IOM • OIM

DTM

THE UN MIGRATION AGENCY

Technical Notes

# Severity Measures using Multisectoral Location Assessment: 2019 Idai Cyclone

**Global DTM Support Team, HQ Geneva**

**April 2, 2019**

Manuscript by E. Zambrano, DTM Data Scientist at Geneva HQ.

Displacement Tracking Matrix (DTM), International Organization for Migration – IOM

## Executive Summary

This document contains the methodology used to calculate the level of severity in humanitarian conditions, base on the Site Assessment component of the Displacement Tracking Matrix (DTM). This methodology applies to the Idai Cyclone Response, in countries as Malawi (perhaps others).

⚠ Severity Measures in humanitarian contexts are aimed to provide support and an data-driven evidence for support the decision-making processes. They are **NOT** replace the criteria of experts in the field.

**Key messages**

I. After revisiting the Multisectoral Location Assessment forms and data, indicators where identified as relevant for a Severity Ranking, for only 3 Sectors:

   (a) Shelter (3 Indicators)

   (b) WASH (3 indicators)

   (c) Education (3 Indicators)

II. The unit for analysis is the Location (defined by the DTM's Multisectoral Location Assessment)

III. It is **NOT** recommended to perform direct aggregations to higher geographical levels. Instead of this, It is advisable to recalculate the severity measures on aggregated

IV. Amongst several criteria, the tools designed in this document are made following the philosophy of *the simpler the better*.

# CONTENTS

# 1 INTRODUCTION

For simplicity, this document assumes that the reader is familiar with the Multisectoral Location Assessment component of the IOM's Displacement Tracking Matrix, and particularly with the forms and data collected during the Idai Cyclone 2019.

As mentioned in the summary, 9 indicators of three sectors: 3 for Shelter, 3 for WASH, and 3 for Education and the total number of IDP ) where identified as candidates for a composite severity ranking. The following sections provide the detail steps to build, calculate, and a recommended way for reporting them. Each section starts with the conceptual basis behind the severity measure. Readers not interested in the detail mathematical calculations, are advised to read only those parts.

# 2 SHELTER SEVERITY MEASURE

**Conceptual basis:**
Shelter severity is measured using the percentage of households in the site sleeping in the different types of shelters. As a pre-requisite, the type of shelter must be ordered to quality, i.e. from the best to the worst conditions. For instance, the DTM Multisectoral Location Assessment form implemented in Malawi, the types of shelters, by order of quality, are:

1. Permanent shelter
2. Emergency shelter as tents, tarps, or make shift shelters
3. No shelter, i.e. people that sleep outdoors

Severity is calculated assuming that each person sleeping in a given type of shelter contributes to the severity index two times more than a person that sleep in the next worse type of shelter. That means, a person sleeping outdoors counts as twice a person sleeping in an emergency shelter and four times more than a person sleeping in a permanent shelter. Roughly, the final shelter severity index proportional to the sum of the IDPs weighted by their type of shelter.
Additionally, the severity report includes a rough estimate of the number of households in the worst situation of shelter.

As mentioned before, DTM Multisectoral Location Assessment in Malawi maps the shelters in three types. If $P_i$ denotes the proportion of individuals sleeping in the type $i$ of shelter (according to the above), the first step for the severity calculation is

$$s_1 = 2P_1 + 4P_2 + 8P_3, \tag{1}$$

where $s_1$ is the un-normalised severity index, where $P_i$ is the best shelter type and $P_3$ is the worse and

$$\sum_{i=1}^{3} P_i = P_1 + P_2 + P_3 = 1. \tag{2}$$

In the case of the Idai Cyclone in Malawi, the category $P_2$ includes several different sub-types of shelters, that do not have the same standard of quality. In fact, the 'quality' order may vary with the context. Shelter experts in the field could provide a better and more accurate ordering.

Note that the un-normalised severity in Eq. 1 is bounded as $2 \leq s_1 \leq 8$. Therefore, a re-scaling of severity index is recommended. For instance, to obtain a number between 1 and 10, the severity index for shelter is

$$s = \frac{9}{6}(s_1 - 2) + 1 = 3(P_1 + 2P_2 + 4P_3) - 2. \quad (3)$$

The DTM Multisectoral Location Assessment in Malawi provides the percentages $P_i$ given by households and in five-option approximate answers:

- Nobody (around 0%)
- A few (around 25%)
- About half (around 50%)
- Most (around 75%)
- Everyone (about 100%)

Since those are rough estimates, in some cases the sum of the percentages are not equal to 100. Thus, a correction of such percentages, where the percentage in the *worst* is privileged, or the percentage in the *best* category is penalised is recommended.

The next table shows the shelter severity indexes for all the possible percentages using the categories of the DTM Multisectoral Location Assessment for Idai Cyclone 2019, where a suggested

| % of HH* outdoors | % of HH in Emergency shelter | Permanent shelter | Shelter Severity | Degree of Severity |
|---|---|---|---|---|
| 0 | 0 | 100 | 1.00 | very low |
| 0 | 25 | 75 | 1.75 | low |
| 0 | 50 | 50 | 2.50 | low |
| 0 | 75 | 25 | 3.25 | medium |
| 25 | 0 | 75 | 3.25 | medium |
| 0 | 100 | 0 | 4.00 | medium |
| 25 | 25 | 50 | 4.00 | medium |
| 25 | 50 | 25 | 4.75 | medium |
| 25 | 75 | 0 | 5.50 | high |
| 50 | 0 | 50 | 5.50 | high |
| 50 | 25 | 25 | 6.25 | high |
| 50 | 50 | 0 | 7.00 | high |
| 75 | 0 | 25 | 7.75 | very high |
| 75 | 25 | 0 | 8.50 | very high |
| 100 | 0 | 0 | 10.00 | critical |

**Table 1: Shelter severity reference table** The most right column is a suggested degree of severity. *HH stands for households.

degree of severity, using categorical variable, is included. The degree of severity or classification is defined as ranges of 0.25 in the shelter severity index, and the both extreme degrees are defined as: very low, if shelter severity less than 1.5; and critical if shelter severity is greater than 9.5. We recommend to report the rough estimate of the households in the worst condition, next to the degree of severity.

This measures quantifies the access to education only, not other aspects.

## 3 EDUCATION SEVERITY MEASURE

**Conceptual basis:**
Education severity is measured as the percentage of minors (persons with less than 18 years) attending school. The severity categories are given by the following table

| % of children without access to school | Severity Degree |
|---|---|
| more than 92% | very low |
| between 92% to 82% | low |
| between 82% to 71% | medium |
| between 71% to 56% | high |
| between 56% to 35% | very high |
| less than 35% | critical |

The ranges for the degree of severity that follows an exponential rule, where each level of the 6 levels is more than 6 times bigger than the previous level. Additionally, the severity report includes a rough estimation of the number of children exposed to the worst situation.

As mentioned above, the only requirement for this severity measure is the percentage of children without access to education. Since, one expects 6 different levels of severity (the same categorical scale used for shelter), a logarithmic scale in base 7 is used to defined the ranges.

In the general case of $N$ severity categories, the base of the logarithm to be use is the number of categories plus one to avoid the zero for the first category. Namely, if $P$ is percentage of children without access to school (or education severity index), it will correspond to the $n$-th most severe category if

$$\log_N(n-1) \leq P \log_N(n), \qquad \text{where } \in \{1, 2, \ldots, 6\}. \tag{4}$$

This guarantees that where each level of the n levels is 7 times bigger than the previous category of severity. Finally, the estimated number of children without access to school is recommended to report as well. Notice that the Malawi DTM Multisectoral Location Assessment have this information extended to 6 indicators, since the access to education and the number of children is collected by age range.

# 4 WASH SEVERITY MEASURE

**Conceptual basis:**
Composite WASH severity measured is the geometric mean of three severity measures: Water Access severity, Hygiene Severity, and Sanitation Severity.

Water Access severity: It is measured using two percentages: IDPs with access to drinking water and IDPs with access to water for domestic use (as laundry, cook, etc.). It is assumed that drinking water is four times more important than water for domestic use. Note that the quality of the water is not included.
Hygiene Access severity: It is measured using two percentages: IDPs with access to functioning bathing/shower facilities and IDPs that have enough soap. Those indicators are aggregated with the same weight.
Sanitation severity: It is measured using two percentages: % of people living in areas where open defecation is frequently visible and % of people where dumped garbage is frequently visible. People exposed to open defecation have the double of weight than people in areas of dumped garbage. In the case where there are no the access to toilets/latrines, the site is classified as the highest severity level.

Additionally, each severity measure is reported with the estimated of the number of people in the worst situation.

## 4.1 WATER SEVERITY

The two indicators are the percentage of people that have access to drinking water, denoted as $P_1$, and the percentage of people that have access to water for domestic use, denoted by $P_2$. The aggregation is performed using the $L2-$norm, as

$$w_1 = \sqrt{|2(1-P_1)|^2 + |(1-P_2)|^2}, \tag{5}$$

where $w_1$ is the no-scaled water severity index, and $0 \leq P_i \leq 1$ for $i = 1, 2$. The above formula provides the access drinking water has four times more weight than the access to water of domestic use.. This $L2$-norm is used to emphasise the extreme values. According to the Eq. (5), $0 \leq w_1 \leq \sqrt{(5)}$, a re-scaling version of this index is recommended. For instance,

$$w = \frac{9}{4}(w_1 - 1) + 1 = \frac{9}{4}\left(\sqrt{|2(1-P_1)|^2 + |(1-P_2)|^2} + 1\right) \tag{6}$$

is re-scaled to the range between 1 to 10. The ranges for the severity degree are chosen following an exponential rule, where each level of the 6 levels (the same of the other severity indexes above mentioned) is 6 times bigger than the previous level. For this sake, one the Eq.(4) for $N = 6$ and where $P$ is the water severity index resulting on the following table

| Water Access Severity Index | Severity Degree |
|---|---|
| $w < 0.05$ | very low |
| $0.05 \leq w < 0.38$ | low |
| $0.38 \leq w < 0.61$ | medium |
| $0.61 \leq w < 0.77$ | high |
| $0.77 \leq w < 0.89$ | very high |
| $w \geq 0.89$ | critical |

**Table 2: Severity levels for Access to Water**

### 4.2 HYGIENE SEVERITY

The two indicators used for this severity index are: number of IDPs have access to functioning bathing/shower facilities and number of IDPs have enough soap. Both are aggregated as in the Eq. (5), without the factor of $2$ for the $P_1$. The rest of the calculation is the same as the Water Access Severity.

### 4.3 SANITATION SEVERITY

The core two indicators for the Sanitation Severity are the number of persons living in areas where open defecation is frequently visible, and the number of persons living live in areas where dumped garbage is frequently visible. They are aggregated as the ones for the Hygiene Severity index, with the difference that if there are no toilets/latrines in the Location, it is automatically classified as the highest severity level.

### 4.4 COMPOSITE WASH SEVERITY

Having classified the sites according to the Severity levels in each of the sub-topic under the WASH sector (Water, Hygiene, and Sanitation), a geometric mean of the values is performed to obtain the final composite WASH Severity index. Explicit, the Degrees of severity are mapped as: very low to 6, low to 5, medium to 4, high to 3, very high to 2, and critical to 1. The geometric mean is given by

$$W = \sqrt[3]{w \times h \times s}, \tag{7}$$

where $w$, $h$, and $s$ are the water, hygiene, and sanitation indexes respectively. A proper re-scaling of this index is recommended for reporting.

## 5 OUTLOOK

This report is the first version of the Severity Indexes for the Idai Cyclone 2019 Response. Note that the current methodology is still in development. Evolution of the crisis requires more contextual information, that the on-going DTM Multisectoral Location Assessment is trying to adapt, and other sectors may be included in the analysis.