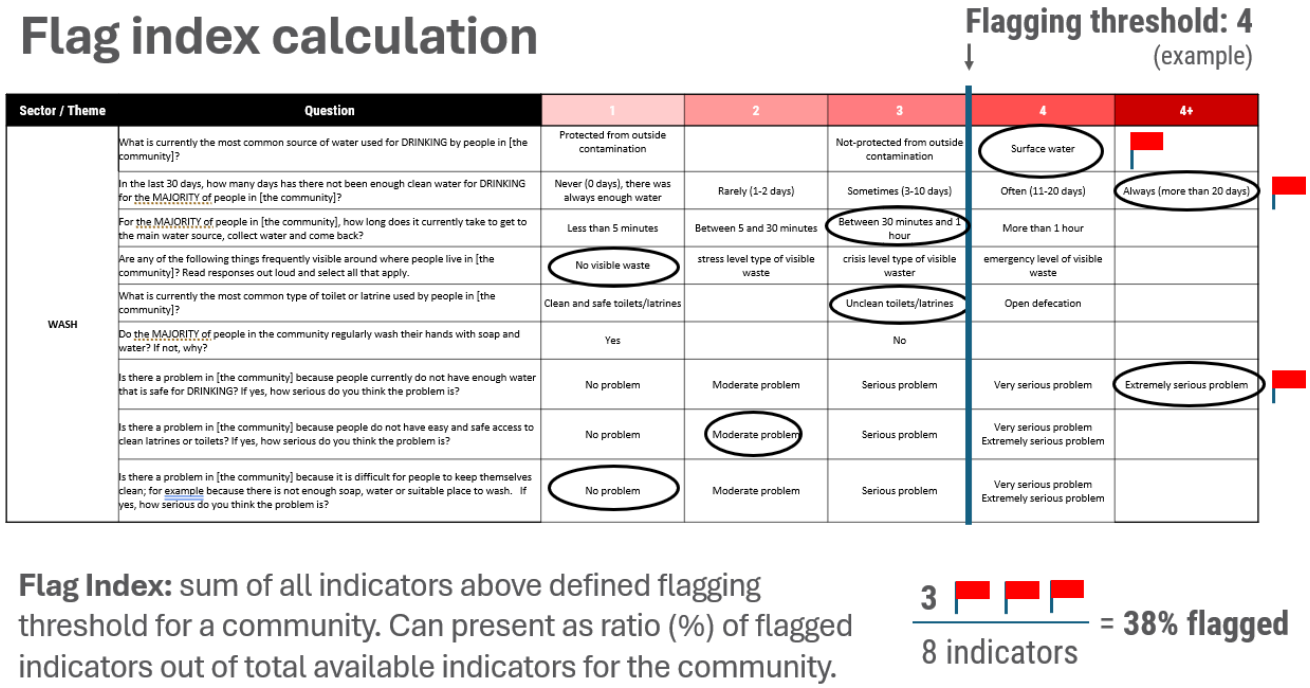
[21] The recommendation is to implement this step whenever possible. However, in contexts where it is expected that adding this extra layer of complexity will risk reducing understanding of the index by external audiences to the extent that it precludes buy-in and use of the index, using simply the calculation in step 1 can be considered. In such cases, the limitations should be clearly communicated.

[22] This threshold (less than half) is arbitrary and simply designed to avoid misleading reporting when there is missing data for many indicators.

b. **Mean Flag 4 Index (Absolute Count)**: Represents the **Mean** (unweighted arithmetic average) **of the total number of flagged indicators** aggregated from all assessed settlements in an area. This can be useful for understanding the average volume of severe issues but does not normalize for differences in available data.

c. **Mean of Proportion 4 Index (proportion)** at the area level is calculated by dividing the total number of flagged indicators (severity 4 or 4+) across all assessed settlements in an area by the total number of available indicators across those settlements.

*Example of the Flag Index aggregation approach for the WASH sector.*




**Flag Index:** sum of all indicators above defined flagging threshold for a community. Can present as ratio (%) of flagged indicators out of total available indicators for the community.

**3** / 8 indicators = **38% flagged**

*The example shows that for the assessed community (and for this sector), 3 indicators surpass the severity threshold of 4 and are thus flagged, which leads to a Flag Index count score of 3. Presenting as a proportion (of flagged indicators over available indicators) leads to a Flag Index proportion score of 3/8 or 38%). This simply means that out of 8 possible severe issues, 3 or 38% were reported as severe issues by KIs in the assessed community.*

Once the data has been collected the Flag Index is calculated by taking the sum of all indicators per community (e.g. settlement) that have passed the set threshold (i.e., that have been "flagged"). As default we set the severity threshold to 4 and name this the Flag 4 Index[23]. This total number of flagged indicators comprises the severity index at community (e.g. settlement) level based on the Flag Index approach. For comparison between communities (e.g. settlements) the Index can be converted to a ratio (proportion), where the denominator is comprised of the total number of available indicators within that community (e.g. settlement).

The calculation is presented formally below:

[23] Threshold 4 is used as the standard because it effectively identifies critical needs while aligning with established frameworks. However, other thresholds can be applied depending on context (e.g. 4+ if the aim is to only prioritise the most severe needs). An interactive dashboard could enable users to filter by thresholds (e.g. 3, 4 and 4+), offering flexibility in exploring the data.

**Flag Severity Index (Absolute Count):**

$$Flag\ SI_s = \sum_{i=1}^{n} 1(x_i \geq T_4)\ 1(x_i \geq T_4)$$

$: Indicator\ function\ that\ returns\ 1\ if\ the\ value\ of\ indicator\ x_i$
$exceeds\ or\ equals\ threshold\ T_4, and\ 0\ otherwise$

$n: Total\ number\ of\ indicators$

**Flag Severity Index (Ratio):**

$$Flag\ SI\ Ratio_s = \frac{\sum_{i=1}^{n} 1(x_i \geq T_4)}{n}$$

The list of all indicators for each sector with their respective value choices and assigned severity thresholds is available in Annex 2.

### 3.3.2 Calculating the Score Index

The Score Index is calculated by identifying the severity value at which the worst 25% of indicators within a settlement or area have an equal or higher severity. Unlike the Flag Index, which counts the number of flagged indicators, the Score Index captures both the presence and depth of severity by ranking indicators and selecting a severity threshold that represents the most critical portion of the assessed indicators.

This approach ensures that the final score reflects the most severe conditions in each level of analysis while allowing for comparison across communities (e.g. settlements) and areas. Because it focuses on the **top quartile (25%) of severity**, the Score Index helps prioritize communities and areas experiencing the most severe needs. The Score Index is calculated as follows:

I. Score Calculation:
   a. The **Score Index** is based on an aggregation of the individual severity scores (1 to 4+, based on the defined severity thresholds) of each measured indicator. For each unit of analysis (e.g., settlement), the Score Index is calculated as the **severity score (1 to 4+) achieved or surpassed by all of the top 25% most severe indicator scores across all indicators**.[24] The result is a single severity score that represents the severity level at which the most severe 25% of needs exist in that unit.
   b. Indicators are ranked by severity (1 to 4+) based on the reference severity thresholds table, and the **severity level at which 25% of the indicators have a higher or equal severity** is selected as the final Score Index value. If the threshold falls between two severity levels, it is

[24]For example, if the 25% of indicators with the highest severity score are all assigned a severity score of 4+ (based on their values in reference to the defined severity thresholds), then the Score Index for the unit (e.g. settlement or area) is 4+. If the 25% of indicators with the highest severity score are assigned a score of 4+ or 4, then the Score Index is 4. If the 25% of indicators with the highest severity score are assigned 4+, 4 or 3, then the score is 3, etc. Note that a simple average or count of flagged indicators is avoided as this would not sufficiently account for the presence of high severity values and thus would not reflect severity adequately. Indeed, the presence of several high severity indicators should be reflected in the final score, which should not be "downgraded" by the simultaneous presence of low severity indicators (i.e. the presence of several severe problems should not be considered to reflect a less severe situation just because of the absence of several other potential problems).

recommended to use interpolation to refine the score (see interpolation calculation below). If there is no capacity to use interpolation, alternatively the value can simply be rounded.

c. **At community (e.g. settlement) level** the Score Index identifies the severity level at which the **worst 25% of indicator values in e.g. a settlement** are at or above that threshold, giving a clearer picture of the most critical issues within that settlement.

II. Sectoral score:

a. The Score Index can also be calculated at the sectoral level by applying the same methodology but restricting the analysis to indicators within a specific sector. This allows for direct comparison of severity across different sectors within a settlement or area.

III. At Area Level (admin2 or admin3) representation:

a. At the area level, the Score Index follows the same principle but is calculated using all indicators from all assessed settlements within the area. The final score is determined by identifying the severity value at which the worst 25% of indicators across the area are at or above that level. This ensures that the most critical needs are captured even when aggregating data across multiple settlements.

*Example of the Score Index aggregation approach for the WASH sector.*

## Score index calculation

| Sector / Theme | Question | 1 | 2 | 3 | 4 | 4+ |
|---|---|---|---|---|---|---|
| WASH | What is currently the most common source of water used for DRINKING by people in [the community]? | Protected from outside contamination | | Not-protected from outside contamination | Surface water | |
| | In the last 30 days, how many days has there not been enough clean water for DRINKING for the MAJORITY of people in [the community]? | Never (0 days), there was always enough water | Rarely (1-2 days) | Sometimes (3-10 days) | Often (11-20 days) | Always (more than 20 days) |
| | For the MAJORITY of people in [the community], how long does it currently take to get to the main water source, collect water and come back? | Less than 5 minutes | Between 5 and 30 minutes | Between 30 minutes and 1 hour | More than 1 hour | |
| | Are any of the following things frequently visible around where people live in [the community]? Read responses out loud and select all that apply. | No visible waste | stress level type of visible waste | crisis level type of visible waster | emergency level of visible waste | |
| | What is currently the most common type of toilet or latrine used by people in [the community]? | Clean and safe toilets/latrines | | Unclean toilets/latrines | Open defecation | |
| | Do the MAJORITY of people in the community regularly wash their hands with soap and water? If not, why? | Yes | | No | | |
| | Is there a problem in [the community] because people currently do not have enough water that is safe for DRINKING? If yes, how serious do you think the problem is? | No problem | Moderate problem | Serious problem | Very serious problem | Extremely serious problem |
| | Is there a problem in [the community] because people do not have easy and safe access to clean latrines or toilets? If yes, how serious do you think the problem is? | No problem | Moderate problem | Serious problem | Very serious problem<br>Extremely serious problem | |
| | Is there a problem in [the community] because it is difficult for people to keep themselves clean; for example because there is not enough soap, water or suitable place to wash. If yes, how serious do you think the problem is? | No problem | Moderate problem | Serious problem | Very serious problem<br>Extremely serious problem | |

**Score Index:** severity score (1 to 4+) achieved or surpassed by all of the top 25% most severe indicator scores across all available indicators.

The 25% (2 out of 8) most severe indicators are at least severity **4+**
→ Final severity score for the community is **4+**

*The example shows that for the assessed community (and for this sector), the 25% of indicators with the highest severity both have a severity of 4+. This means the final severity score for the community is 4+. (In an alternative scenario where the severity for the 25% of indicators with the highest severity was 3 and above, the final severity would be 3).*

Interpolation[25] calculation: if we want to estimate the severity value at a given cumulative proportion (e.g., 25%) and it falls between two known data points, use this formula, which is the one used by the R-script:

$$\text{Estimated Severity} = S_{\text{low}} + \frac{(\text{Target Cum Prop} - P_{\text{low}})}{(P_{\text{high}} - P_{\text{low}})} \times (S_{\text{high}} - S_{\text{low}})$$

Where:

- $S_{\text{low}}$ = Severity value just **below** the target cumulative proportion
- $S_{\text{high}}$ = Severity value just **above** the target cumulative proportion
- $P_{\text{low}}$ = Cumulative proportion just **below** the target
- $P_{\text{high}}$ = Cumulative proportion just **above** the target
- **Target Cum Prop** = The proportion we are trying to estimate for (e.g., 25%)

## 3.4 Advantages & Limitations

### 3.4.1 Flag Index

The Flag Index aggregation approach used for the AoK SI was chosen after considering a number of tradeoffs and conducting testing to identify the best aggregation approach (see Annex 3). The Flag Index approach has the following advantages and limitations:

**Advantages**

- Best suited for prioritization. It provides more variance in the index scores and captures outliers relevant for comparing severity on a more granular and nuanced scale to allow for better prioritization.
- Simple, transparent in its construction, easily replicable and easy to interpret.
- Low risk of understating needs.
- Higher levels of spatial correlations than other aggregation methods. Allow us to more confidently make conclusions on settlements outside the sampling frame, which is particularly relevant for AoK as sampled settlements are in most cases not sampled for statistical representativeness.

**Limitations**

- Depth of the severity. The Flag Index, by construction, flags the number of indicators that reach a severity threshold, namely 3, 4 and 4+. However, it doesn't provide any information on the scope of the severity – we do not know how much the severity of the settlement is distant from the set threshold (e.g. a flagged indicator could have a value of 4, or 4+ if the threshold is 4). This means that for each indicator all settlements above

[25] How interpolation works: Imagine you're climbing a staircase where each step represents a severity level (from 1 to 4+), and the height of each step tells you how much of the total data is covered (cumulative proportion). If you want to find the severity level at exactly 25%, but there's no step there, you estimate based on the two closest steps. For example, if 20% of indicators have severity 2 and 30% have severity 3, then 25% falls between them. Instead of rounding up or down, interpolation finds a precise spot between these levels, like saying the score should be 2.5 if it's halfway. This method ensures a smooth and accurate estimation rather than making rough jumps between severity levels.

the threshold are considered at the same level of severity. One approach to counter this limitation is to calculate the index based on all three thresholds respectively: crisis (3), emergency (4), and extreme emergency (4+). Results can then be presented based either one of these thresholds to show how needs are distributed based on severity level (this can be thought of as a "filter", which can be used to show e.g. only results based on the 4+ threshold i.e. the most severe needs, or based on lower thresholds to show less severe needs as well – and such a filter can for example be added in a dashboard where a severity map could be filtered to show only 4+ indicators, or indicators 4 and above, or 3 and above). Severity 4 is recommended as the standard threshold as it adequately highlights acute needs without being too broad or too narrow.

- Implicit weighting. The selection and number of indicators influences the weight of the Severity Index. It is thus important that sectors more directly related to mortality in the analytical framework have a relatively larger number of indicators as well as indicators with values affecting thresholds 4 and 4+.
- Outliers. The flag index does not correct for any outliers. Since it counts the number of indicators above thresholds, there is no correction for outliers. By mapping communities (e.g. settlements), individual outliers will be relativized and provide more granularity useful for analyzing relative severity across assessed settlements.
- No interaction. There is no interaction between the dimensions. Each indicator is analyzed as a silo, without any interaction being conceived in the index. The Flag Index ignores dynamics across indicators but by identifying which sectors reflect more severity the interaction between sectors can be identified. By allowing for the analysis of AoK data at community level, the index also allows for analysis of the co-occurrence of various sectoral needs.
- Interpretation. The number can be hard to interpret; the number of flags doesn't have a range. There is a maximum observed value in each scenario the index is applied to. It can also be misleading in its interpretation. To improve the interpretation the representation of the Flag Index as a proportion (as described in the methodology above) is recommended.
- Missing values. It risks misleading audiences into believing some communities with low index scores are not experiencing severe needs in cases where this is in fact unknown due simply to missing data. However, to correct for missing values or indicators the Flag Index Ratio approach described above is recommended as it accounts for available indicators in the denominator and thus presents the score as the ratio of flagged indicators by the number of indicators for which data is available.

### 3.1.1 Score Index

**Advantages**

- Provides an absolute estimate of the severity needs on a 1 to 4+ scale which is easily interpretable (with 4+ being understood as the worst possible severity, and 1 the absence of needs)
- The scale can be aligned (to some extent) on global reference frameworks such as the JIAF or REACH Multi Sectoral Needs Index (MSNI).
- Captures the full depth of severity (1 to 4+) for each indicator.
- Score is normalized (ranges within a fixed set of values).
- Accounts for differences in data availability as it is based on proportions rather than absolute counts, thereby adjusting for variations in the number of available indicators across communities or areas.
- Reduces bias from missing indicators as it considers all available indicators and ranks them proportionally. It is therefore less affected by differences in the number of indicators assessed in different settlements.

- It provides a clearer picture of extreme severity by focusing on the worst 25% of indicator values.
- Can be considered as integer (1-4+) or as continuous severity value (all values between 1 and 5).

**Limitations**

- Produces a slightly lower variance, allowing for less distinct prioritization of communities/areas. In some contexts, this approach can lead many communities to be assigned the same severity score, which limits its usefulness for prioritization.
- The percentile-based ranking method can be less intuitive for operational decision-making compared to a simple count of flagged indicators.
- When there are few available indicators, the Score Index may be overly influenced by extreme values, reducing reliability.
- It does not capture the total number of severe issues, focusing only on the severity level at which 25% of indicators are at or above.
- The need for interpolation when the severity threshold falls between two values adds complexity to the calculation.

## 4. Key ethical considerations and related risks

The proposed research design meets / does not meet the following criteria:

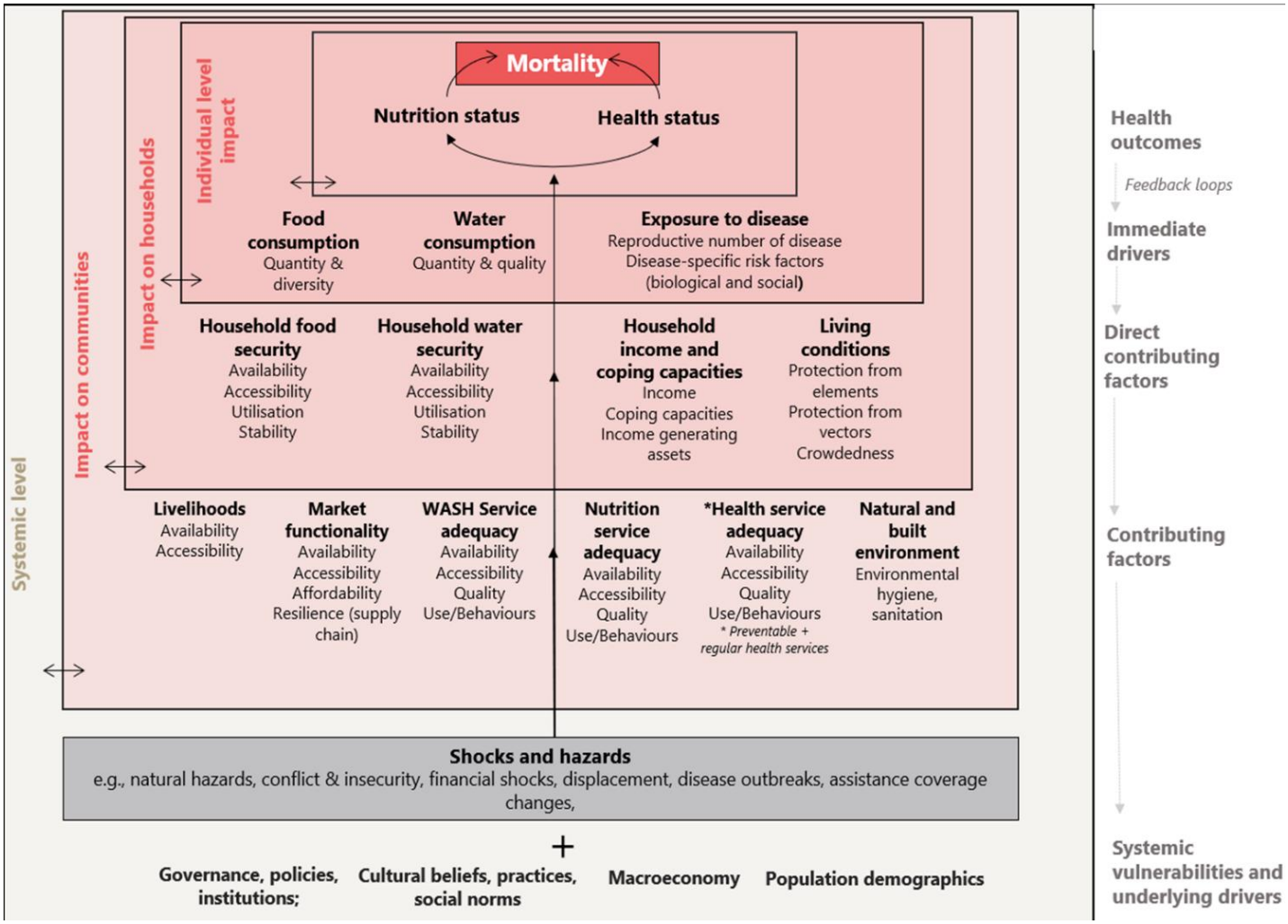
| ***The proposed research design…*** | ***Yes/ No*** | ***Details if no (including mitigation)*** |
|---|---|---|
| … Has been coordinated with relevant stakeholders to **avoid unnecessary duplication** of data collection efforts? | Yes | |
| … **Respects respondents, their rights and dignity** (*specifically by: seeking informed consent, designing length of survey/ discussion while being considerate of participants' time, ensuring accurate reporting of information provided*)? | Yes | |
| … Does not **expose data collectors to any risks as a direct result** of participation in data collection? | Yes | |
| … Does not **expose respondents / their communities to any risks as a direct result** of participation in data collection? | Yes | |
| … Does not involve **collecting information on specific topics which may be stressful and/ or re-traumatising** for research participants (both respondents and data collectors)? | Yes | |
| … Does not involve **data collection with minors** i.e. anyone less than 18 years old? | Yes | |
| … Does not involve **data collection with other vulnerable groups** e.g. persons with disabilities, victims/ survivors of protection incidents, etc.? | Yes | |

| | | |
|---|---|---|
| … Follows IMPACT SOPs for management of **personally identifiable information**? | Yes | |

## 5. Data Analysis Plan

See the AoK Severity Index indicator and thresholds table draft available here or on request to the Global Emergencies Unit in IMPACT HQ.

# ANNEX 1: IMPACT ACUTE NEEDS FRAMEWORK



## ANNEX 2: LIST OF INDICATORS COMPOSING THE AOK SI AND THEIR VALUE CHOICES AND ASSIGNED SEVERITY THRESHOLDS

Below is a copy of the AoK SI indicator and thresholds table available here or on request to the Global Emergencies Unit in IMPACT HQ. See section 3.1 for the rationale on indicator selection and the definition of thresholds (based on the underlying analytical frameworks).

| WASH indicators | 1 | 2 | 3 | 4 | 4+ |
|---|---|---|---|---|---|
| What is currently the most common source of water used for DRINKING by people in [the community]? | Protected from outside contamination | | Not-protected from outside contamination | Surface water | |
| In the last 30 days, how many days has there not been enough clean water for DRINKING for the MAJORITY of people in [the community]? | Never (0 days), there was always enough water | Rarely (1-2 days) | Sometimes (3-10 days) | Often (11-20 days) | Always (more than 20 days) |
| For the MAJORITY of people in [the community], how long does it currently take to get to the main water source, collect water and come back? | Less than 5 minutes | Between 5 and 30 minutes | Between 30 minutes and 1 hour | More than 1 hour | |
| Are any of the following things frequently visible around where people live in [the community]? Read responses out loud and select all that apply. | No visible waste | stress level type of visible waste | crisis level type of visible waster | emergency level of visible waste | |
| What is currently the most common type of toilet or latrine used by people in [the community]? | Clean and safe toilets/latrines | | Unclean toilets/latrines | Open defecation | |
| Do the MAJORITY of people in the community regularly wash their hands with soap and water? If not, why? | Yes | | No | | |
| Is there a problem in [the community] because people currently do not have enough water that is safe for DRINKING? If yes, how serious do you think the problem is? | No problem | Moderate problem | Serious problem | Very serious problem | Extremely serious problem |
| Is there currently a problem in [the community] because people do not have easy and safe access to clean latrines or toilets? If yes, how serious do you think the problem is? | No problem | Moderate problem | Serious problem | Very serious problem Extremely serious problem | |

| | | | | | |
|---|---|---|---|---|---|
| Is there currently a problem in [the community] because it is difficult for people to keep themselves clean; for example because there is not enough soap, water or suitable place to wash. If yes, how serious do you think the problem is? | No problem | Moderate problem | Serious problem | Very serious problem Extremely serious problem | |

| FSL indicators | 1 | 2 | 3 | 4 | 4+ |
|---|---|---|---|---|---|
| In the last [30 days], did some people in [the community] do any of the following things because they did not have enough money ? | No coping strategies | | stress livelihood strategies | crisis livelihood strategies | emergency livelihood strategies |
| In the last [30 days], did some people in [the community] do any of the following things because there is not enough food or money to buy food? | No coping strategies | | stress food security coping strategy | crisis food security coping strategy | emergency food security copying strategy |
| In the last [30 days], what proportion of the population in [the community] had to do very unusual and desperate things just to obtain a small amount of food? | Nobody or almost nobody (around 0%) | A few (around 25%) | About half (around 50%) | Most (around 75%) | Everyone (around 100%) |
| In the last [30 days], how would you describe the situation for hunger in [the community] because people were not able to get enough food? | No hunger or almost no hunger | | Hunger is small | Hunger is widespread and bad | Hunger is the worst it can be |
| In the last [30 days], what proportion of the population in [the community] had very insufficient food? | Nobody or almost nobody (around 0%) | A few (around 25%) | About half (around 50%) | Most (around 75%) | Everyone (around 100%) |
| Is there currently a problem in [the community] because people do not have enough income, money or resources to meet their needs? If yes, how serious do you think the problem is? | No problem | Moderate problem | Serious problem | Very serious problem | Extremely serious problem |

| | | | | | |
|---|---|---|---|---|---|
| Is there currently a problem in [the community] with food? For example, because people do not have enough food. If yes, how serious do you think the problem is? | No problem | Moderate problem | Serious problem | Very serious problem | Extremely serious problem |

| **Shelter indicators** | 1 | 2 | 3 | 4 | 4+ |
|---|---|---|---|---|---|
| Which of the following responses best describes the current level of building damage or destruction in [the community]? | 1. No damage | 2. Moderate damage: a few buildings are unusable (less than 1 in 4) | 3. Severe damage: many buildings are unusable (more than 1 in 4 but less than half) | 4. Extreme damage: more than half of buildings are unusable | |
| Do people in [the community] currently live in severely damaged shelters that are unsafe to live in? If yes, what proportion of people in [the community] are currently living in severely damaged shelters? | Nobody or almost nobody (around 0%) | A few (around 25%) | About half (around 50%) | Most (around 75%) | Everyone (around 100%) |
| Are some people in [the community] currently living in collective centres? If yes, how many? (for example: public buildings, religious buildings, schools, health centres, etc.) | None | A very small number of people | A small numberof people | A large number of people | |
| Are some people in [the community] currently living in makeshift shelters? If yes, how many? | None | A very small number of people | A small numberof people | A large number of people | |
| Are some people in [the community] currently sleeping outside in the open because they do not have an adequate shelter to live in? If yes, how many? | None | A very small number of people | A small numberof people | A large number of people | |

| | | | | | |
|---|---|---|---|---|---|
| Is there currently a problem in [the community] because some people do not have an adequate place to live in? If yes, how serious do you think the problem is? | No problem | Moderate problem | Serious problem | Very serious problem Extremely serious problem | |

| Health indicators | 1 | 2 | 3 | 4 | 4+ |
|---|---|---|---|---|---|
| For majority of people in [the community], how long does it take to get to the nearest, functional health facility, using the most common mode of transport? | Less than 30 minutes | More than 30 minutes to 1 hour | More than 1 hour to half a day | More than half a day to 1 full day | More than 1 full day or no health facility |
| What proportion of the population in [the community] can currently access adequate healthcare when they need it? | Everyone (around 100%) | Most (around 75%) | About half (around 50%) | A few (around 25%) | Nobody or almost nobody (around 0%) |
| What types of health structures are available to people in the community? | Hospital Primary care facilities / clinics | Mobile clinic / field hospital Informal emergency care points | Pharmacy | Traditional practitioner | |
| Where do the MAJORITY of women in [the community] obtain healthcare when they are pregnant or give birth? | Nearest health facility | Mobile health team that visits [the community] regularly | | No healthcare available for women who are pregnant or give birth | |
| Where do the MAJORITY of children and babies in the [community] currently get vaccinated? | Nearest health facility | Mobile health team that visits [the community] regularly | | No vaccination accessible | |

| | | | | | |
|---|---|---|---|---|---|
| Is there currently a problem in [the community] because people are not able to get adequate healthcare for themselves? For example treatment or medicines, or healthcare for women during pregnancy or childbirth, etc. If yes, how serious do you think the problem is? Read responses out loud | No problem | Moderate problem | Serious problem | Very serious problem | Extremely serious problem |

| **Education indicators** | 1 | 2 | 3 | 4 | 4+ |
|---|---|---|---|---|---|
| Are the MAJORITY of BOYS in [the community] attending school currently? | The majority of boys and girls attend school | | The majority of boys and girls do not attend school | | |
| Are the MAJORITY of GIRLS in [the community] attending school currently? | The majority of boys and girls attend school | | The majority of boys and girls do not attend school | | |
| Is there currently a problem with children's education in [the community]? For example, because some children cannot attend school, or education has been recently disrupted. If yes, how serious do you think the problem is? | No problem | Moderate problem | Serious problem<br>Very serious problem<br>Extremely serious problem | | |

| **Protection indicators** | 1 | 2 | 3 | 4 | 4+ |
|---|---|---|---|---|---|
| What are the main reasons why people or their families are not safe or protected where they live now? | No barriers to safety | stress protection barriers to safety | crisis protection barriers to safety | emergency protection barriers to safety | (Potentially: life-threatening barriers to safety) |
| Is there currently a serious problem in [the community] because people are not able to move between places? For example, going to another village or town, going to the market, or going to their farmland or pasture. | No problem | Moderate problem | Serious problem | Very serious problem<br>Extremely serious problem | |

| | | | | | |
|---|---|---|---|---|---|
| Is there currently a serious problem in [the community] because people or their families are not safe or protected where they live now? For example, because of conflict, violence or crime in [the community], city or village. | No problem | Moderate problem | Serious problem | Very serious problem Extremely serious problem | |

| Cash & Markets | 1 | 2 | 3 | 4 | 4+ |
|---|---|---|---|---|---|
| In the last 30 days, where did the MAJORITY of people in [the community] buy or sell items if they needed to? | [Marketplace or store] in this [community] [Marketplace or store] in a neighbouring [community]/village/city | [Marketplace or store] in a far away [community] Rely on own production / no need to go to marketplace Mobile vendors or traders who visit this [community] | Cannot reach a functioning [marketplace or store] | | |
| Has there been a sudden change in prices in the last 30 days in food items? | No change | A small increase/ a small decrease | A large increase / A large decrease | | |
| Has there been a sudden change in prices in the last 30 days in basic non-food items? | No change | A small increase/ a small decrease | A large increase / A large decrease | | |

| Shocks | 1 | 2 | 3 | 4 | 4+ |
|---|---|---|---|---|---|
| In the last 60 days, how many people have left [the community]? Please give your best estimate even if you do not know the precise answer, but feel free to say if you don't know. | None | A very small number of people | A small number of people | A large number of people | |
| How many displaced people are currently in [the community]? Please give your best estimate even if you do not know the precise answer, but feel free to say if you don't know | None | A very small number of people | A small number of people | A large number of people | |

# ANNEX 3: SEVERITY INDEX MAPPING SOP

## 1. Introduction

Once the severity index analysis scripts have been run, there are a number of ways to present this information spatially. This SOP is intended for in-country GIS officers/specialists with intermediate skills in GIS. However, section 1.1 (which map?) explains the map format recommendations and would also be useful for assessment officers/research managers to help determine the most appropriate map for the country/context.

### 1.1. Which map?

Depending on whether settlement coordinates are available (see box below), there are a number of options to display severity index data (or other relevant indicators from your HSM). Each option can be used either based on the Flag Index or the Score Index approach. Our recommendation is to use the following maps (see details below):

If most/all settlement coordinates are available:

- **Dot maps**[26]
- **Hexagon maps**
- **Area aggregated maps (e.g. aggregated to admin2/3 or livelihood zones)**

If settlement coordinates are not available/many are missing:

- **Area aggregated maps (e.g. aggregated to admin2/3 or livelihood zones)**

**Important note on settlement coordinates**

If you want to map data at settlement level, ensure you have the coordinates of all (or at least most) of the settlements that you are assessing. Ideally these should be in a master spreadsheet with a column for latitude, longitude as well as a unique identifier column so that the data can easily be linked to a matching column in your severity index data table. This unique identifier can be the name of the settlement or a PCODE but must be unique and exactly match a column in your data. If using the settlement name, you may also need to include a low-level admin area (e.g. admin 3 or 4) in the unique identifier name/code as there may be multiple settlements throughout the country with the same name (see example unique identifiers used for South Sudan in the "Settl_paym" column below which include settlement name & admin 3 PCODE, merged using the Concatenate function in Excel).

| Settl_paym | lat | long |
|---|---|---|
| AACTACH SS090103 | 7.29411 | 28.4391 |
| AANGARI SS050101 | 8.25909 | 26.9091 |
| ABA PING SS050206 | 9.15932 | 27.426 |
| ABABA SS050102 | 8.434744 | 26.50347 |
| ABABANYA SS010509 | 5.71926 | 31.7001 |
| ABADAI SS080605 | 9.15039 | 28.4588 |
| ABAGA SS040303 | 7.2056 | 29.7172 |
| ABAGAR SS080203 | 8.65128 | 28.2551 |
| ABAIAT SS070902 | 10.3082 | 32.5457 |
| ABAIAT SS070906 | 10.3 | 32.56 |

If you do not have such a list already available, it is wise to work on this step before or during data collection so that it is ready by the time data collection has finished, minimising delays to producing any outputs.

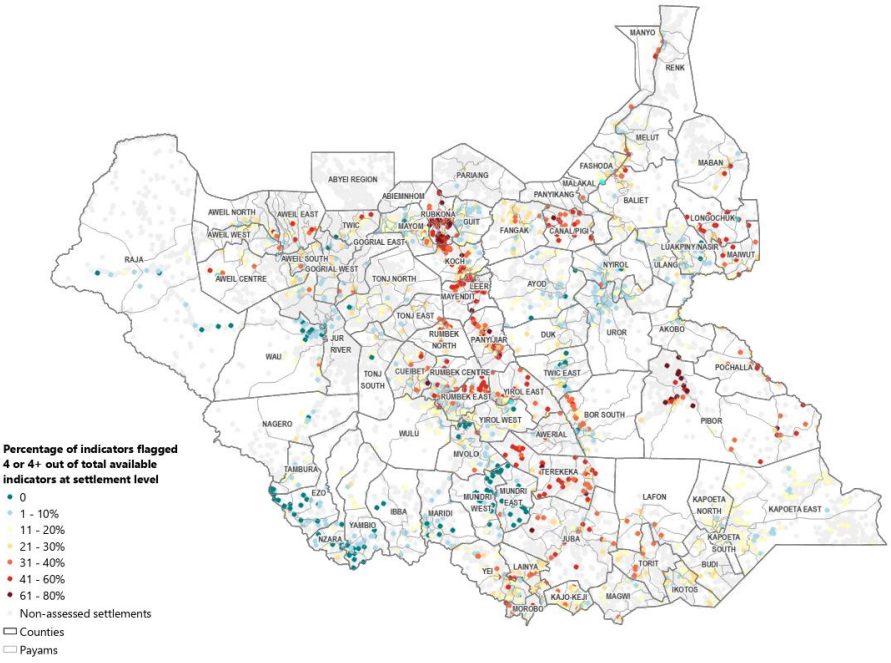
[26] If you do not have coordinates for the settlements, you can exclusively use the area-aggregated approach. Areas should be selected based on what the data intends to inform, e.g. admin 2, or a lower level admin area such as admin 3 for more detail (if these have been recorded in your assessment and you have a shapefile for them). Area-aggregated maps may also be a more appropriate option if you are missing a large proportion of settlement coordinates.

**Dot map:**

Dot maps are useful because they are the most granular depiction of the spatial distribution of severity across the assessed units of analysis.[27] They can show patterns of need within and across any arbitrary boundaries, for example showing how needs might cross two different admin boundaries in a way that would not be noticed in maps based on admin boundaries. They are useful for identifying hotspots and can potentially inform operational responses by providing granular information on where severe needs are reported (keeping in mind the limitation that this is based on indicative samples of settlements only and so non-sampled settlements with potentially severe conditions are not mapped).

When using the **Flag Index** methodology (example map below), the following title and explanation paragraphs can be used for the maps in information products:

- Title: *Percentage of indicators flagged 4 or 4+ out of total available indicators at settlement level*
- Explanation: *Each dot on the map represents the overall severity of multisectoral needs reported by KIs in an assessed settlement. Overall severity is calculated as the percentage of indicators which cross the emergency threshold (severity 4 out of 5) out of the total number of indicators for which there is data (i.e. out of all the available indicators that could be flagged as severe, what proportion are in fact flagged as severe).*




When using the **Score Index** methodology, the following title and explanation paragraphs can be used for the maps in information products:

- Title: *Severity score (1 to 4+) per settlement*
- Explanation: *Each dot on the map represents the overall severity of multisectoral needs reported by KIs in an assessed settlement. Overall severity is calculated as the severity score (1 to 4+) achieved or surpassed by all of the top 25% most severe indicator scores across all indicators measured in each settlement (based on their values in reference to the defined severity thresholds). In short, each dot highlights the severity of the worst-off indicators in each settlement.*

[27] Typically the unit of analysis is the settlement, and dot maps represent settlements. However, note that in cases where the unit of analysis is e.g. an admin 3 (which can happen even though it is not typical), then the dot map methodology can still be used but admin 3 boundaries will of course act as the "dots". This is technically different than the area-aggregated map approach described below as it is then not based on an aggregation, and so the map title and explanation from the dot map approach should be used.

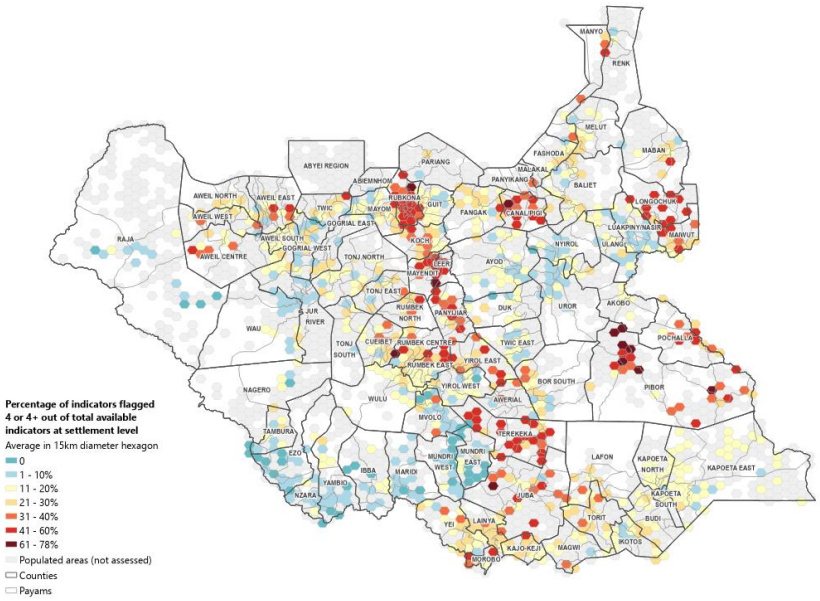
**Hexagon map:**

In this map, settlement level data from the map above is aggregated, i.e. averaged, to hexagon level. Appropriate hexagon size should be determined based on the country/context. Hexagons have several benefits for spatial aggregation compared with square grids.[28] This is a good option as it better highlights hotspots compared to the settlement-level data (because the hexagons are larger than the dots) whilst still providing more spatial detail compared to using admin areas. It is recommended to use a hexagon map in cases where the settlement dot map leads to many overlapping dots which hides some of the dots and leads to a noisy overall picture. Using both a dot map and hexagon map can also be an option, to benefit from the advantages of both (if used in a dashboard, it can be considered to add a filter to switch the view between a dot map, a hexagon map and an admin map).

Hexagons containing settlements that were not assessed should also be included in grey to highlight populated areas where data was not collected. One drawback is that some hexagons may only contain 1 or a few settlements, whilst others may contain many settlements, meaning the sample size within each hexagon may vary. In addition, some detail is lost by aggregating to hexagon level, meaning some smaller hotspots may be "watered down" and values for individual hexagons may not be fully representative of the entire area covered by that hexagon. This can be mitigated by presenting alongside the settlement map.

When using the **Flag Index** methodology (example map below), the following title and explanation paragraphs can be used for the maps in information products:

- Title: *Percentage of indicators flagged 4 or 4+ out of total available indicators at settlement level, average in x km diameter hexagons*
- Explanation: *Each hexagon on the map shows the average overall severity of multisectoral needs reported by KIs in assessed settlements within the hexagon. Average overall severity is calculated as the proportion of indicators which cross the emergency threshold (severity 4 out of 5) out of the total number of indicators for which there is data (i.e. out of all the available indicators that could be flagged as severe, what proportion are in fact flagged as severe), based on the average number of flagged indicators across assessed settlement in each hexagon*.




[28] See: https://pro.arcgis.com/en/pro-app/latest/tool-reference/spatial-statistics/h-whyhexagons.htm#:~:text=Hexagons%20tend%20to%20break%20up,be%20perceived%20in%20fishnet%20grids

When using the **Score Index** methodology, the following title and explanation paragraphs can be used for the maps in information products:

- Title: *Average settlement severity score (1 to 4+) per x km diameter hexagon*
- Explanation: *Each hexagon on the map shows the average overall severity of multisectoral needs reported by KIs in assessed settlements within the hexagon. Overall severity is calculated as the severity score (1 to 4+) achieved or surpassed by all of the top 25% most severe indicator scores across all indicators measured in each settlement (based on their values in reference to the defined severity thresholds). In short, each hexagon highlights the severity of the worst-off indicators in all settlements within that hexagon.*

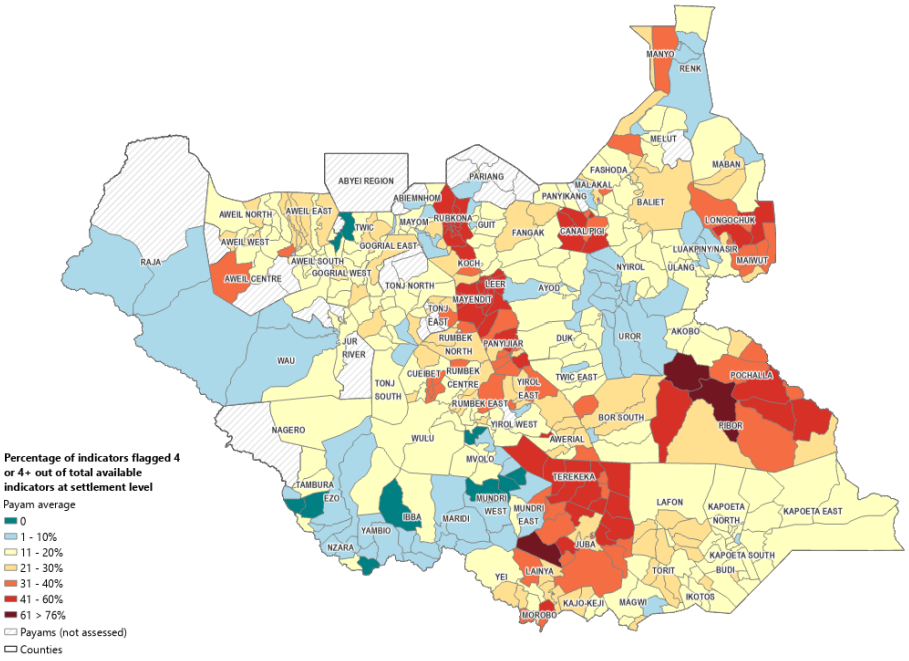
**Area aggregated map (e.g. aggregated to admin2/3 or livelihood zones):**

In most cases, results should also be mapped based on area boundaries (typically admin 2 boundaries) to inform prioritization between these admin units (which are usually the reference point for humanitarian planning and prioritization). Other area units can also be used, such as admin 3 or even livelihood zones. The chosen areas should be selected based on what the data aims to inform, e.g. if the primary aim is to inform prioritization processes that exist in the humanitarian system and are based on admin 2, then aggregation should be done at admin 2. Such maps can then be presented in parallel with settlement dot maps or hexagon maps to present a more strategic and localized view of needs.

If you do not have settlement coordinates or if a large amount is missing, you can exclusively create area aggregated maps as an alternative to settlement dot maps or hexagon maps. As mentioned, the selected areas should be the most appropriate for what you want the data to inform, and you may want to show aggregations to different area units such as admin 2 and admin 3 if appropriate. On the other hand, if settlement location data is available for some but not all settlements, you can even show the settlement-level map alongside this area-level map, but ensure to highlight the fact that some settlements are missing. Finally, mapping at livelihood zone level can be a useful way of presenting the data due to potentially similar drivers of needs across livelihood systems (see this research piece conducted by REACH). However, for this you will need to conduct sampling at livelihood zone level or have the settlement coordinates in order to aggregate them to livelihood zone level (see box about settlement coordinates above).

When using the **Flag Index** methodology (example map below), the following title and explanation paragraphs can be used for the maps in information products:

- Title: *Percentage of indicators flagged 4 or 4+, out of total available indicators at settlement level - [admin level, e.g. admin 2/3] average*
- Explanation: *Each [admin division, e.g. admin 3 in the example] on the map shows the average overall severity of multisectoral needs reported by KIs in assessed settlements within the [admin division]. Average overall severity is calculated as the percentage of indicators which cross the emergency threshold (severity 4 out of 5) out of the total number of indicators for which there is data (i.e. out of all the available indicators that could be flagged as severe, what proportion are in fact flagged as severe), based on the average number of flagged indicators across assessed settlement in each admin zone.*




When using the **Score Index** methodology, the following title and explanation paragraphs can be used for the maps in information products:

- Title: *Average settlement severity score (1 to 4+) per [admin level, e.g. admin 2 or District]*
- Explanation: *Each area on the map shows the average overall severity of multisectoral needs reported by KIs in assessed settlements within the [admin level, e.g. admin 2 or District]. Overall severity is calculated as the severity score (1 to 4+) achieved or surpassed by all of the top 25% most severe indicator scores across all indicators measured in each settlement (based on their values in reference to the defined severity thresholds). In short, each [admin level, e.g. admin 2 or District] highlights the severity of the worst-off indicators in all settlements within that [admin level, e.g. admin 2 or District].*

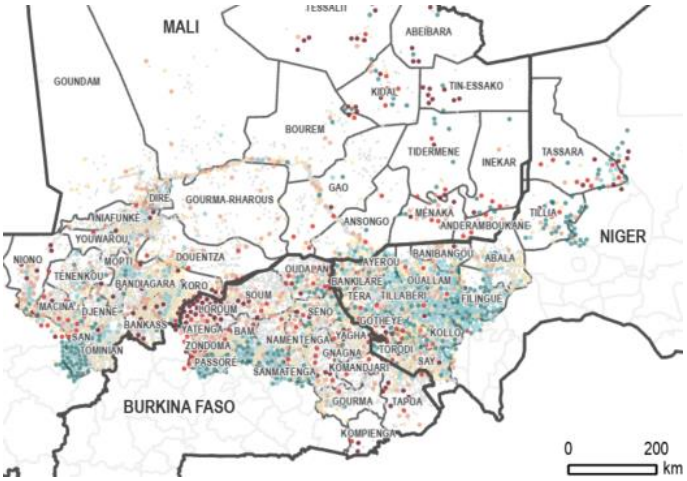
## 2. Creating the maps

As mentioned, you can show a combination of the above maps depending on the country/context, e.g. a settlement level map and hexagon level map or a settlement level map with an admin 3 level map for example. Please follow the instructions below **using the ArcGIS Pro template attached** and making adjustments for your country as appropriate to develop your map layout.[29] Please reach out to HQ if you would like to discuss the most appropriate visualisation options or need any support on producing the maps.

### 2.1. Creating a dot map

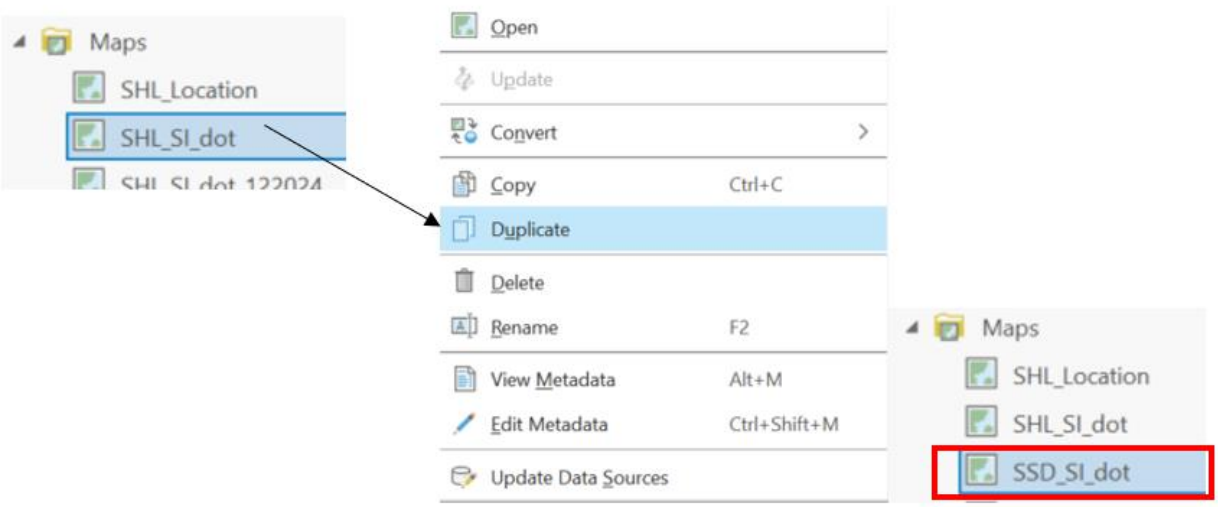
As mentioned in section 1, the dot map shows results coloured for each assessed settlement (depending on which aggregation approach is followed). Ideally the map should also show non-assessed settlements to highlight populated areas that were not assessed. In the example below from the Sahel, the pockets of populated areas that were not assessed can be seen in grey. Whilst it looks like the majority of northern Mali is not covered by the assessment, the inclusion of the non-assessed settlements in grey indicate that the majority of the area is actually unpopulated/sparsely populated.

[29] The templates are based on the Flag Index aggregation approach and should be adjusted if using the Score Index approach (e.g. the legend will be different, etc.).

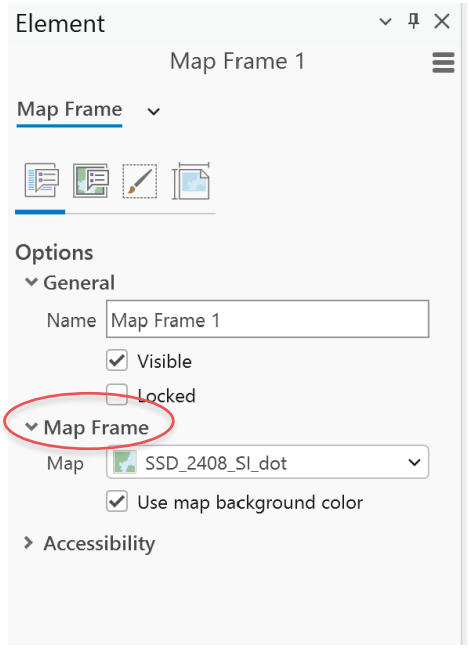



To create a dot map, follow these steps:

**Step 1: create a new map and layout in your ArcGIS project.** You can open the ArcGIS template linked above. Duplicate and rename an old dot map from the Catalog pane to use as a template. For example, for a map for South Sudan (SSD):




Duplicate an old map layout too for your dot map. Make sure in the Map Frame properties that the Map Frame on the new layout is updated to show the correct map!




**Step 2: prepare severity index data.** Once you have received the severity index data, copy and reformat the file as a CSV file including the following two columns:

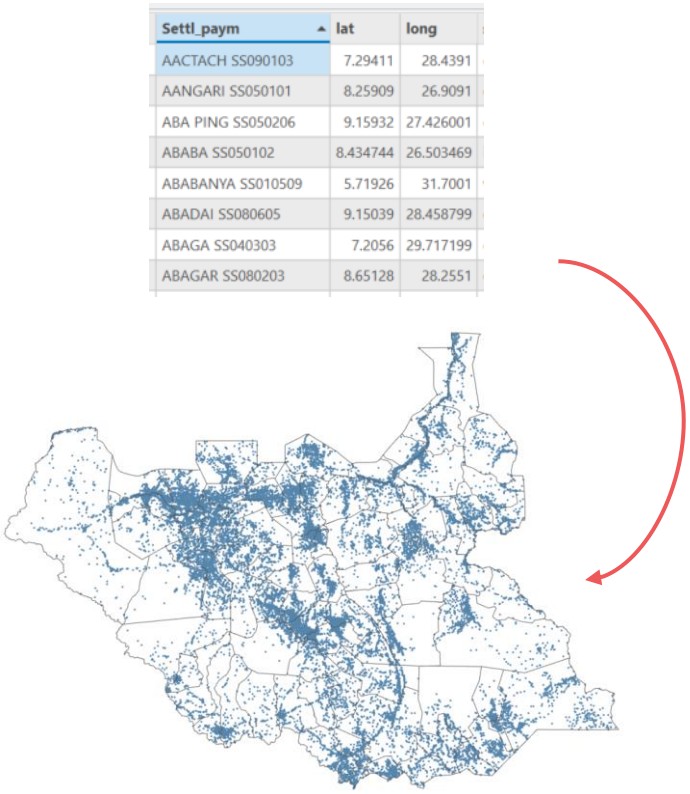
- Settlement ID column: a column containing the settlement name/pcode. This should be unique and exactly match those in the master settlement list that contains the settlement coordinates (see section 1.2).
- Severity index column: dependent on the aggregation approach used (Flag Index or Score Index). If using the Flag Index approach, it is recommended to use the column representing the proportion (ratio) of flag 4/4+ flags, as shown in the example below.

Save the data as a CSV and add to your map in ArcGIS Pro. The attribute table should look something like this:

| Settl_paym | ratio_4_settlement |
|---|---|
| RUBU SS100203 | 20 |
| WAYIMBA SS010402 | 20 |
| WEEK SS031108 | 20 |
| YAKUACH SS030701 | 20 |

**Step 3: prepare settlement location data.** This is your master settlement list for your country/region. It should contain rows with unique settlement names/locations across your country in a geospatial format (e.g. shapefile). Ensure there are no duplicate settlements. This script was used in South Sudan to prioritise settlement locations from a list of duplicate settlement entries based on the most reliable source.

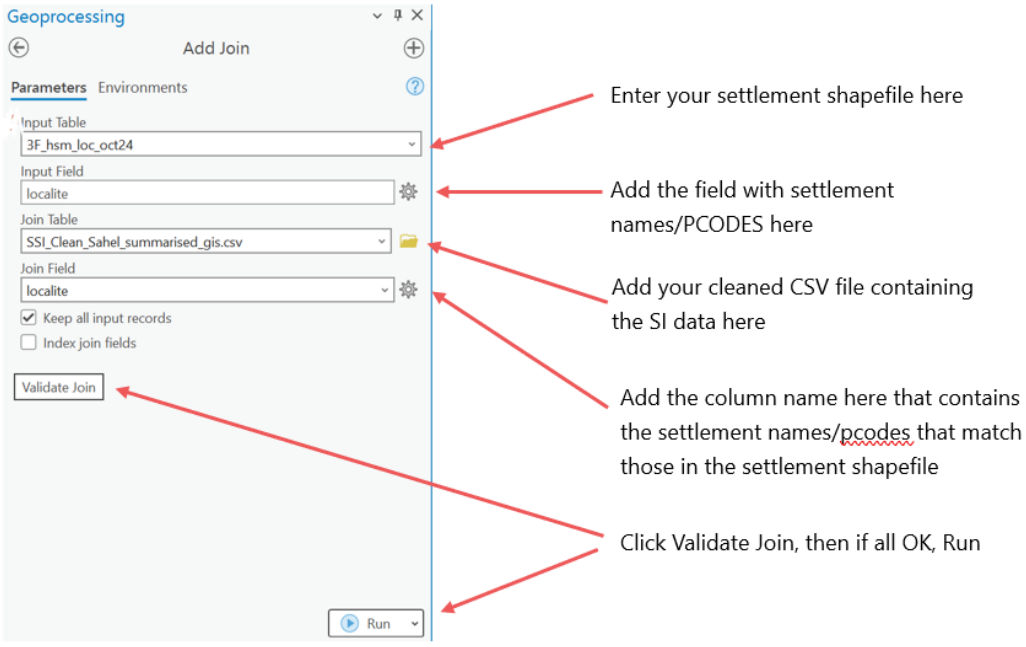
If the file in CSV format, columns with coordinates are also needed to plot these in ArcGIS Pro and convert the data to a shapefile. When opened in ArcGIS Pro, it should look something like this, with a column containing unique identifiers that matches your data file above (e.g. settlement names, PCODES or settlement names with PCODES appended as in this example).



| Settl_paym | lat | long |
|---|---|---|
| AACTACH SS090103 | 7.29411 | 28.4391 |
| AANGARI SS050101 | 8.25909 | 26.9091 |
| ABA PING SS050206 | 9.15932 | 27.426001 |
| ABABA SS050102 | 8.434744 | 26.503469 |
| ABABANYA SS010509 | 5.71926 | 31.7001 |
| ABADAI SS080605 | 9.15039 | 28.458799 |
| ABAGA SS040303 | 7.2056 | 29.717199 |
| ABAGAR SS080203 | 8.65128 | 28.2551 |

**Step 4: join the SI data to the settlement location data.** Use the Add Join tool to join the CSV file containing your severity index data to your settlement location shapefile based on the unique settlement ID field (settlement name/PCODE). Use Validate Join to check for unmatched settlements and clean the data if necessary.

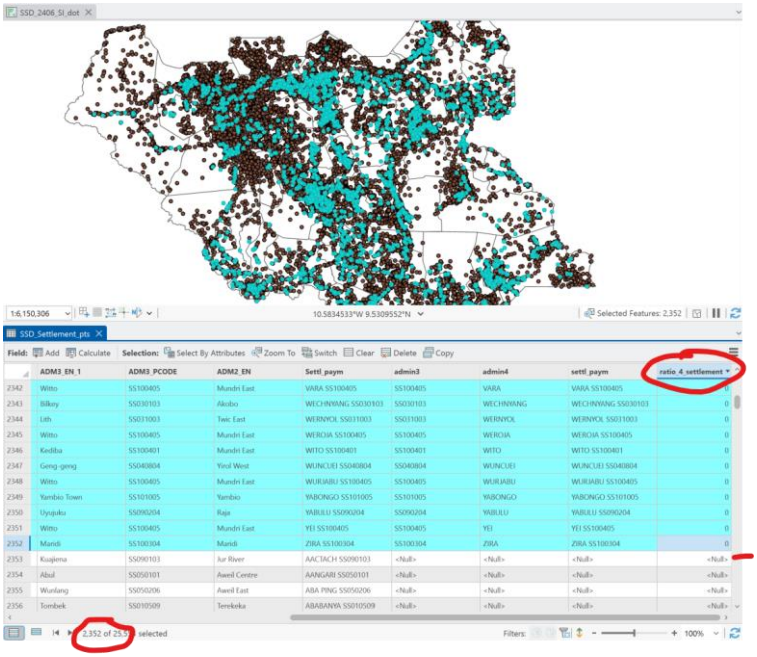
Note: if you joined previous SI data to an existing settlements point shapefile, you may need to first remove the previous join using the Remove Join tool.

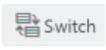



After running the tool, order the features by the "ratio" column and select the features with non-null values. These are the settlements in your severity index data that had matching records in the settlement shapefile. If there are some missing, this is because there was no match with the settlement in the shapefile. In this example below, there are only 2,352 matching

settlements, even though 3,680 were assessed. As such a large proportion of settlements are missing, it would be recommended in this case to also aggregate this to admin 3 level and if also showing a settlement or hexagon map alongside it, make it clear that a large proportion of settlement locations are missing from these maps.

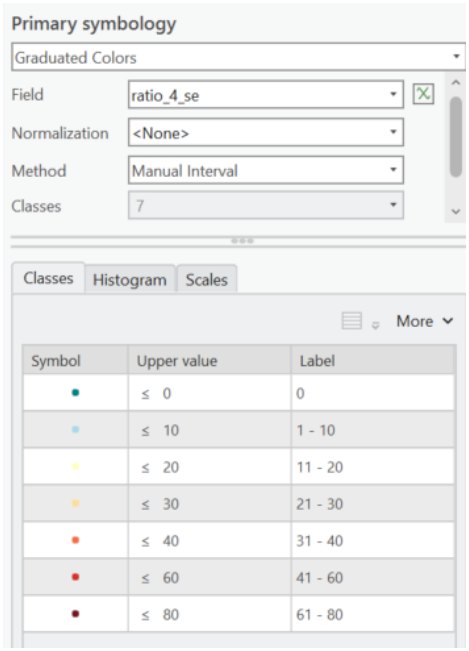
Export these selected features and save as a new shapefile representing your assessed settlements.

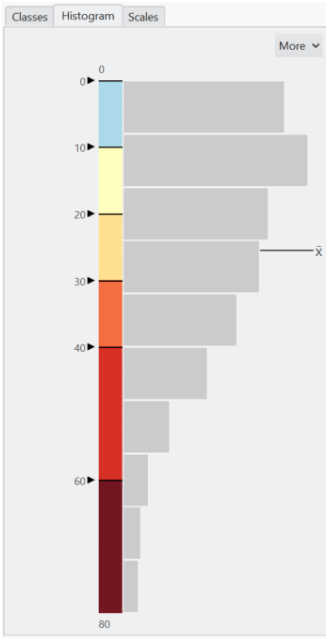


Invert the selection using this button in the attribute table 

and then export these features as a new shapefile. These are your non-assessed settlements, which can be displayed as grey dots.

**Step 5: symbolise the assessed settlements based on the relevant column (e.g. ratio column).** You can use the Apply Symbology tool to apply the same symbology used in the previous layer, and then adjust the value ranges if necessary. For consistency and to enable comparisons over time, it is recommended to use the same colour ranges for each data collection round. Those shown below (used for South Sudan) were chosen because they allow to adequately highlight severity hotspots (blue is used to symbolize "cold" as the opposite of hotspots. But different value ranges may be more appropriate for other countries. You can check the histogram to look at the spread of values. If you can, it would be worth checking value distributions from a number of rounds to get an idea of the annual variation in values. A separate colour should be used for zero values. Note that you may also need to adjust the label for the upper value range in case of different values, or just label it as e.g. "80+". Please refer to the IMPACT colourblind safe colour palettes to get HEX/RGB codes here.



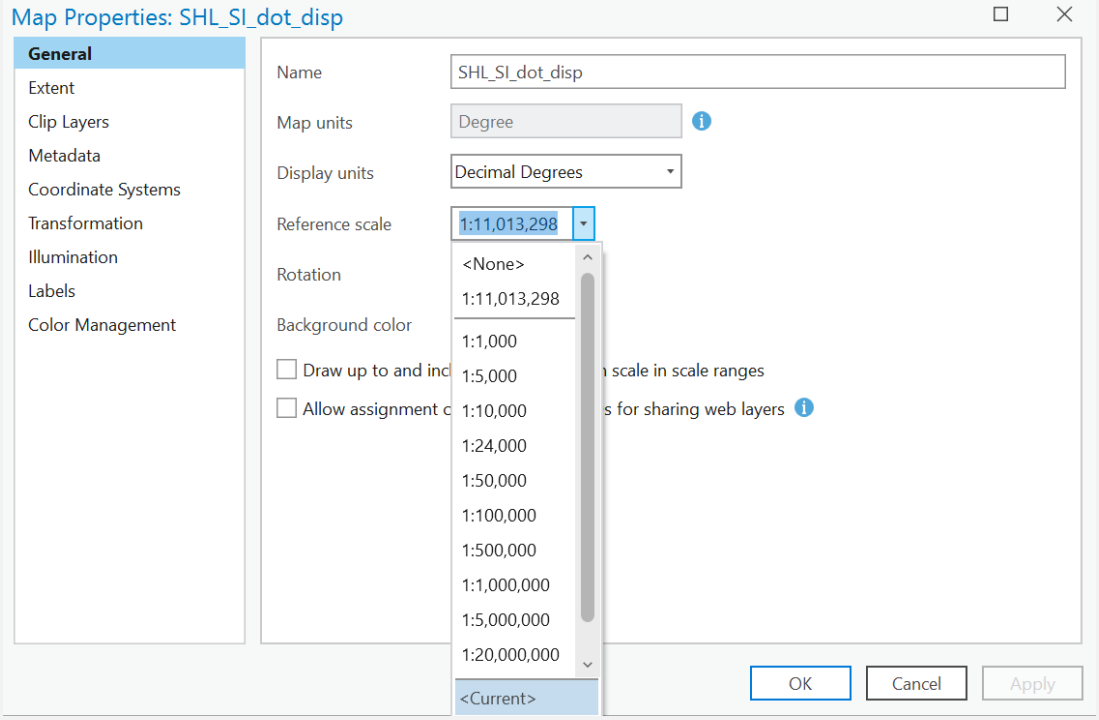

**Step 6: assess results.** Check your results with the assessment/field team to confirm that the map shows expected results.

**Disperse points (optional additional steps)**

If many of the settlements are overlapping, you can follow these additional steps to disperse the points. Note that whilst this ensures all points are visible, it does mean that their geographical position on the map becomes altered, so this is an important consideration.

**A. Export as a new shapefile.** Export the original settlement layer with SI data joined as a new shapefile with the "_disp" suffix in the filename (this should be the one you created in step 4 once you joined the SI data and with all assessed and non-assessed settlements included before you extracted those separately).

**B. Set reference scale for your map.** Create a new map (duplicate your current map from the catalog frame). Ensure your map is zoomed to your area of interest. Now go to Properties> Set Reference Scale and click <Current>.




**C. Use Disperse Markers tool.** The shapefile you just exported will be your input. Set the minimum distance to a very small value such as 10 metres. This will displace settlement points just enough so that they are no longer overlapping. You can use the "Expanded" dispersal pattern. Note this tool may be very slow to run if you have a large number of settlements.

**D. Symbolise layers.** Extract assessed and non-assessed settlements separately as before (second part of step 4 above) and apply appropriate symbology (step 5 above).

## 2.2. Creating a hexagon map

**Step 1. Duplicate map & layout.** As before, duplicate an old map and layout from the Catalog frame for your hexagon map. As before, make sure in the Map Frame properties that the Map Frame on the new layout is updated to show the newly created map!

*Important note: if you've completed these maps before for different rounds, skip step 2 and 3 and use the existing hexagon grid you created in the first round for consistency.*

**Step 2. Add or generate a shapefile representing the area covered by your assessment** – usually this is just the country boundary. However, in the case of a transboundary assessment, e.g. in Sahel HSM, this could include admin areas spanning across multiple countries. Ensure this shapefile is in a projected coordinate reference system or convert it to one, e.g. UTM, Africa Albers Equal Area Conic, etc. You may also need to set the project CRS to match. This will ensure the hexagon grid will be generated in metres.

**Step 3. Create hexagon grid.**

I prefer to use the Create Grid tool in QGIS as you are able to set the hexagon diameter. Optimal hexagon diameter will vary by country and may depend on several factors such as the density of assessed settlements and spatial diversity. For example, for South Sudan, a diameter of 15km was used. You can set this under the horizontal and vertical spacing options. Grid type should be set to "Hexagon". Set your grid extent to the AOI file generated in step 2 and ensure you have set to a projected CRS so that units are in metres.

As mentioned, you should only need to create a grid once – ideally you would use the same grid for subsequent data collection rounds for consistency/ comparability.

**Step 4. Use Summarise Within Tool.**

Go back to the assessed settlement shapefile that you exported with the severity index data joined that you created in step 4 of the dot map process above. This is the file just containing assessed settlements.

This "assessed settlements" shapefile can then be used as an input to the Summarise Within tool (in ArcGIS).

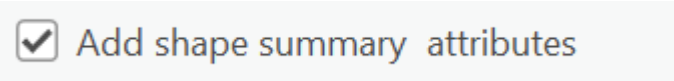
- Input polygons: the hexagon grid you just generated
- Input summary features: the assessed settlement layer
- Summary field: this should be the ratio field, with the statistics set to "mean." This will calculate the average value of all settlements in each hexagon.
- Note that the output file has to be saved in a File Geodatabase.

**Step 5. Apply symbology from previous layer.**

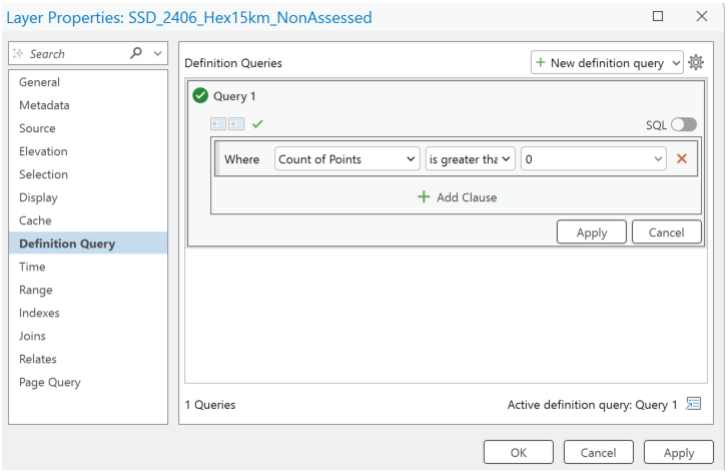
Symbolise the output shapefile by the relevant column (e.g. ratio mean field) generated in the previous step. You can use the Apply Symbology tool to copy over the symbology from an old hexagon layer. The value ranges should match those used for the settlement dot map for consistency.

**Step 7. Add non-assessed hexagons (non-assessed populated zones)**

For this, you can can use the Summarize Within tool again. This time you should put this non-assessed settlement file (that you created for your dot map) as the input summary features. You don't need to add anything under Summary Fields. Just ensure that the "Add shape summary attributes" option is checked.




The output shapefile will then contain a column named "count of points" that will contain the number of non-assessed settlements in each hexagon. You can symbolise the hexagons as light grey and only show hexagons containing settlements, i.e. where "count of points" is greater than 0 by setting a definition query in the layer properties, as shown below. Ensure this layer is played underneath the assessed hexagons. These will be your non-assessed populated zones.



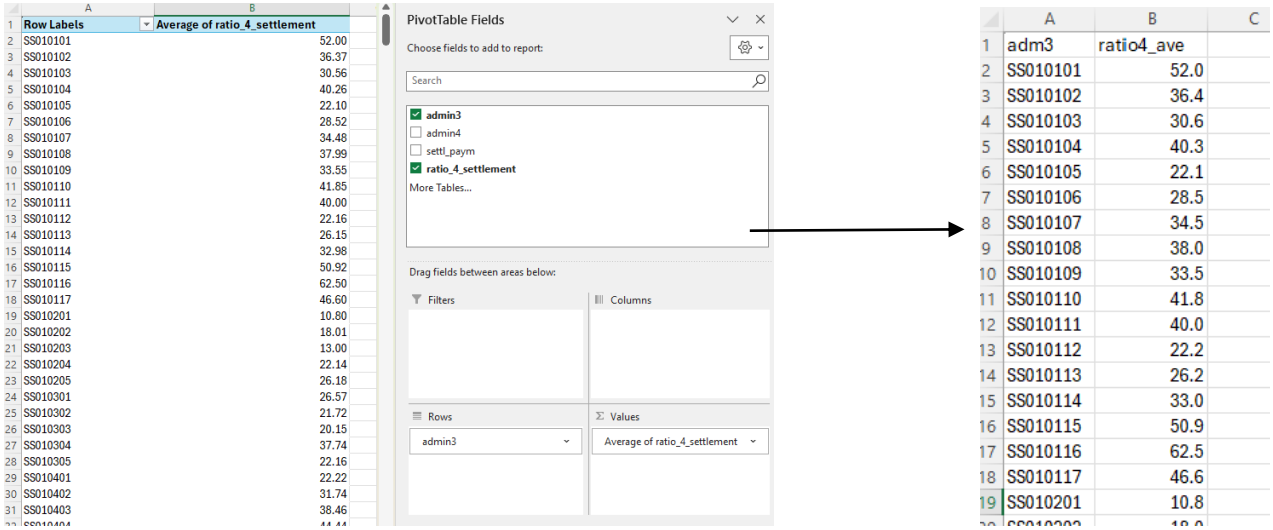

**Step 8. Assess results.** Check your results with the assessment/field team to confirm that the map shows expected results.

## 2.3. Creating an area aggregated map

**Step 1.** Prepare an area shapefile (e.g. admin 2/3, or livelihood zones, etc) and ensure it contains a column with unique identifiers (e.g. PCODES or livelihood zone IDs) which can be matched to those in your SI data.

**Step 2.** Prepare your severity index data. This should be a table containing a column with your unique area IDs (e.g. PCODES or livelihood zone IDs) and (when using the Flag Index approach) the percentage of flagged indicators that are 4 or 4+ out of the total number of available indicators at settlement level, averaged to your areas. You can calculate the area averages in R or using a pivot table in Excel based on your settlement level data.

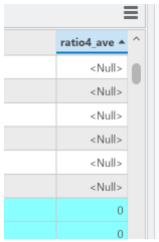
*Note: if using livelihood zones, you may first need to conduct a spatial join from the livelihood zones layer to the settlements point layer to join the relevant livelihood zone ID to each settlement. You can then export the shapefile as a table (CSV) and generate the average by livelihood zone using a pivot table as indicated.*




Ensure that the admin PCODE column only contains PCODES and delete any other entries such as "grand total" which come from the pivot table. Export this payam average table as a CSV file and add it into ArcGIS Pro.

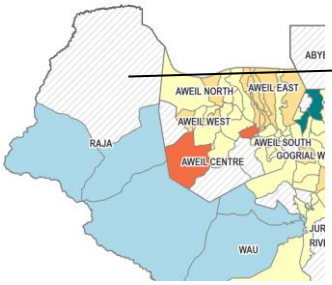
**Step 3.** Use the Add Join tool to join the severity index data CSV file to the area shapefile based on the unique identifier field (e.g. admin PCODE column).

In the attribute table of the area shapefile, select the areas with non-null values in the ratio average column. These are your assessed areas.




Export this data as a new shapefile representing your assessed areas.

Next invert (switch) your selection in the attribute table and export these features as a shapefile. These are your non-assessed payams. You can display these as grey hashed-line shapes.




Non-assessed payams

**Step 4.** Use the Apply Symbology tool to apply symbology based on the SI data to your assessed payam layer from an old layer if available. Adjust the value ranges, ensuring they correspond to those used for the other maps.

## 3. Alternatives

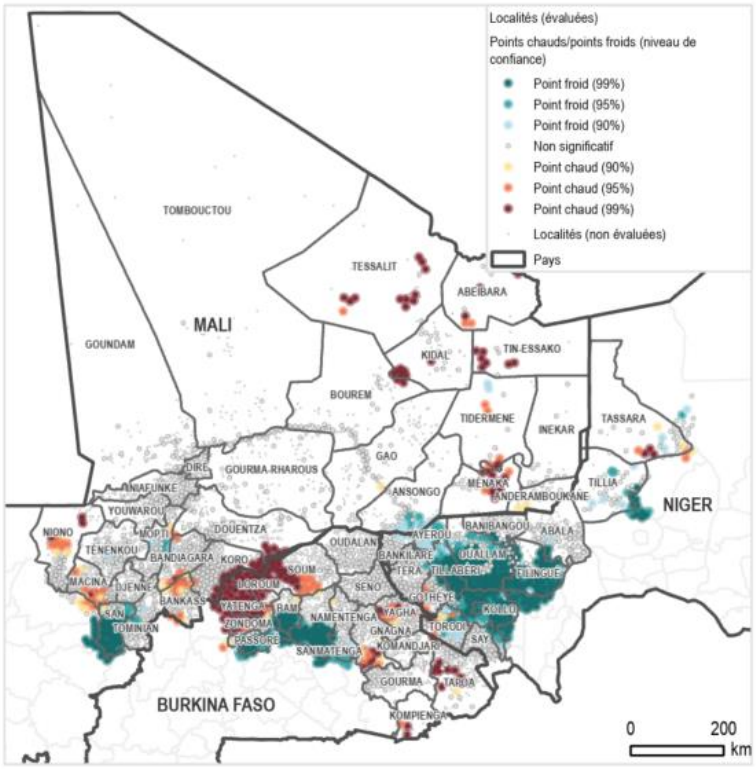
### 3.1. Hotspot map

The hotspot map is another possible option for displaying severity index data but in most cases it is recommended to use the approaches above. If you consider this option, please first discuss with IMPACT HQ as there are some additional considerations to take into account given that this format may be more challenging for non-technical audiences to digest and some additional interpretation information is needed.

This example from the Sahel was created using the Hotspot Analysis - Getis Ord Gi* algorithm in ArcGIS Pro with a 25km distance threshold. Areas beyond the distance threshold applied may appear as grey because there are not enough points in the vicinity to class it as a hotspot, yet there may still be high severity in that area.

**Hotspot map (alternative option):**

This map shows hot spots and cold spots based on settlement values within a specified distance of each settlement (set at 25km in this example). This map is effective at showing "clusters" of severity that are very easily identifiable for prioritisation purposes. However, this methodology comes with some limitations. Specifically, if there is a lot of variety in values in the specified radius, it will appear as non-significant (grey areas) and thus potentially mask some locations with high severity (small but severe hotspots). Equally, if there are not enough assessed settlements in that radius, it may miss the smaller hotspots. This methodology may or may not be appropriate in different contexts depending on sampling and coverage etc. It may also require more explanation and be more difficult for a non-technical audience to interpret. In most cases, it is recommended to use the maps presented above and simply ensure the colour coding adequately captures highlight hotspots.


Localités (évaluées)
Points chauds/points froids (niveau de confiance)
Point froid (99%)
Point froid (95%)
Point froid (90%)
Non significatif
Point chaud (90%)
Point chaud (95%)
Point chaud (99%)
Localités (non évaluées)
Pays
TOMBOUCTOU
TESSALIT
ABEIBARA
MALI
GOUNDAM
KIDAL
TIN-ESSAKO
BOUREM
TIDERMENE
INEKAR
TASSARA
GAO
DIRE
GOURMA-RHAROUS
MENAKA
TILLIA
ANSONGO
TANDERAMBOUKANE
NIGER
YOUWAROU
NIONO
MOPTI
DOUENTZA
AYEROU
BANIBANGOU
ABALA
TENENKOU
OUDALAN
BANDIAGARA
KORO
BANKILARE
OUALLAM
MACINA
DJENNE
SOUM
TERA
TILLABERI
TILLIGUE
BANKASS
SENO
GOTHEYE
KOLLO
SAN
YATENGA
RAM
NAMENTENGA
NAGHA
TOMINIAN
ZONDOMA
GNAGNA
TORODI
SAY
PASSORE
SANMATENGA
KOMANDJARI
GOURMA
TAHOUA
BURKINA FASO
KOMPIENGA
0
200
km

## ANNEX 4: METHOD AND RESULTS OF THE SENSITIVITY ANALYSIS

1. Missing values

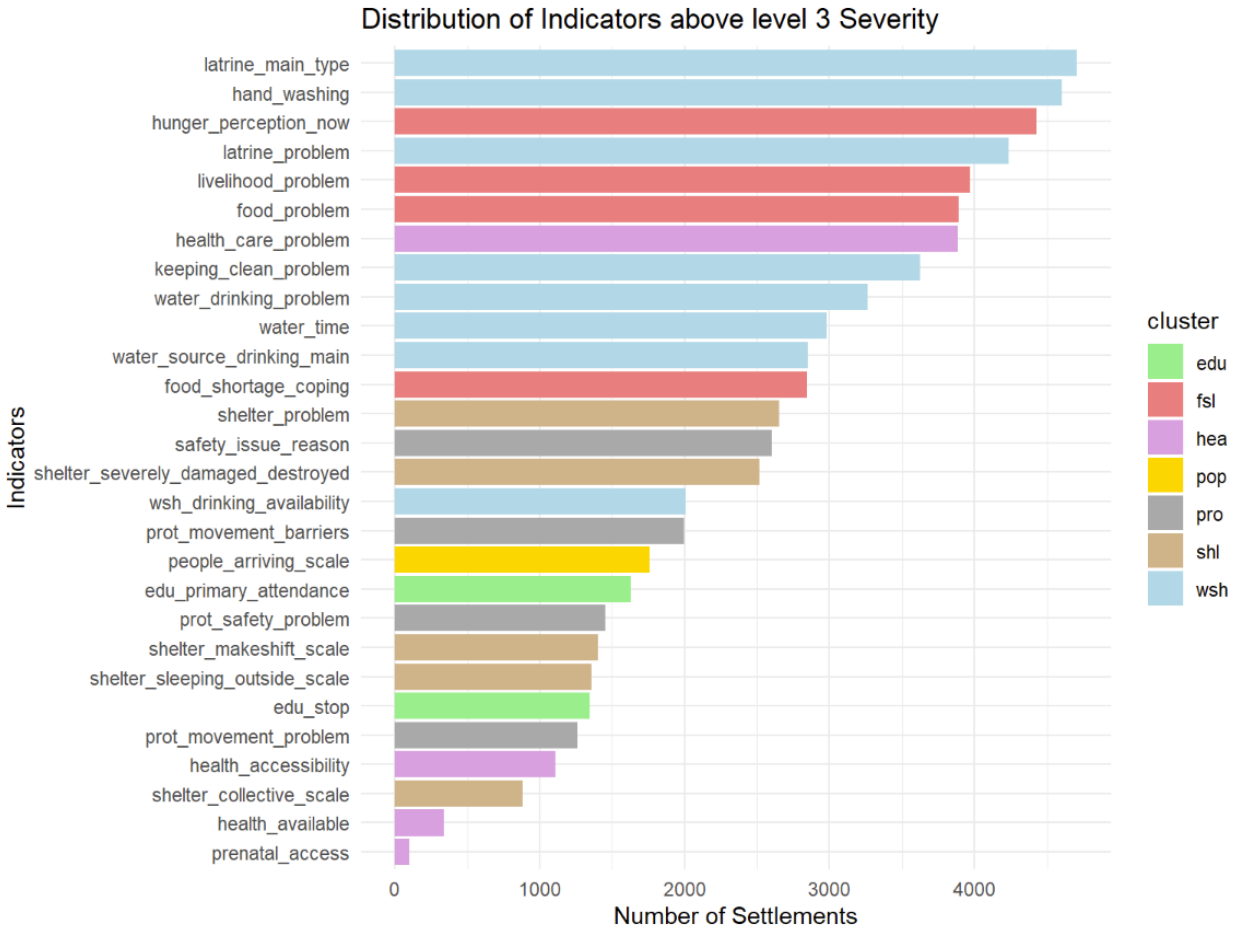
The first step of the sensitivity analysis is to identify if there are any missing values. A suggested approach is to do a distribution of the missing values. The Flag Index is very simple: it counts the number of indicators that go above a defined severity thresholds. One needs to make sure that whatever is not being counted is "not severe" and not missing values. To identify missing values, make sure that in the Data Analysis Plan all choices that relate to "don't know", "prefer not to answer" and "no response" have NA as severity value. Then display the distribution of Nas per indicator.

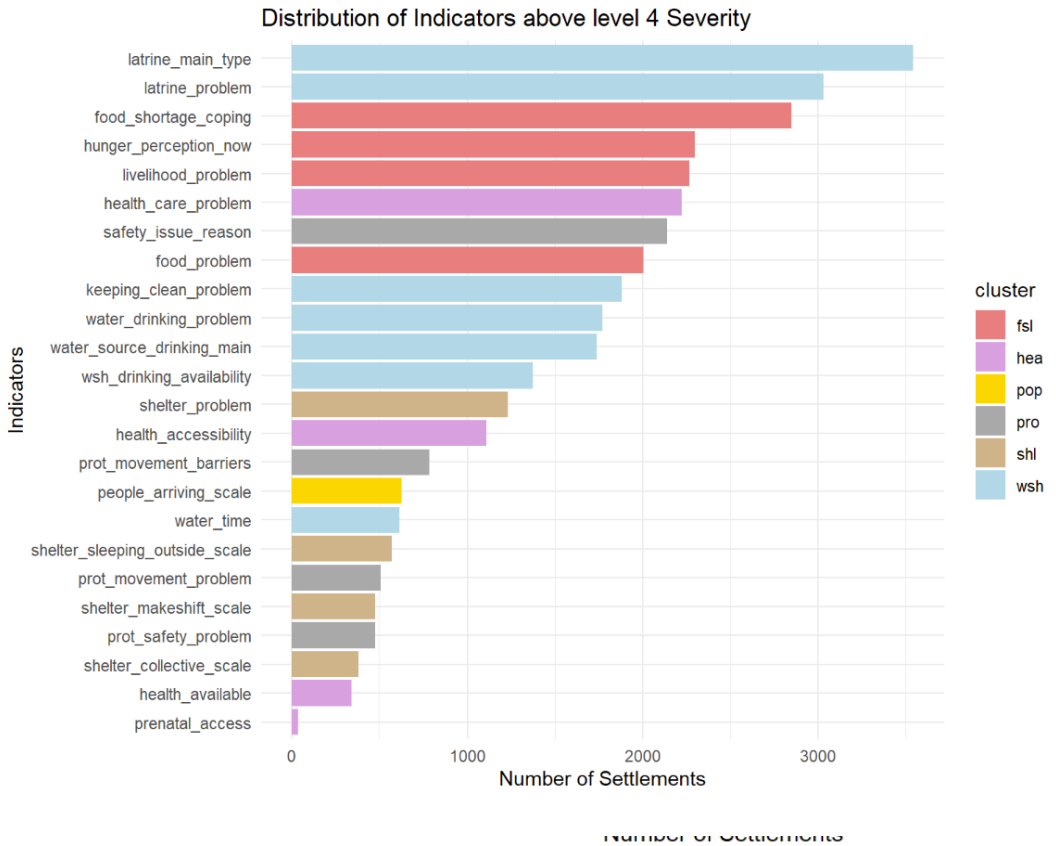
In the case of the SSD HSM November 2024 data there were no NAs in any of the core indicators.

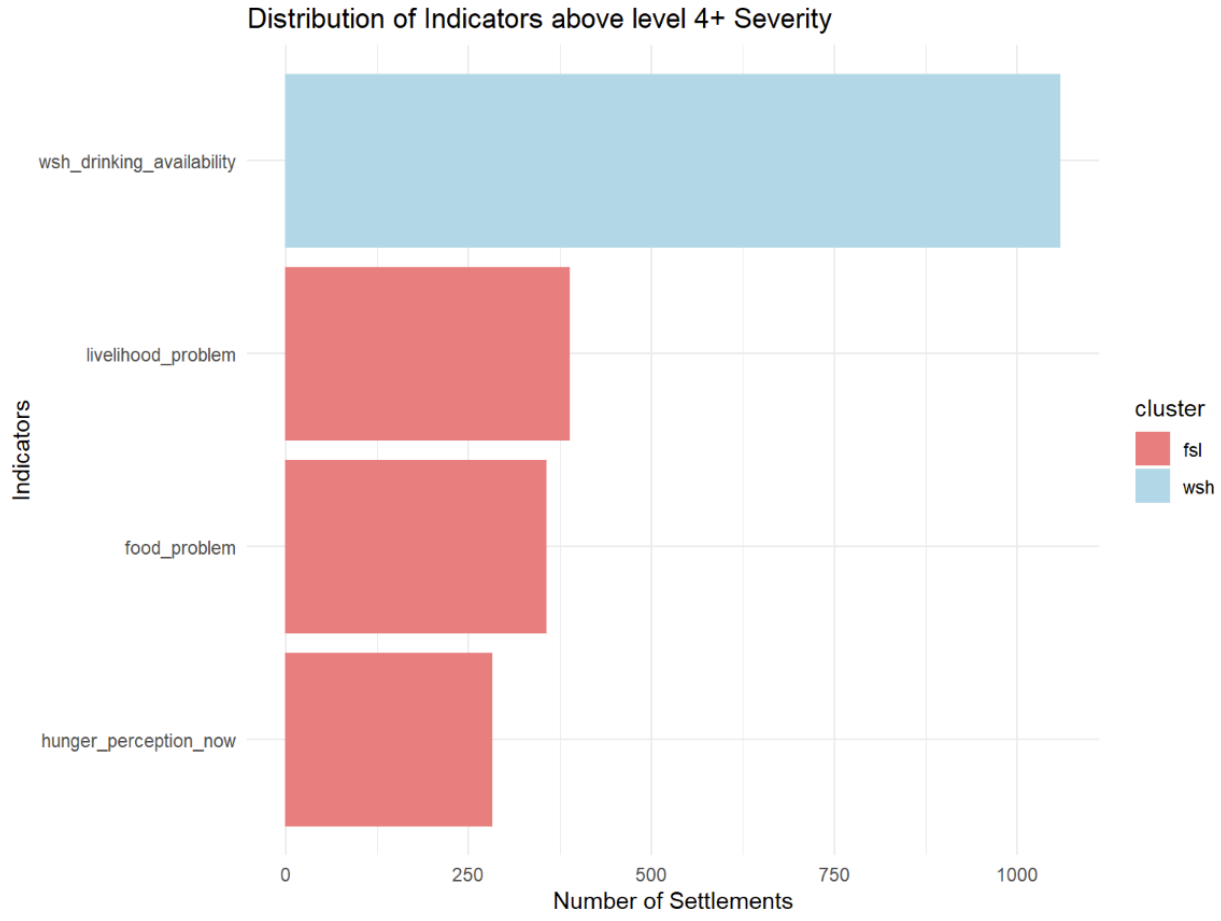
2. Distribution of Indicators and Flag Index

**Distribution of Indicators**

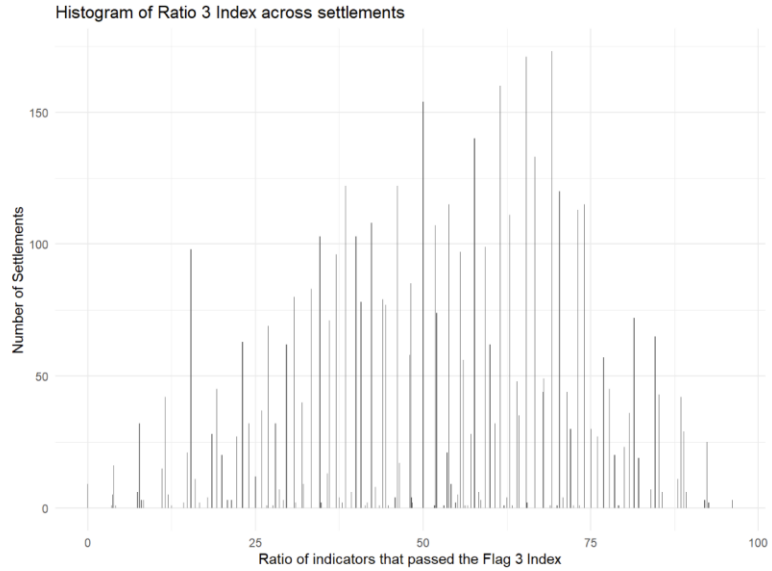
The goal of this section is to look at how often each indicator is above the severity thresholds. The thresholds are 3, 4 and 4+, which is why the bar plot is repeated three times. It is important to look at the overall distribution of each indicator, because an indicator that is very often extremely severe might be due to a wrongly-set threshold. For example do we expect FSL, WASH and Health to be more frequent the more severie the threshold. On the contrary, it might also be that the situation is indeed very severe in most of the country. This is why contextual knowledge is key in the definition of the thresholds.

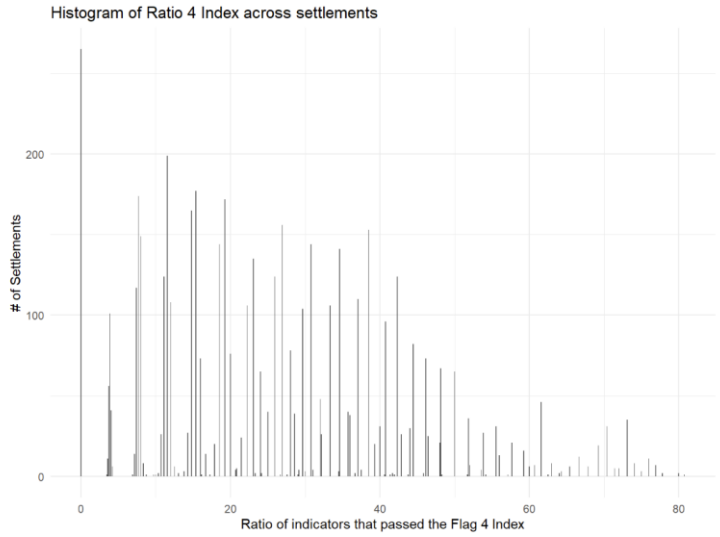


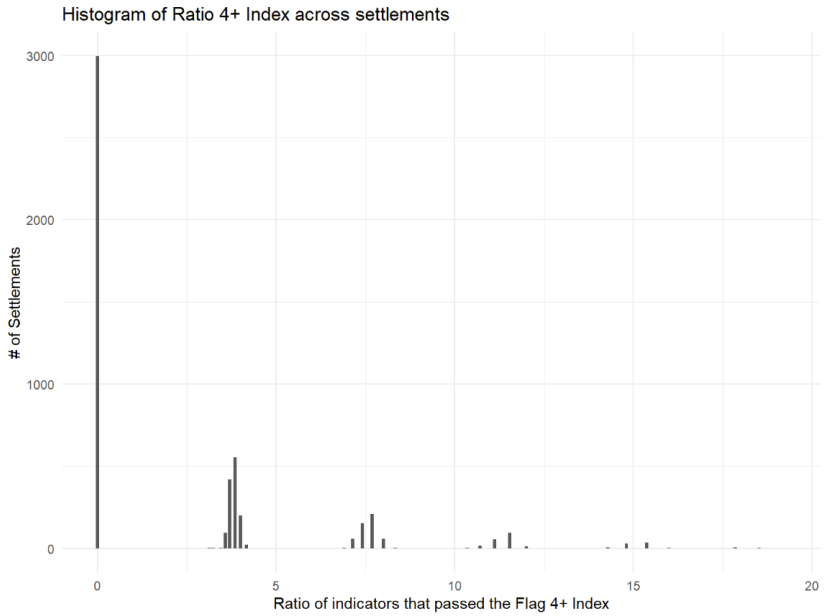

Distribution of Indicators above level 4 Severity
latrine_main_type
latrine_problem
food_shortage_coping
hunger_perception_now
livelihood_problem
health_care_problem
safety_issue_reason
food_problem
keeping_clean_problem
water_drinking_problem
water_source_drinking_main
wsh_drinking_availability
shelter_problem
health_accessibility
prot_movement_barriers
people_arriving_scale
water_time
shelter_sleeping_outside_scale
prot_movement_problem
shelter_makeshift_scale
prot_safety_problem
shelter_collective_scale
health_available
prenatal_access
Indicators
0
1000
2000
3000
Number of Settlements
cluster
fsl
hea
pop
pro
shl
wsh


Distribution of Indicators above level 4+ Severity
wsh_drinking_availability
livelihood_problem
food_problem
hunger_perception_now
Indicators
0
250
500
750
1000
Number of Settlements
cluster
fsl
wsh

## Distribution of Index value (Ratio or Absolute) across settlements

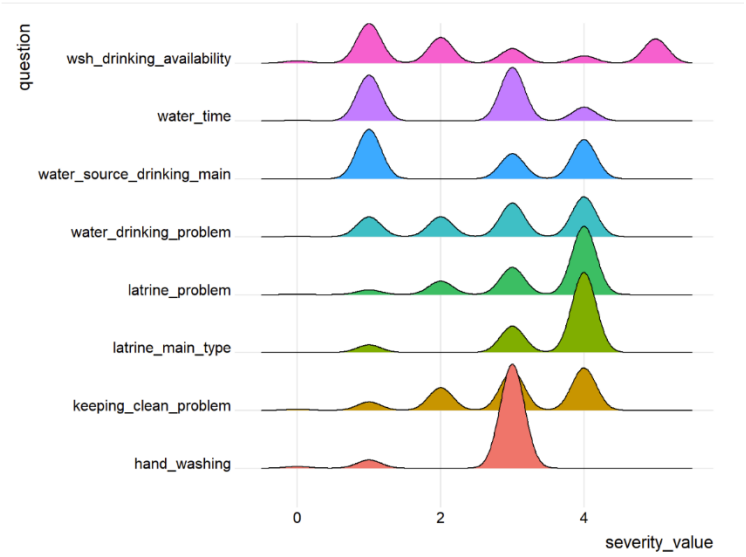


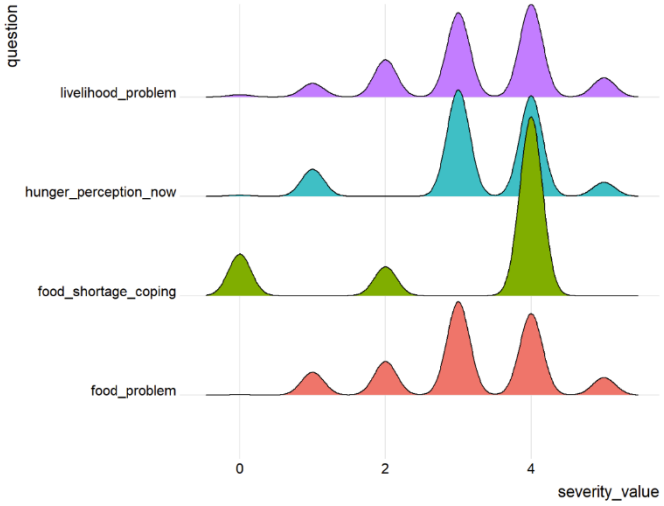



**Distribution of indicator values within sector**

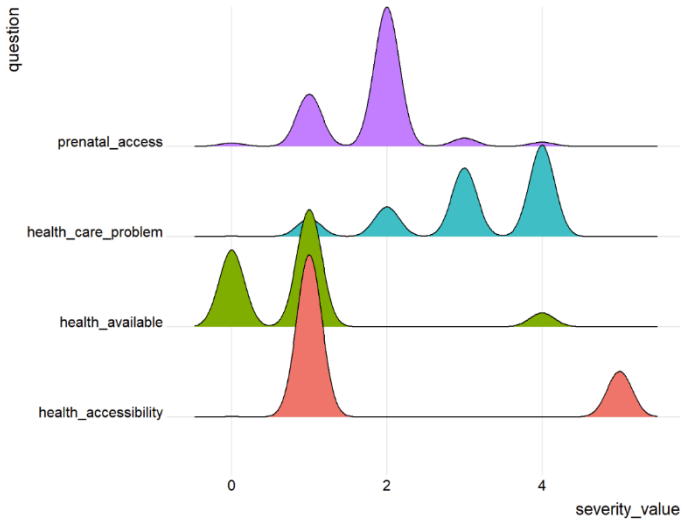
WASH



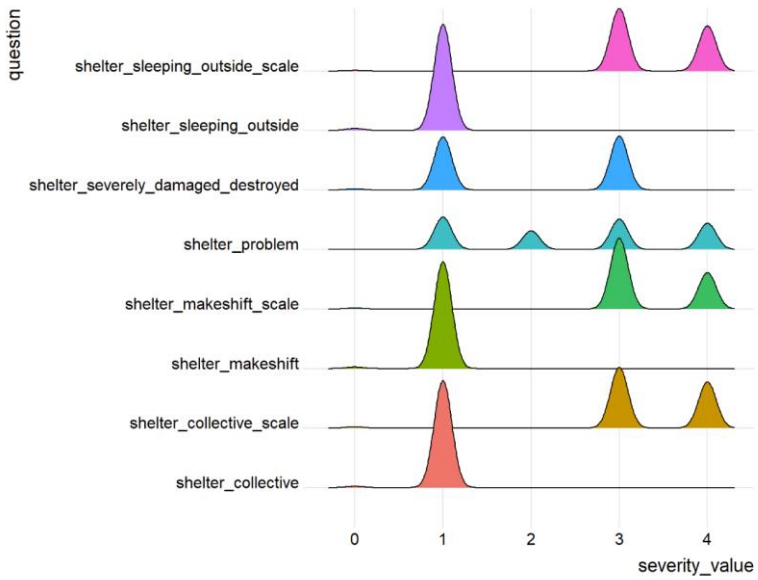

FSL



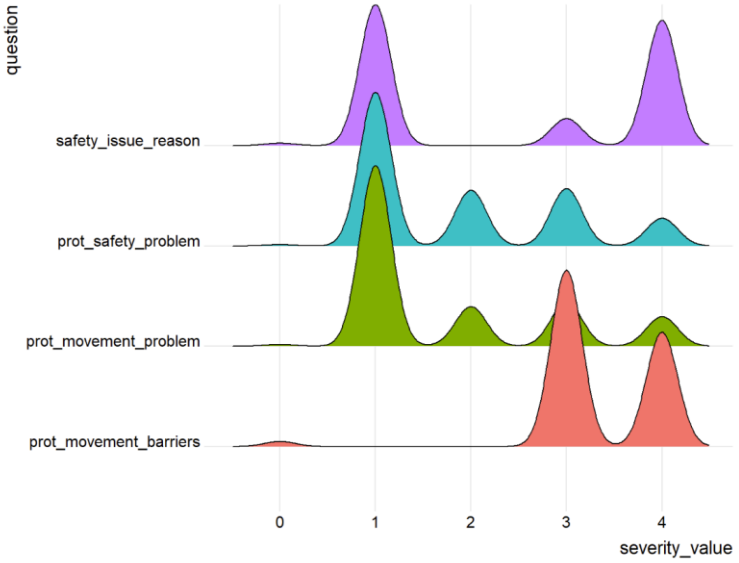

Health



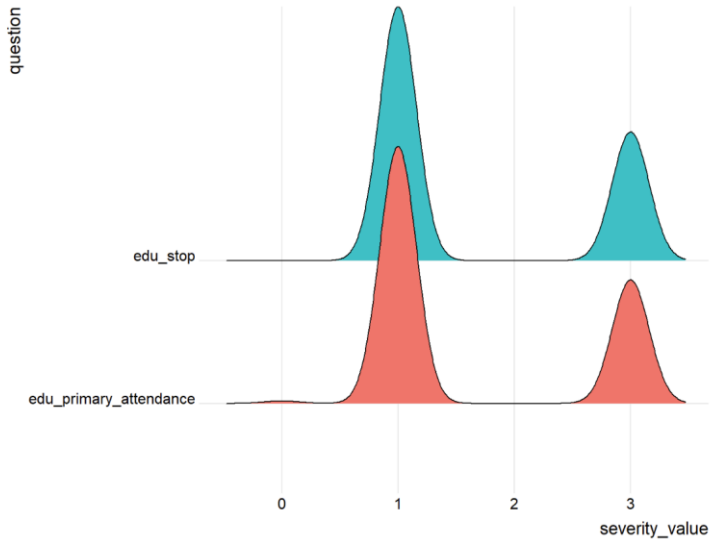
Shelter



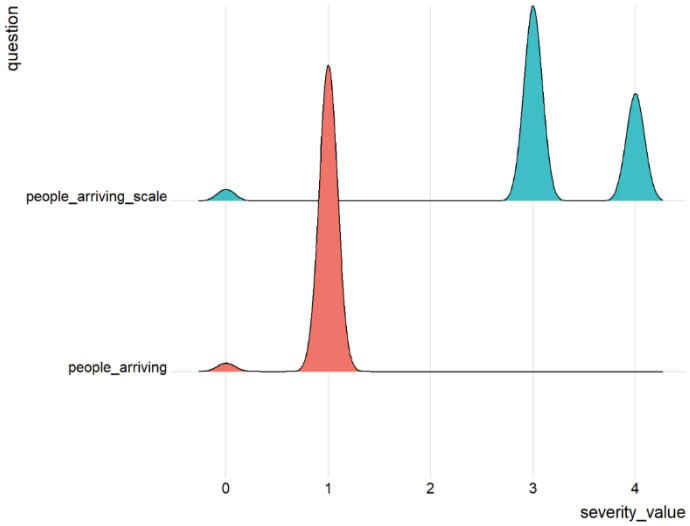

Protection




Education



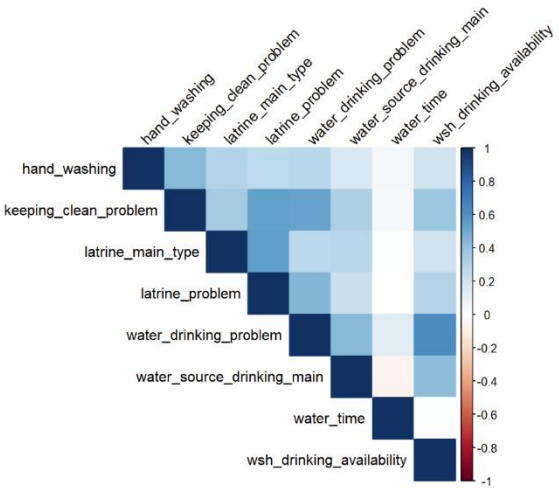
Population Movement



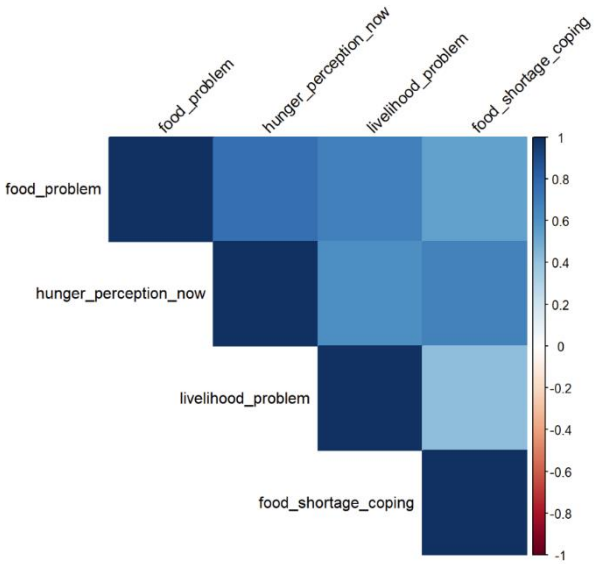

3. Correlation of Indicators

Run correlation matrices across indicators to see the relationship between indicators and identify if there are any indicators that strongly correlate with each other and might be redundant or counting double similar information. If indicators within a sector are identified that correlate very strongly with each other than it should be considered if all of these indicators should be kept and are indeed valuable to the severity index, as most likely the double counting might implicitly give more weight to that type of information covered.

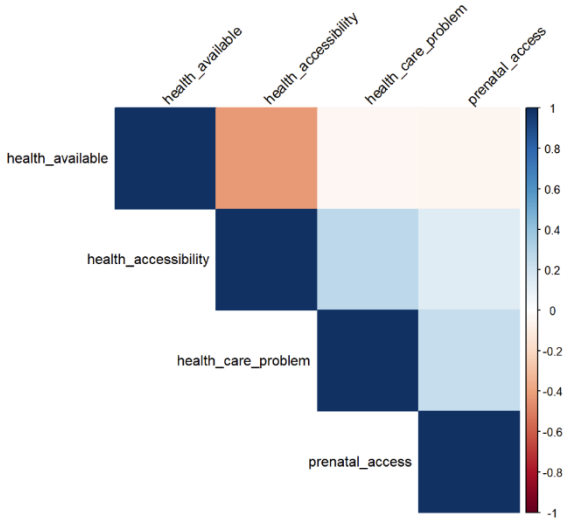
WASH



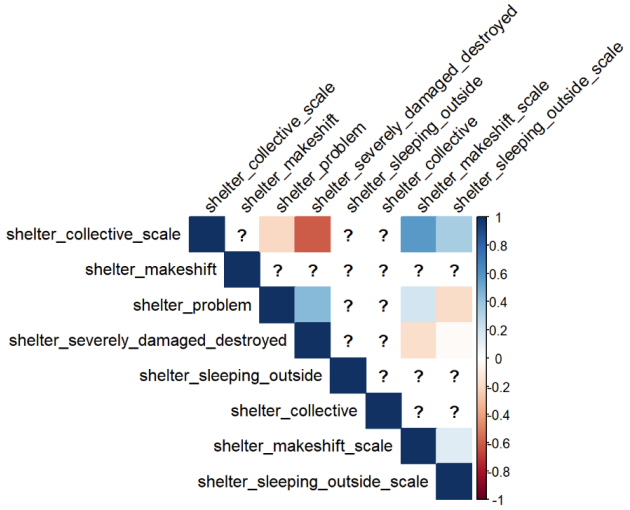
FSL



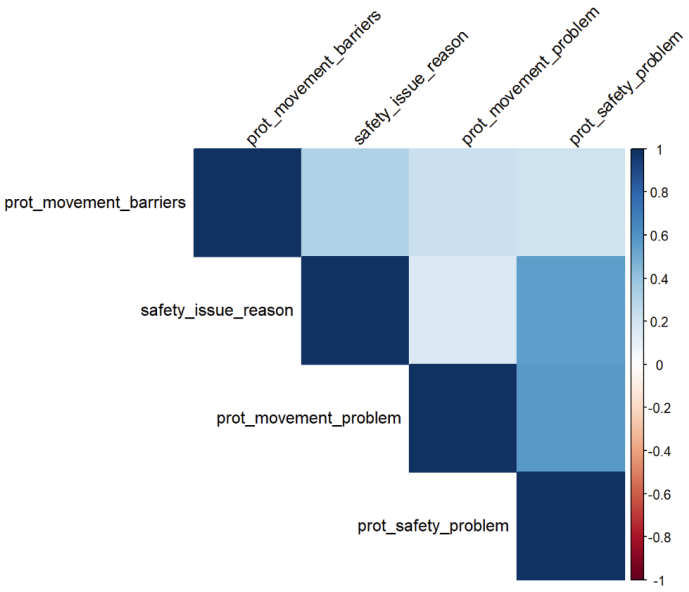

Health



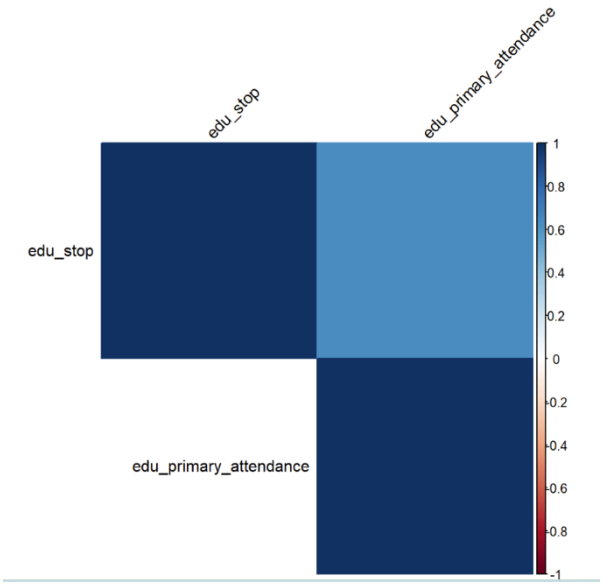

Shelter



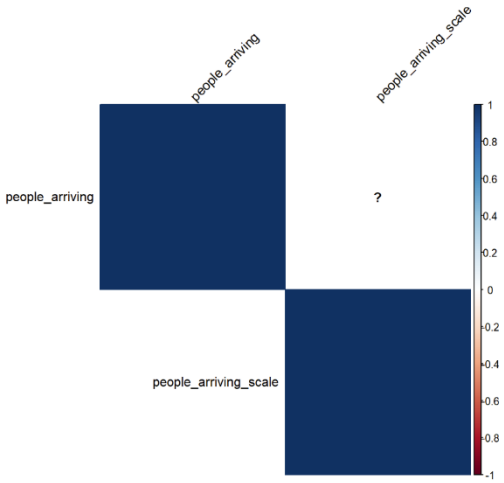
Protection




Education




Population Movement



## ANNEX 5: RESULTS OF THE AGGREGATION METHOD COMPARISON

**Summary**: During the development of the AoK SI methodology, a plethora of aggregation methods were considered in the aggregation method comparison and the focus was to consider aggregation method for both, the settlement level, and the area level. The analyses that were conducted and the conclusions used as a basis for deciding on which aggregation methodologies should be used of the AoK SI is outlined in this annex. The general recommendation is to use the following approaches:

- **Flag 4 Proportion at settlement and Median Flag 4 Proportion at area-level for prioritization**
- **Score Index (25% Severity Threshold Index) to reflect the actual severity value at settlement and area-level.**

Use the **Flag Index** when the goal is to prioritize response actions within a crisis, especially when variance across communities is needed. The Flag Index provides a transparent and simple count of severe indicators, making it useful for comparing communities and identifying those with the highest number of critical issues.

Use the **Score Index** when the objective is to compare the absolute severity of needs within or across crises. The Score Index captures not only the presence of severe indicators but also their depth by identifying the severity level at which the worst 25% of indicators fall. This makes it more suitable for strategic decision-making, such as informing high-level planning, inter-sectoral analyses, and cross-crisis comparisons.

For a comprehensive analysis, both indices can be used together. The Flag Index helps highlight where the most pressing issues are, while the Score Index provides a more nuanced understanding of how severe those issues are relative to the predefined scale. Combining both approaches ensures better-informed response prioritization and strategic planning.

All the aggregation methods that were tested are the following:

- Max Aggregated Index

In the case of the max aggregated index, we created the cluster-level subindices by doing the max of each indicator within each cluster. Then we computed the max of the subindices at the settlement level.

- Mode Aggregated Index

In the case of the mode aggregated index, we created the cluster-level subindices by doing the mode of each indicator within each cluster. Then we computed the mode of the subindices at the settlement level.

- Geometric Mean Aggregated Index

In the case of the geometric mean aggregated index, we created the cluster-level subindices by doing the geometric mean of each indicator within each cluster. Then we computed the geometric mean of the subindices at the settlement level.

- No Weight Mean Index

In this case, the no-weight mean index is obtained using the arithmetic mean of the “numerical” responses without aggregative at the cluster level first.

- Mean Max Index

In the case of the mean mx index, we construct the sub-indices at the cluster level by taking the max value and then we aggregate all clusters through an arithmetic mean. The results are not extremely different compared to the other aggregation methods that involve means.

- Mean Aggregated Index

In the case of the mean aggregated index, we created the cluster-level subindices by doing the arithmetic mean of each indicator within each cluster. Then we computed the arithmetic mean of the subindices at the settlement level.

- Flag Index

In the case of the flag system, there are no “cluster level subindices”. This method counts the number of indicators that are above severity level 4.

- Score Index (25% Severity Threshold Index (1-5 scale)

This method determines the severity value at which the 25% worst of indicator values in an area reach or exceed a given severity level.

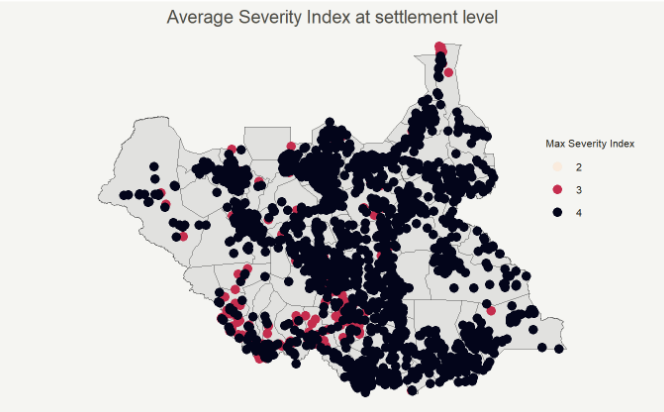
**Summary Table** - This table provides a quick overview on the various aggregation methods tested.

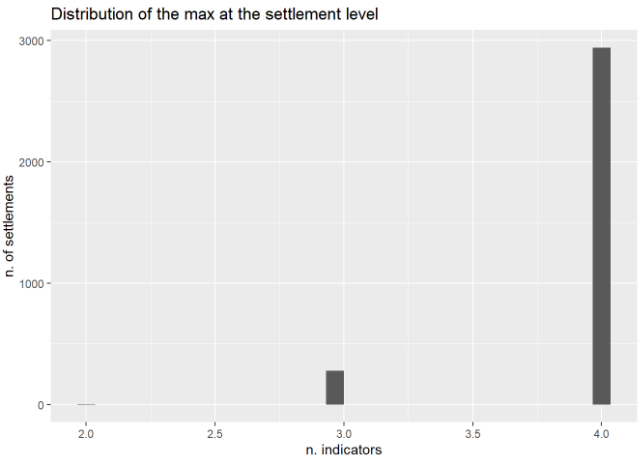
| Name of the index<br>Steps taken | Score Index | Flag Index >= 4 | Mean Aggregated Index | No Weight Mean Index | Mode Aggregated Index | MSNI-like Aggregated Index | Geometric Mean<br>Aggregated Index | Max Mean Index |
|---|---|---|---|---|---|---|---|---|
| Brief description | The Flag Index counts the number of indicators with severity level >= 3 | The Flag Index counts the number of indicators above severity >= 4 | This index follows the mean as the main aggregation method | This index follows the mean as the main aggregation method, but it doesn't filter per clusters | This index follows the mode as the main aggregation method | This index follows the max as the main aggregation method (similarly to MSNI) | This index follows the geometric mean as the main aggregation method | This index follows the max at cluster level and the mean at settlement level |
| **Step 0:** Selection of Indicators | We selected the relevant indicators based on the Severity Index indicator and thresholds table and set thresholds of severity. | | | | | | | |
| **Step 1:** Aggregation of one KI per settlement | The data is aggregated at the settlement level so as to have 1 observation per settlement. | | | | | | | |
| **Step 2:** | Produced a numeric scale (1:4+) for each indicator selected. N.B. not all indicators are a perfect scale from 1 to 4+, but the thresholds are set in the Severity Index indicator and thresholds table. | | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Defining thresholds | | | | | | | | |
| **Step 3:** Create cluster sub-indices | The Score Index is calculated as the severity score (1 to 4+) achieved or surpassed by all of the top 25% most severe indicator scores across all indicators within the sector. | Ratio sub-Index at the cluster level using the ratio of indicators flagged over available indicators in the sector | Created a sub-index at the cluster level using the mean as an aggregation method | | Created a sub-index at the cluster level using the mode as an aggregation method | Created a sub-index at the cluster level using the max as an aggregation method | Created a sub-index at the cluster level using the geometric mean as an aggregation method | Created a sub-index at the cluster level using the max as an aggregation method |
| **Step 4:** Create settlement-level composite index | The Score Index is calculated as the severity score (1 to 4+) achieved or surpassed by all of the top 25% most severe indicator scores across all indicators within the settlement. | Count number of indicators >= 4. Create ratio considering available indicators | Mean of the sub-indexes | Mean of the numeric indicators | Mode of the sub-indexes | Max of the sub-indexes | Geometric Mean of the sub-indexes | Arithmetic mean of the sub-indixes |
| **Range of values** | 1-5 | Absolute Flag Index depends on n. indicators. Ratio goes from 0 to 100%. | 1-5 | | | | | |

### Max Aggregation Method

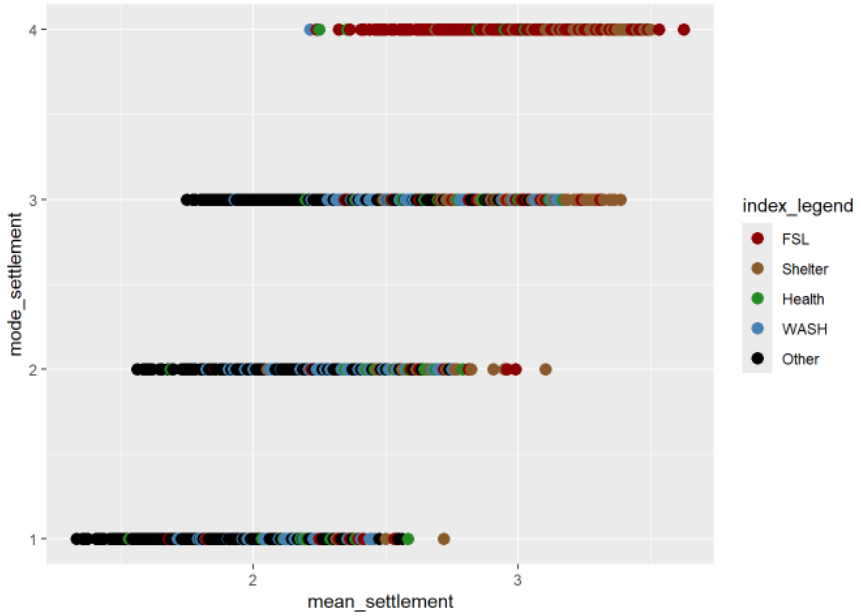
Based on testing we conclude that the max aggregation method is not appropriate. The biggest strength of this method is that there is little to no risk of under-stating the severity of needs. However, there is little to no variance within the sample, most of the settlements in the sample are flagged as level 4 severity, therefore no prioritization would be possible according to this method. The dot map below allows us to visualize this aggregation method's limitations very clearly.



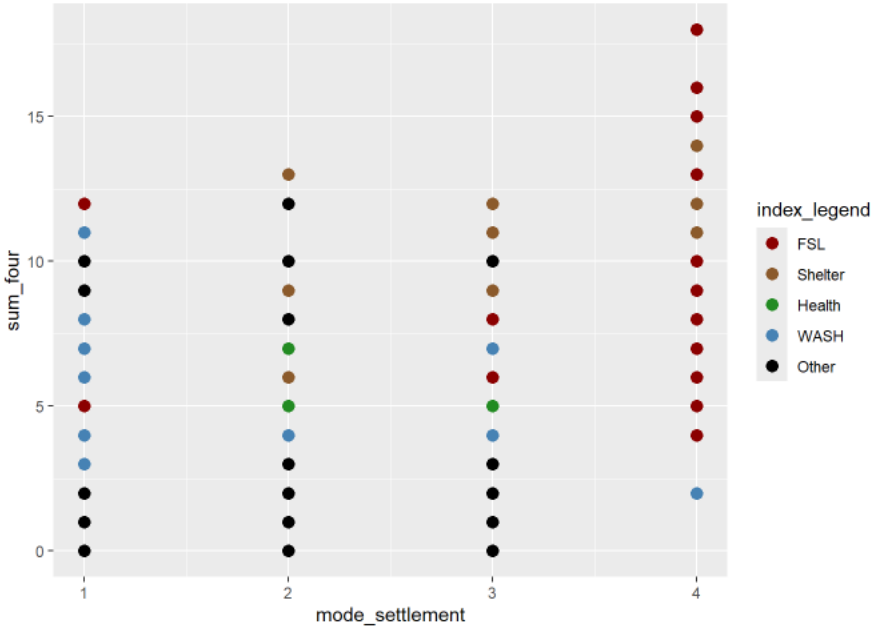




### Mode Aggregation Method

We ran several tests to assess the limits of the mode aggregation method. Firstly, we compared it to the mean aggregation method. The two are quite similar, the correlation is 0.71, however, the mode is much less sensitive to outliers than the mean. In our case, all variables are forced to assume a value between 1 and 4, therefore the outliers are extremely valuable information. In this plot, we have the mean index vis-à-vis the mode index. The points are color-coded so that if Food Security and Livelihood has mode 4 the point is red, ignoring all the other modes. If the point is brown, the shelter's mode is 4, FSL's mode is not 4, but other clusters could be 4, and so on for Health and WASH. Health appears after Shelter because in SSD data, the indicators of health are not super robust and shelter is not about damage to the shelters, but whether people don't have access to shelter at all. We clearly see in this graph that the mode is under-reporting cases with a high mode both in food security, shelter, and health.



Next, we compared it to the flag index. Again, we see that the Mode is 1 for settlements that flag 5 or more indicators as severity level 4, which is a clear sign of compensability. Non-compensability refers to a concept where poor performance in one area (e.g., high severity needs) cannot be fully offset or balanced by good performance in another area (e.g., low needs). In other words, we want to avoid an index where severe issues in one cluster can be "compensated" or nullified by strengths in another. The color-coding follows the same logic as in the previous graph.

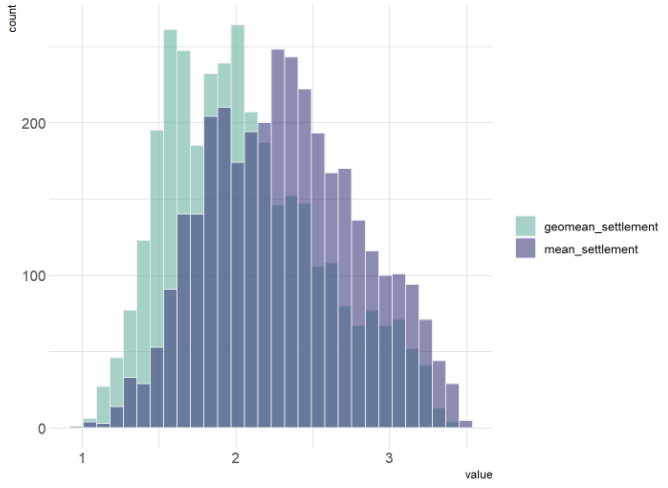


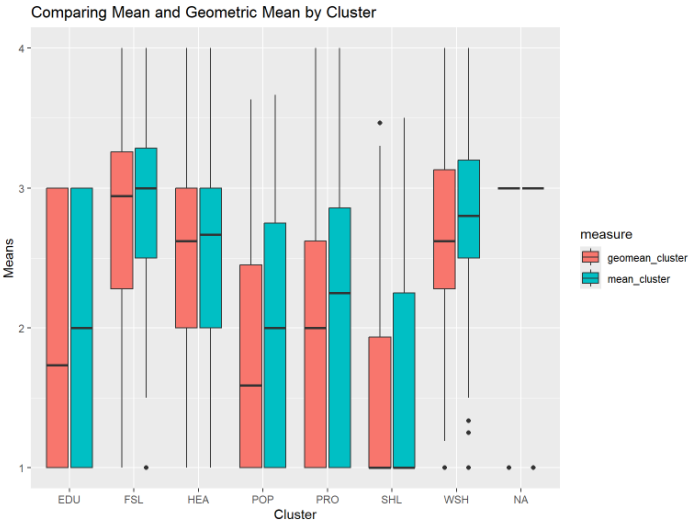

Lastly, we looked at spatial correlations. The ideal index should be strongly spatially correlated assuming that severity is geographically concentrated and that close-by settlements have similar severity conditions. We looked at the “closest neighbor” spatial correlation, which means correlating the severity index of settlement j with the geographically closest settlement, z. We did this both for the mode and for the mean. As one would expect, we found that the correlation increased as we looked at closer pairs of settlements. However, the correlations for the mode are significantly lower than the correlations for the mean, by almost 0.20 percentage points, meaning that the mode index is less spatially correlated than the mean index.

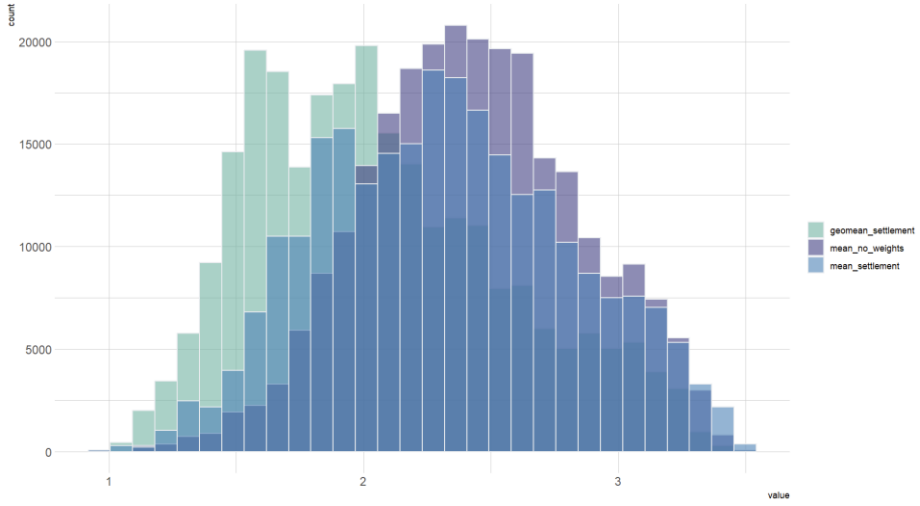
Following these analyses, we concluded that the mode was not a desirable aggregation method for the severity index.

### Geometric Mean Index

We compared the geometric mean to the arithmetic mean index and we found that the geometric mean is much less sensible to outliers than the arithmetic mean both at the cluster level and at the settlement level.




A conceptual difference between the arithmetic mean and the geometric mean, is that the arithmetic mean (but not the geometric mean) allows for full compensability, in that low needs in one indicator or sector "compensate" (in terms of affecting the index) indicators or sectors with severe needs. For example, food security can compensate for protection issues.

Lastly, we run the Moran's I test to assess the correlation between settlement j and all other settlements weighted by their distance to settlement j. Systematically, we found that the spatial correlation for the geometric mean was slightly lower than the one of the arithmetic mean, but the difference is not always significant. Overall, we did not find a significant gain from shifting from the arithmetic to the geometric mean, as they are highly correlated. Therefore, between two similar methods, we opted for the simplest one.

### No-weight Mean Index

We tested a mean aggregated index without any previous "cluster" aggregation. Except for the flag index, all other indexes have been the result of a function applied to the "sub-indexes". In this case, we are averaging directly the numerical indicators without the creation of the sub-indexes. This is the plot of the three mean indexes that

we tested: the mean index (which is clustered), the no-weight mean index (no clustering), and the geometric mean index (which is clustered using a geometric mean rather than an arithmetic one). The goal of the comparison is to assess whether there is a big significance in indexes that have been aggregated at cluster level before being aggregated to settlement level vis-à-vis the ones that are aggregated directly at settlement level. The rationale is that when we aggregate from cluster to settlement, we give each cluster the same weight, even though some clusters cannot reach certain levels of severity. This might skew our indexes. On the other hand, if we aggregate directly to the settlement level, we implicitly do not give the same weight to all clusters as some clusters have more indicators.

Here is the distribution of the three different types of mean that we tested:

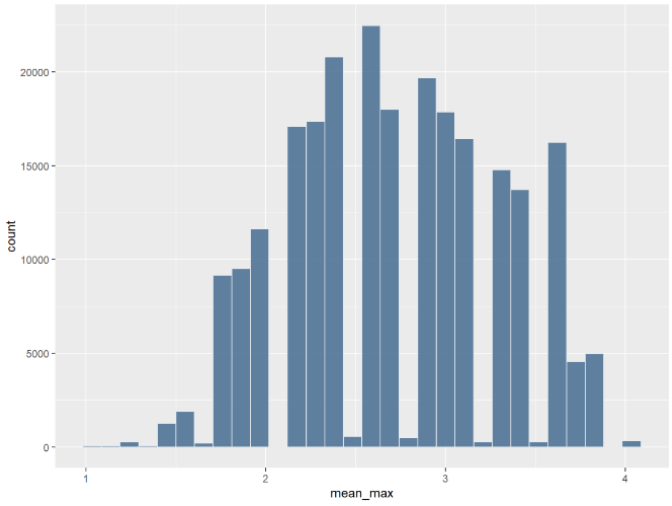
Correlation between types of Mean and the Flag Index

| Type of Mean | Estimate | P-Value | Standard Deviation |
|---|---|---|---|
| mean | 0.8663 | 0 | 0.001 |
| geomean | 0.8657 | 0 | 0.001 |
| noweightmean | 0.8757 | 0 | 0.001 |

We see that the “no-weight mean” is not so distant from the mean aggregated index, but it does have a higher mean and overall is more likely to be higher. We correlated the three types to the flag index and found that the no-weight mean is the one that correlates the most to the flag index. Even though the difference is statistically significant, it is not “economically” significant, meaning that it is not large enough to be able to draw any significant conclusion.

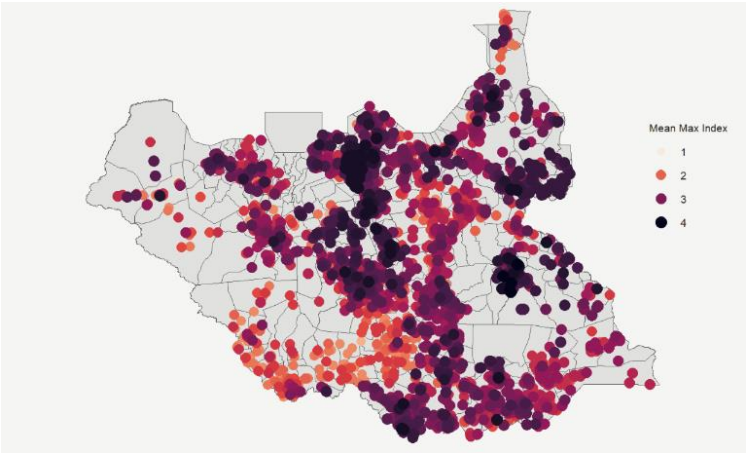
### Mean Max Index

In the case of the mean max index, we construct the sub-indices at the cluster level by taking the max value and then we aggregate all clusters through an arithmetic mean. This is the distribution of the values of the index:




The mode is were one would expect the mode to be, around 2.5, but we see that the distribution is skewed to the left considering that there are more settlements on the right of the mode rather than the left.

The dot map of the country shows that there is some variance within the country, definitely much more than the max method, but not as much as the flag index. This is clearly a result of the construction of the index, since the mean max ranges from 1-4 and the flag index from 1-19. However, if we compare it to the dot map of the mean aggregated index, it is clear that there are more settlements flagged as severe, which makes it less optimal to prioritize settlements/areas.

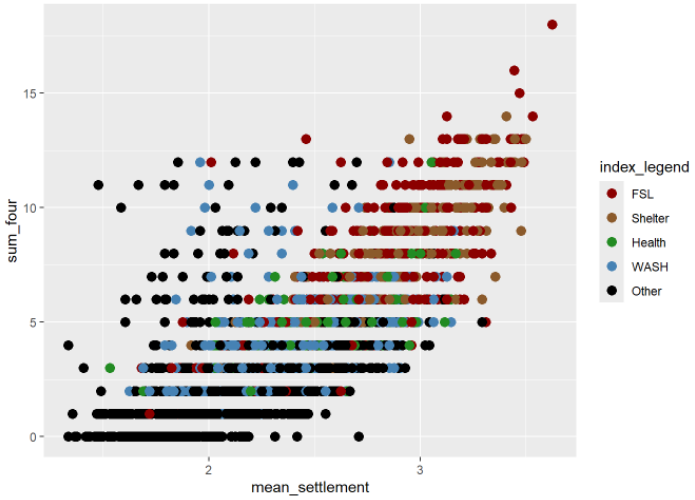



The next step of the analysis was to look at correlations between the mean max and the other aggregation methods. The correlation with the flag index is equal to 0.81 (Pearson method), which is a strong correlation but the lowest compared to all other mean-aggregated indexes. The correlation with the mean index is equal to 0.91, with the unweighted mean is equal to 0.92 and 0.90 for the geometric mean.

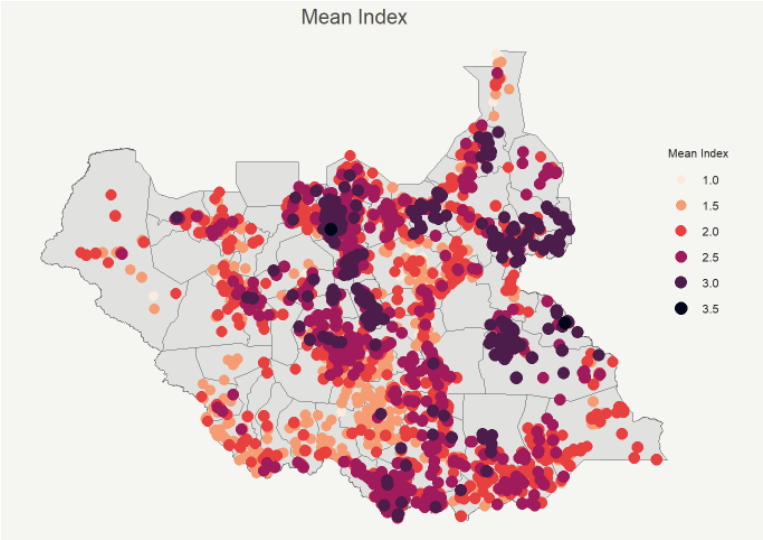
Finally, we looked at Moran's I and spatial correlogram. Moran's I is equal to 0.14, meaning that it performs slightly better than the unweighted mean (the mean-aggregated index which has the strongest spatial correlation) and very close to the flag index. The spatial correlogram performs slightly worse than the unweighted mean but slightly better than the mean aggregated index. Further explanation of spatial correlations can be found in the spatial correlation paragraph of this note.

### Mean Aggregated Index

We compared the mean aggregated index to the flag index, and we obtained a quite strong correlation between the two, except for a few outliers. The internal brainstorming of the team concluded that these outliers might be due to the not-so-clear distinction between 1-2 thresholds. The color coding in this graph follows the logic of the previous ones: each dot represents a settlement, and the colors represent the severity of the clusters in descending order. We see that the outlier settlements do not contain extreme conditions of food security and shelter.



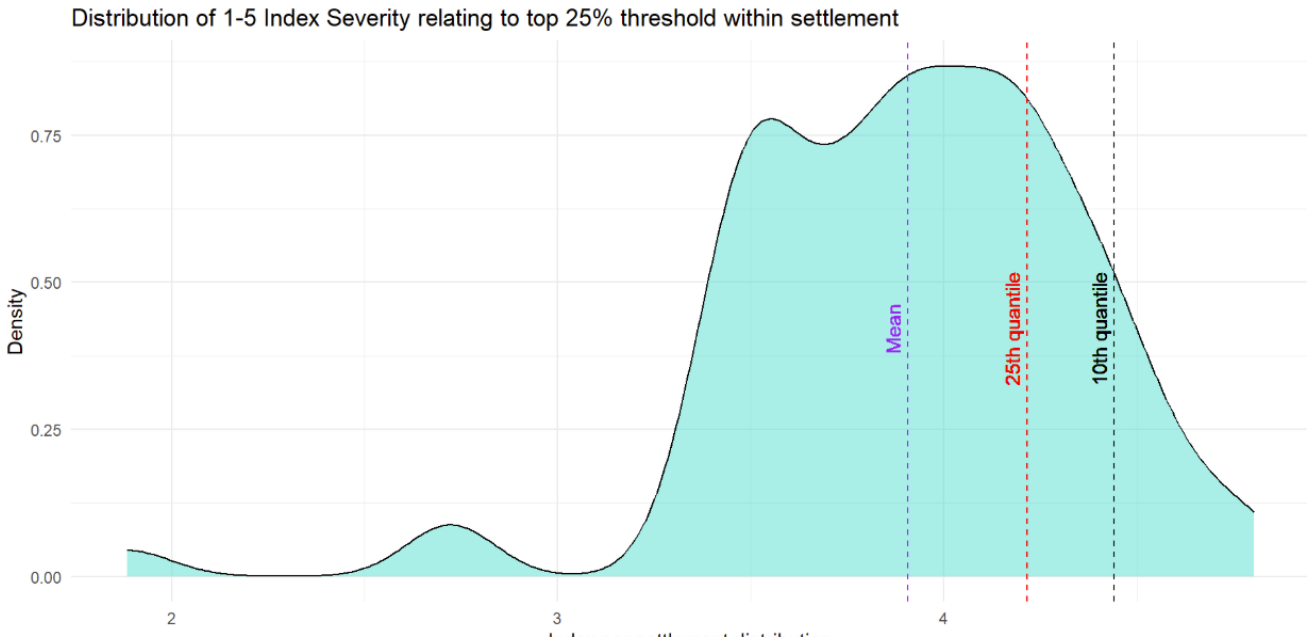
The mean index does show some variance as we can see in the dot map. It is to be noted, that around 10% of the settlements do not have coordinates and therefore they are missing from the map.



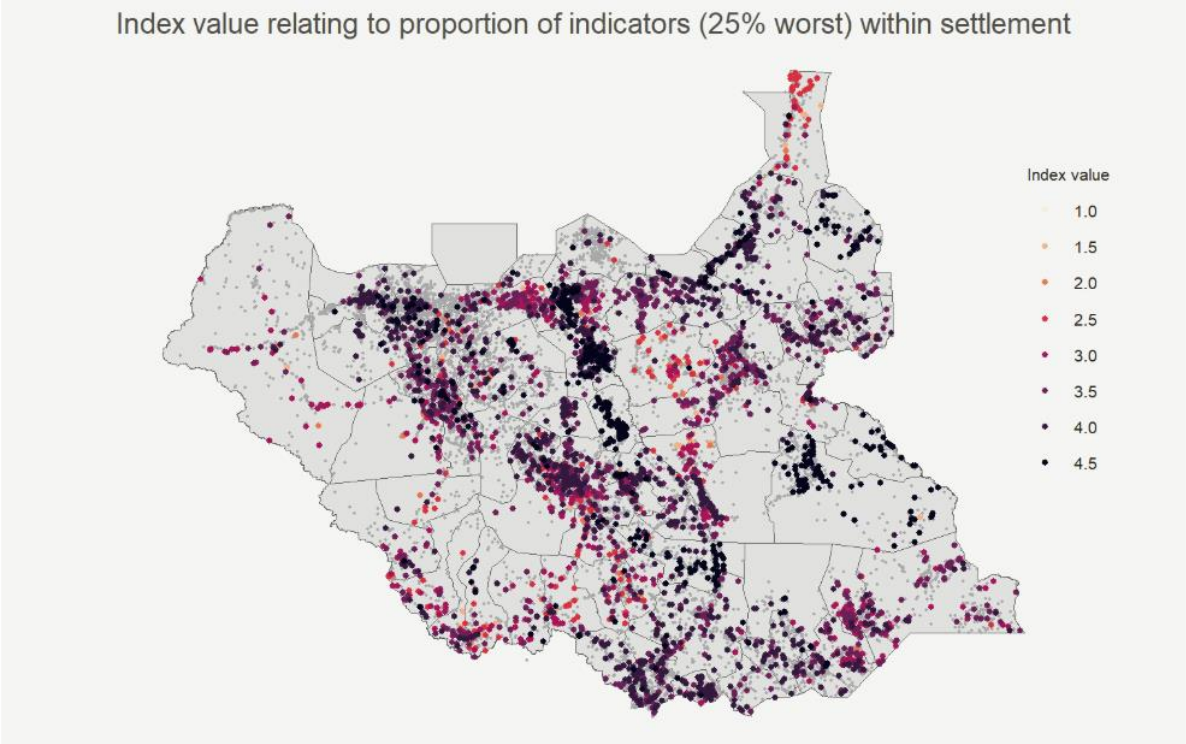

The spatial correlation analysis for the mean index needs to be properly concluded, however, we have some early findings. When doing the spatial correlation among neighbors (correlations between sets of the closest pairs of settlements in terms of Euclidean distances), there is no statistically significant difference between the correlations of the mean index and the one of the flag index. However, when conducting the Moran's I test, the mean index shows statistically significant lower spatial correlations than the flag index.

### Score Index (25% threshold)

The Score Index focuses here to the most severe indicators severity values that results from setting up the threshold at the 25% proportion level of all indicators.

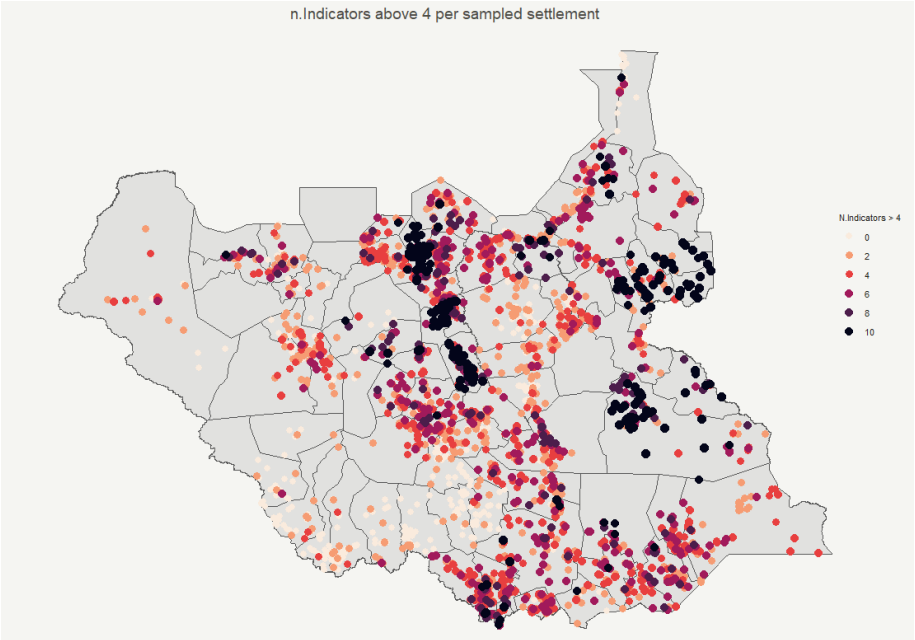


When considering the Score Index at the settlement level, we can see that it reflects mostly high severity values, reducing the variance of information but highlighting still the high severity pockets. The Score Index also best reflects the true severity value, that aligns with global and cluster standards.




### Flag Index

Lastly, some conclusions on the Flag Index. This is the distribution of the number of flags above 4 on the map of South Sudan. The thresholds are set so that the highest category is the minimum value of the top 10% worst-off settlements. The map shows great variance across settlements and strong geographical agreement among settlements.



Here are some of the strengths of the flag index we found and made us focus on this type of index specifically:

- There is no risk of underreporting with the flag index. Since it sums the indicators that exceed severity thresholds, it ensures that very severe flags are accurately captured and not understated. Unlike a mean-based index, which might 'smooth out' severe indicators due to less severe indicators in other sectors, the flag index minimizes this issue by still accounting for each indicator individually. This approach is similar to a max approach but allows for more variability while ensuring that severe indicators are not overshadowed by lower needs in other sectors.
- It is extremely transparent. Firstly, the system is extremely simple, at its core is just a sum, and therefore easily understandable and replicable. Secondly, it allows to show very clearly what are indicators or the clusters driving the flag index.
- Compared to the Mean Aggregated Indicator, the Flag Index gives more weight to clusters based on the number of indicators that are within that cluster. When we average across sub-cluster indexes, the arithmetic mean gives the same weight to all clusters. On the other hand, the Flag Index gives more weight to certain clusters, because they have more indicators, therefore, they are also more likely to be severe.
- The spatial correlation of the flag index was the best out of the other methods. Spatial correlation is extremely important in the case of indicative data. Since the data is not randomly sampled, we cannot make assumptions about settlements where we didn't collect data. However, if the non-randomly sample data shows a strong spatial correlation, that allows us to make assumptions a bit more freely. If within a 50km radius, sample settlements show a strong spatial correlation and extreme severity, it is not impossible to deduce that the other settlements within that radius might be in similar conditions. Further testing needs to be done to claim this with confidence, but at least it's a first start.
- It fits well with non-randomly sampled data. A flag index is much more transparent in conveying to the reader the fact that the data is not randomly sampled.

### Conclusions for Aggregation Methods at the Settlement Level

| Name | Brief Conclusion |
|---|---|
| **Max Aggregated** | This method gives 4 severity level to the vast majority of the settlements in the sample. It might be because we are taking more indicators than the MSNI, but still, it is not very informative |
| **Mode Aggregated** | Mode is not a good aggregation method as it under-reports systematically, as, by construction, it is much less sensible to outliers. |
| **Geometric Mean Aggregated** | There is not a stark difference between the geometric mean and the arithmetic mean, therefore we picked the simplest method between the two. The geometric mean will always under-report in comparison to the arithmetic mean. |
| **Arithmetic Mean without weights** | The arithmetic mean without any weight is constructed without any previous cluster-level aggregation. This way clusters with more indicators are given implicitly more weight. It spatially correlated better than the other mean indexes, but worse than the flag index. |
| **Arithmetic Mean Aggregated** | The arithmetic mean spatially correlates a bit worse than the flag index and it allows for less variance. Overall, it is a good aggregation method, but there is the risk of understating severe needs according to some indicators. |
| **Score Index** | The Score Index is one of the best aggregation methods among the ones tested because:<br>• Provides an absolute estimate of the severity needs on a 1 to 4+ scale which is easily interpretable (with 4+ being understood as the worst possible severity, and 1 the absence of needs)<br>• Has a high variance similar to the Flag Index. Can be considered as integer (1-4+) or as continuous severity value (all values between 1 and 5).<br>• Score is normalized (ranges within a fixed set of values).<br>• Accounts for differences in data availability as it is based on proportions rather than absolute counts, thereby adjusting for variations in the number of available indicators across communities or areas.<br>• Reduces bias from missing indicators as it considers all available indicators and ranks them proportionally. It is therefore less affected by differences in the number of indicators assessed in different settlements.<br>• It provides a clearer picture of extreme severity by focusing on the worst 25% of indicator values. |
| **Flag Index** | The flag index is one of best aggregation method among the ones tested because:<br>• It is designed to capture the severity of needs at a settlement level.<br>• It is simple and easily replicable<br>• It is very transparent<br>• There is little to no risk of understating needs<br>• It allows for great variance across settlements. |

## AREA-LEVEL AGGREGATION COMPARISON

This intial analysis on area-level aggregation is conducted with SSD HSM 2024/11 data as this data most closely captures indicators and information from the AoK Severity Index Framework. The objective of the analysis is to identify the best method of aggregating the AoK Severity Index from settlement up to admin2 area-level.

### Findings

It seems that at the area-level all methods perform somewhat similarly in terms of ranking, however there are some methods that are best fit-for-purpose. Our general recommendation is to use the following indices:

1. Flag 4 Proportion at settlement and Mean Flag 4 Proportion at area-level for prioritization as it reflects closest the information from settlement level.
2. 25% Severity Threshold Index to reflect the actual severity value at settlement and area-level, following the JIAF methodology. This method is somewhat more complex in it's calculation but focuses on the most severe indicators that are present in the data and thus reflects well the level of severity. It reflects most accurately the actual severity and can still be used for prioritizastion given it's continuous scale. It also correlates best with the Mean Flag 4 Proportion.

### Methods used:

Given the need to aggregate the AoK Severity Index from the settlement level up to the admin2 level, the following approaches are proposed:

#### 1. Mean of Flag 4 Proportion Index

This method calculates the average proportion of flagged indicators (4 or 4+) out of the total available indicators at the settlement level and then aggregates them to the area level by averaging across all assessed settlements. It provides a broad measure of severity concentration but may be influenced by extreme values.

#### 2. Median of Flag 4 Proportion Index

Instead of averaging, this method takes the median proportion of flagged indicators (4 or 4+) at the area level. It is less affected by outliers and provides a more balanced representation of severity across settlements within an area.

#### 3. 25th Quantile of Flag 4 Proportion Index

This approach identifies how much of an area's assessed settlements belong to the worst 25% of settlements nationwide based on Flag 4 indicators. It measures the degree to which an area contributes to the most severe conditions nationally, helping to identify pockets of extreme severity.

#### 4. Mean Severity Index (1-5 scale) at Area-Level

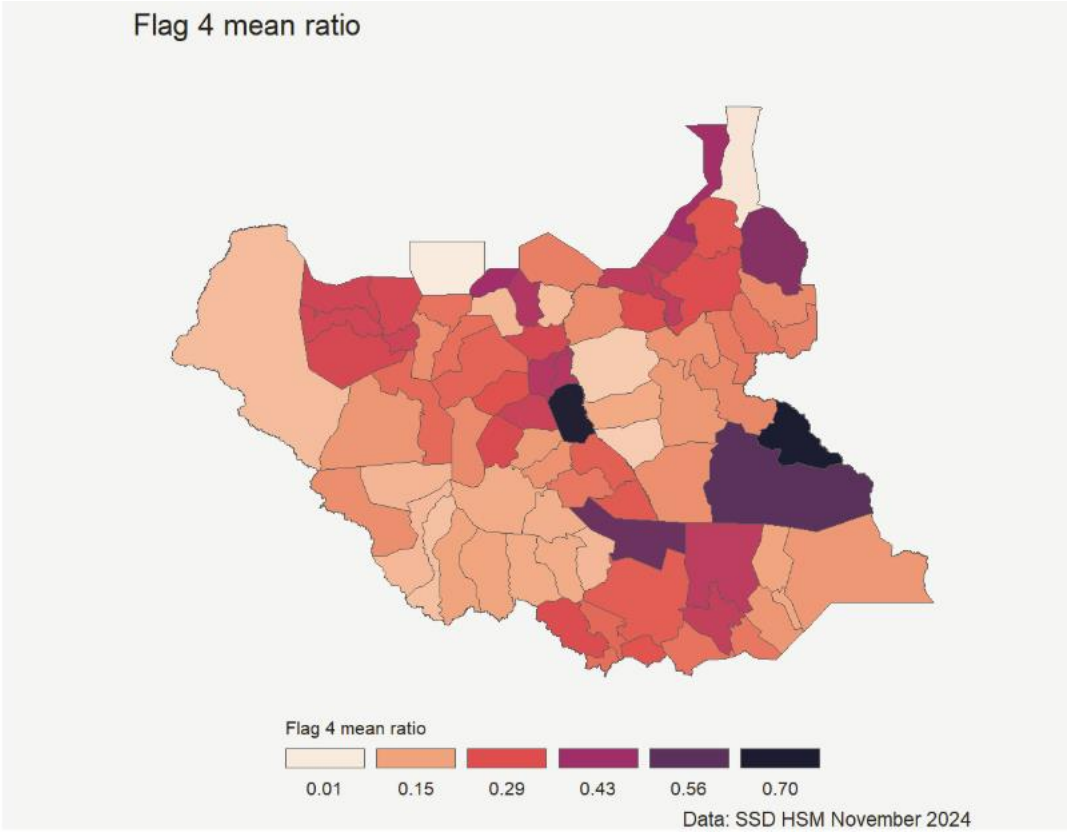
This method takes the mean severity score (on a 1-5 scale) of all settlements within an area. It provides a general overview of severity levels but does not emphasize the concentration of extreme conditions.

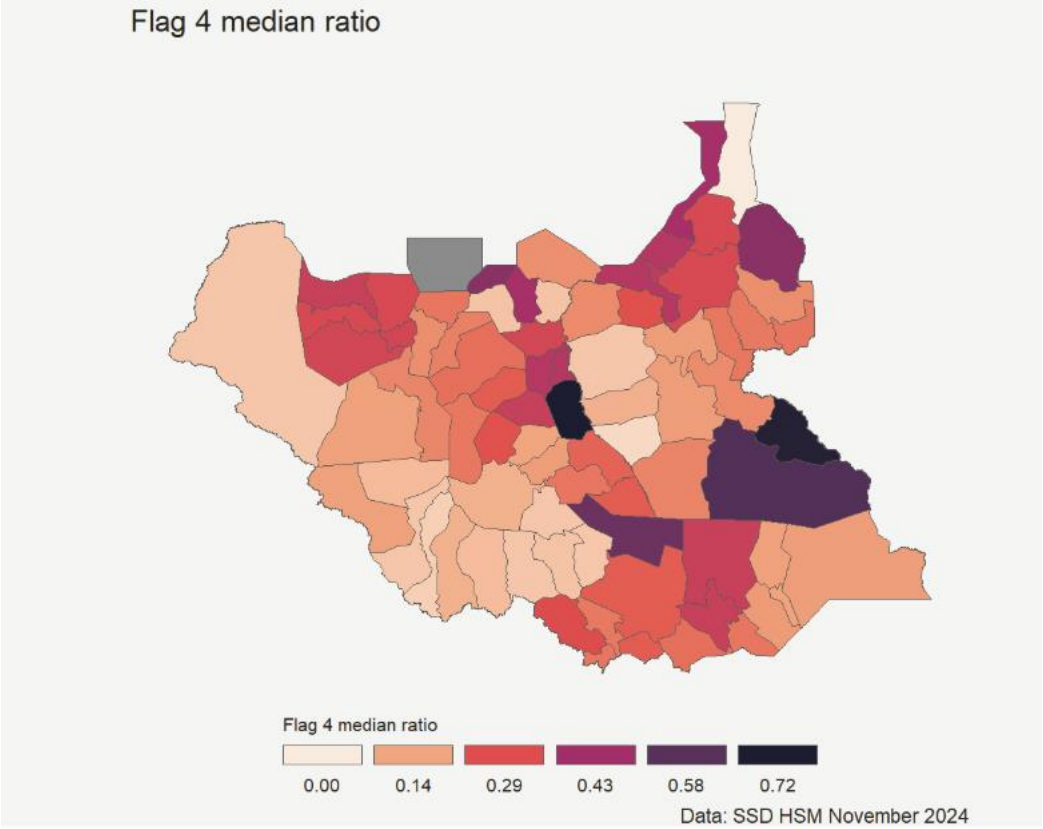
#### 5. ANF Mean Severity Index (1-5 scale)

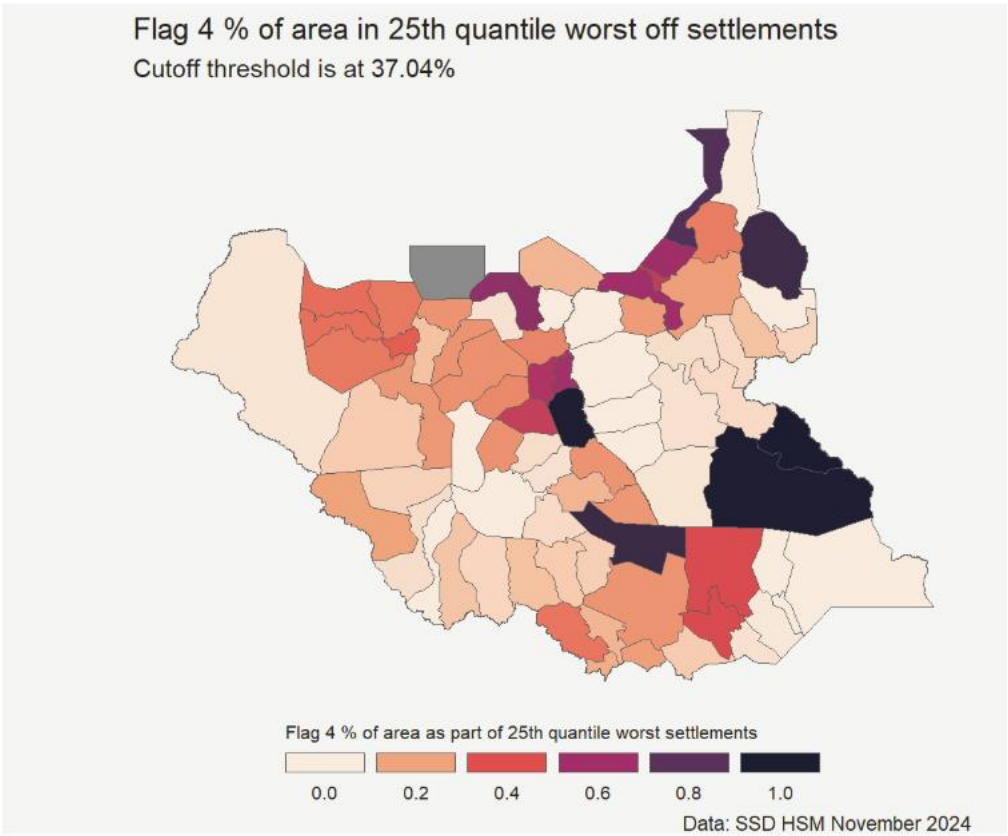
This method is similar to the mean severity index but excludes non-acute needs sectors like Cash and Markets and Education (which only reach severity 3). It focuses on sectors with acute needs, making it a better indicator of critical humanitarian concerns.

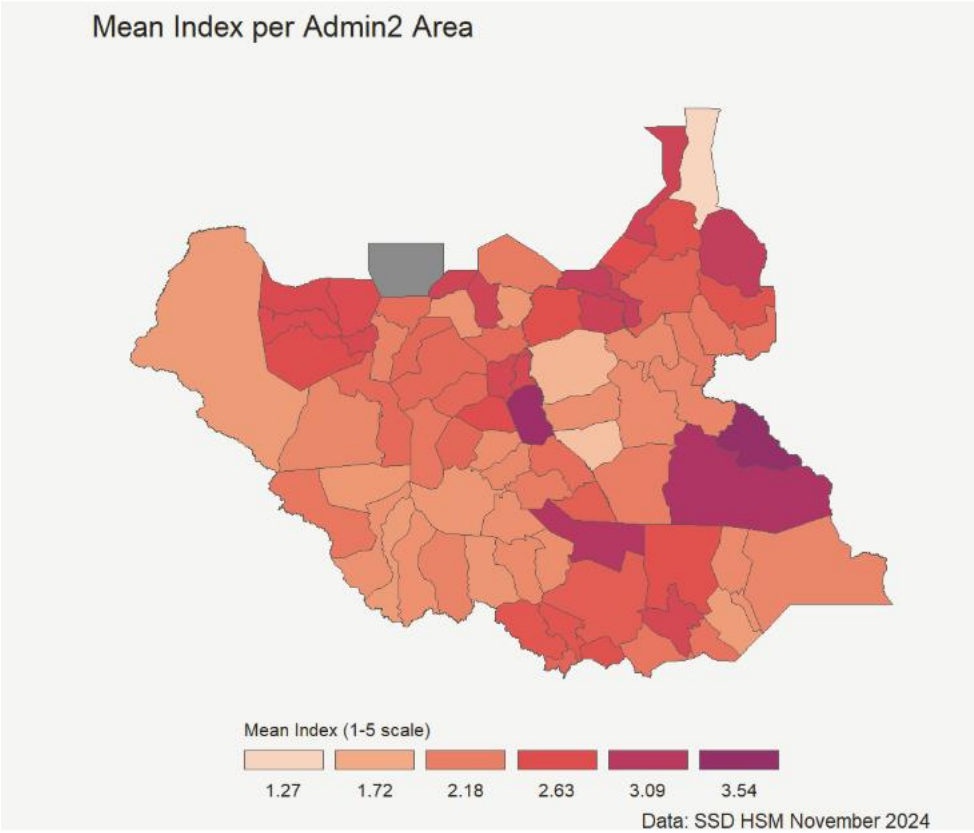
**6. 25% Severity Threshold Index (1-5 scale)**

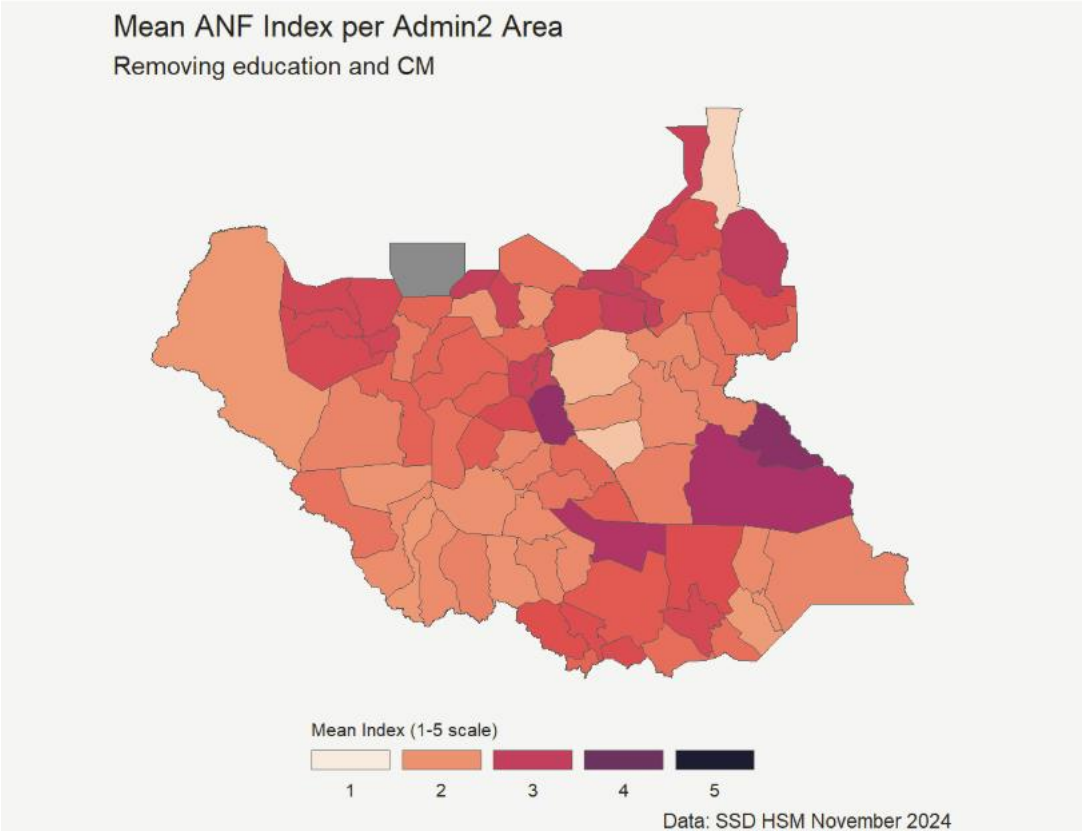
This method determines the severity value at which the 25% worst of indicator values in an area reach or exceed a given severity level. It follows the JIAF methodology and helps identify the threshold of concentrated impact, making it useful for prioritization and response planning.

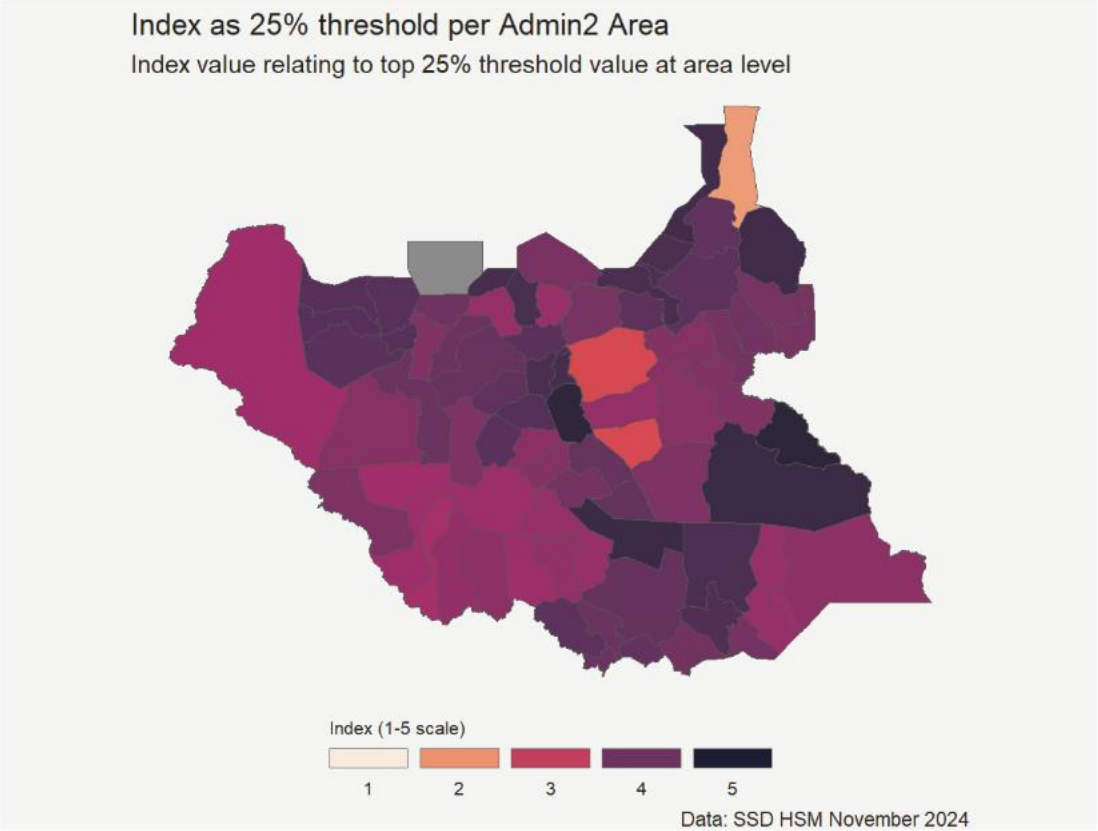



Flag 4 median ratio
Flag 4 median ratio
0.00
0.14
0.29
0.43
0.58
0.72
Data: SSD HSM November 2024


Flag 4 % of area in 25th quantile worst off settlements
Cutoff threshold is at 37.04%
Flag 4 % of area as part of 25th quantile worst settlements
0.0
0.2
0.4
0.6
0.8
1.0
Data: SSD HSM November 2024


Mean Index per Admin2 Area
Mean Index (1-5 scale)
1.27
1.72
2.18
2.63
3.09
3.54
Data: SSD HSM November 2024


Mean ANF Index per Admin2 Area
Removing education and CM
Mean Index (1-5 scale)
1
2
3
4
5
Data: SSD HSM November 2024




Ranking of Admin2 Areas by different methods

| Admin2 | Mean Ratio | Median Ratio | 25th quantile | Mean Index | Mean ANF Index | 25% threshold Index |
|---|---|---|---|---|---|---|
| Pochalla | 1 | 2 | 1 | 1 | 1 | 1 |
| Panyijiar | 2 | 1 | 2 | 2 | 2 | 2 |
| Pibor | 3 | 3 | 3 | 3 | 3 | 3 |
| Terekeka | 4 | 4 | 4 | 4 | 4 | 4 |
| Maban | 5 | 6 | 5 | 5 | 5 | 5 |
| Abiemnhom | 6 | 5 | 8 | 9 | 7 | 7 |
| Manyo | 7 | 7 | 6 | 8 | 9 | 6 |
| Rubkona | 8 | 8 | 7 | 10 | 12 | 9 |
| Mayendit | 9 | 9 | 12 | 11 | 10 | 11 |
| Leer | 10 | 10 | 11 | 14 | 11 | 8 |

Correlation Analysis of Flag 4 Ratio with the other 1-5 methods

| Method | Index 25% severity | P_Value_25 | Mean ANF Index | P_Value_ANF | Mean Index | P_Value_Mean |
|---|---|---|---|---|---|---|
| Pearson | 0.8558550 | 0 | 0.9113039 | 0 | 0.9133110 | 0 |
| Spearman | 0.9531360 | 0 | 0.9145255 | 0 | 0.9164655 | 0 |
| Kendall | 0.8453352 | 0 | 0.7597494 | 0 | 0.7618442 | 0 |

For this analysis, Spearman correlation is the most appropriate choice because:

The data is not normally distributed. The relationship between the Flag 4 Ratio and severity index may not be strictly linear. It provides a robust measure of association that is less affected by outliers compared to Pearson. By using Spearman correlation, we can better capture the strength and direction of the relationship between the

What we can see from the table is that the 25% Proportion Index is most correlated with the Flag 4 Index.