Madagascar Index of Need Explorer Instructions

This publication was produced by Abt Global LLC as part of the LASER PULSE program, led by Purdue University and funded by the United States Agency for International Development (USAID). The views expressed in this publication do not necessarily reflect the views of USAID or the United States Government. This application was produced as part of a buy-in from USAID/BHA/TPQ/SPADe into the Long-Term Assistance and Services for Research (LASER) project currently in place between USAID/DDI/ITR/R and Purdue University under a cooperative agreement. This project has been executed by Abt Global LLC under a subcontract with Purdue University.

The USAID Bureau for Humanitarian Assistance (BHA) seeks to reduce the need for ongoing and future food and nutrition security humanitarian assistance in Madagascar and build resilience among households and communities affected by recurrent shocks. The **Madagascar Index of Need Explorer** allows users to (a) calculate a custom index of need using indicators from nine themes relevant as drivers of ongoing humanitarian need, and (b) explore the underlying geospatial data which informs the index creation and provides additional information about the spatial distribution of different factors contributing to humanitarian need. The information gained from this tool will provide users with evidence-based data to inform critical decisions around identifying and strategically targeting assistance toward the communes within the country with the highest degree of need.

These instructions are to guide users of the application through the process of calculating an index of need and exploring the underlying geospatial data. This document begins by reviewing the purpose of the tool and providing an overview of the application interface. We then provide detailed instructions on the use of each of the three tabs. Details on the methodology and indicators can be found at the end of the document.

Purpose of this tool

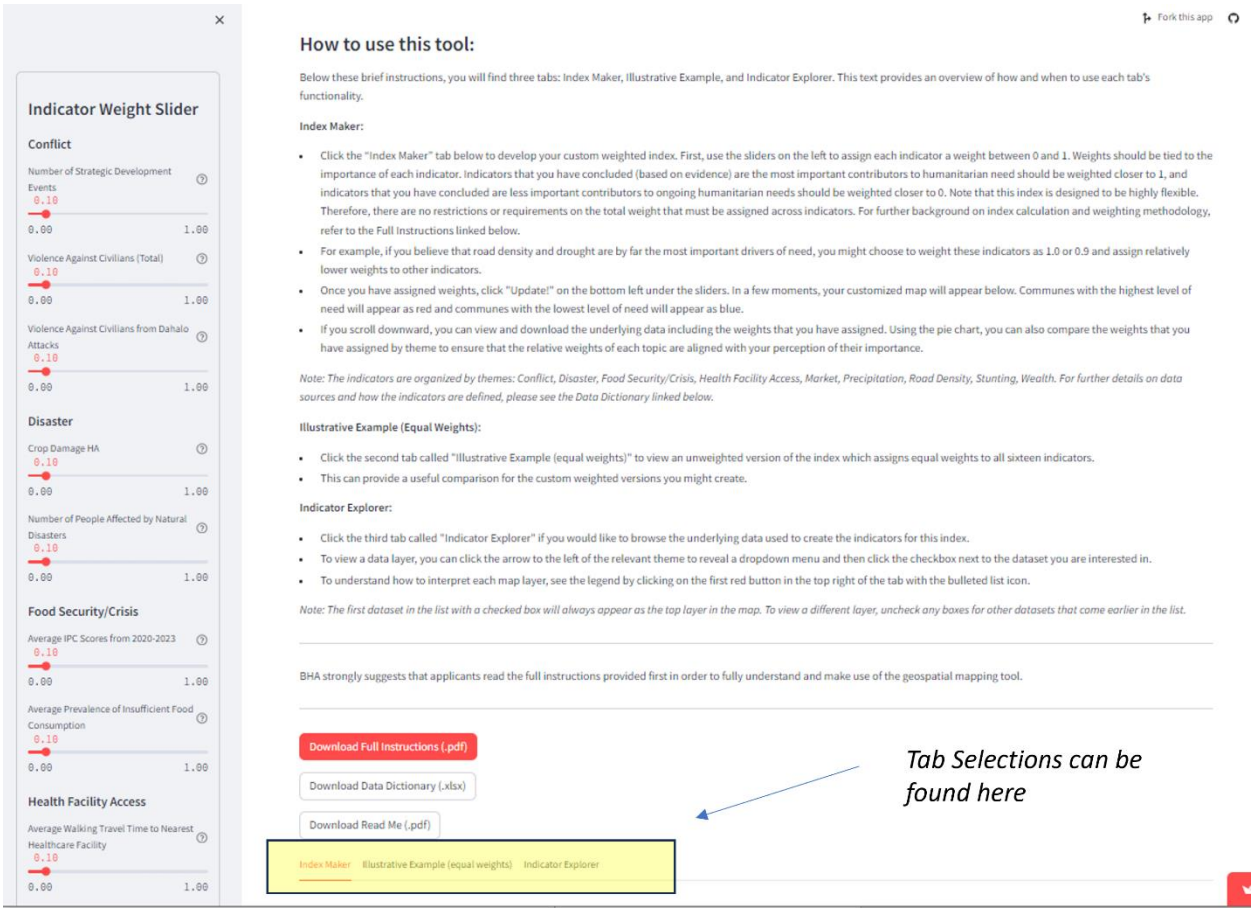
This tool is designed to assist users with evidence-based design and decision-making for the Resilience and Food Security Activity (RFSA) in Madagascar. The tool enables users to 1) visualize indicators related to resilience and food security across different communes in RFSA geographic areas and 2) select the relative importance of each indicator for the calculation of an Index of Need, which uses colors to visually represent each commune's level of need for a RFSA relative to the other communes. The ability of the user to manually select the weight for each indicator in the Index of Need allows users to decide for themselves the relative importance of each indicator in determining the level of need for a RFSA and incorporate this evidence into their RFSA design.

Application Interface

The application has three tabs: **Index Maker, Illustrative Example**, and **Indicator Explorer (ArcGIS)**.

- **Index Maker** Calculates the Index of Need using custom weights. The indicator weight determines how important each indicator is in the calculator of the Index of Need. To calculate the index, the user adjusts the weights for the indicators in the left sidebar and after clicking the update button, the index is generated. This index is designed to be highly flexible, and therefore there are no restrictions or requirements on the total weight that can be assigned across indicators. The weights do not need to add up to a specified value. For further details on weighting and calculations, see "Background on Calculation Methodology" below.
- **Illustrative Example (equal weights)** Calculates the Index of Need using equal weights across all variables.
- **Indicator Explorer** Displays a map of the indicators without Index of Need calculation.

Figure 1: Screenshot of application noting location of three tabs



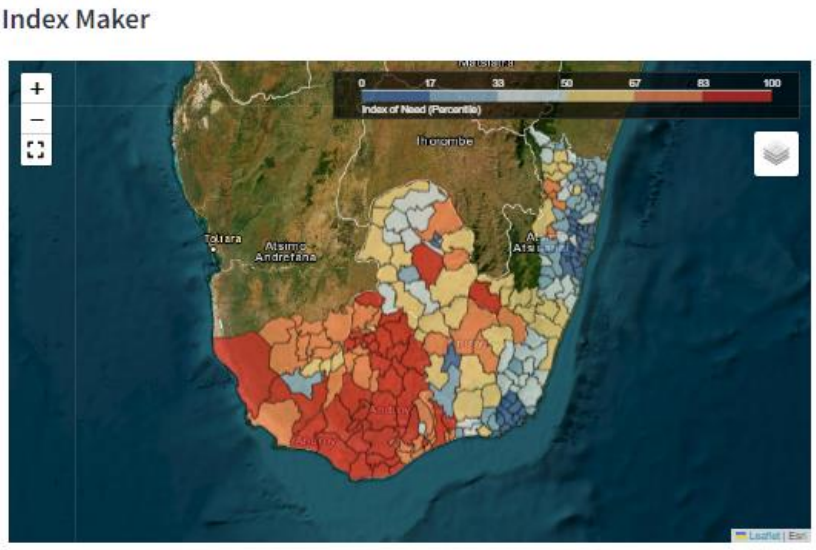
Index Maker Tab

Calculating a weighted Index of Need

Indicators that can be weighted are organized by themes: **Conflict, Disaster, Food Security/Crisis, Health Facility Access, Market, Precipitation, Road Density, Stunting, Wealth.**

1) **Click the "Index Maker" tab to develop your custom weighted index.**
    a. First, use the sliders on the left to assign each indicator a weight between 0 and 1. For example, if you believe that road density and drought are the most important drivers of need, you might choose to weight these indicators as 1.0 or 0.9 and assign relatively lower weights to other indicators.
2) **Once you have assigned weights, click "Update!" on the bottom left under the sliders.**
    a. In a few moments (it may take up to 30 seconds), a customized map, table, and pie chart will appear in the center of your screen.
    b. Communes with the highest level of need will appear as red and communes with the lowest level of need will appear as blue. If you scroll downward, you can view and download a csv file of the underlying data including the weights that you have assigned and use the pie chart compare the relative weights that you have assigned by theme to ensure that the relative weights of each topic are aligned with your perception of their importance. (Note: for further details on data sources and how the indicators are defined, please see the Data Dictionary linked in the application).
3) **To save a copy of the map image that you have created**, first put the map in full screen mode by clicking the third (bottom) button in the top left corner of the map. Then use your browser or computer's screen-capture tool to take a screenshot of the map and save it in your preferred file format.

Figure 2: Resulting map after assigning weights



4) **The Index Maker Dataframe displays the map's underlying data**, incorporating the user-generated weights. **To download this data**, hover your cursor over the table. A download symbol will appear in the upper right of the table which will export the results as a csv file. To support interpretation of this data, please refer to the Data Dictionary file linked on the app.

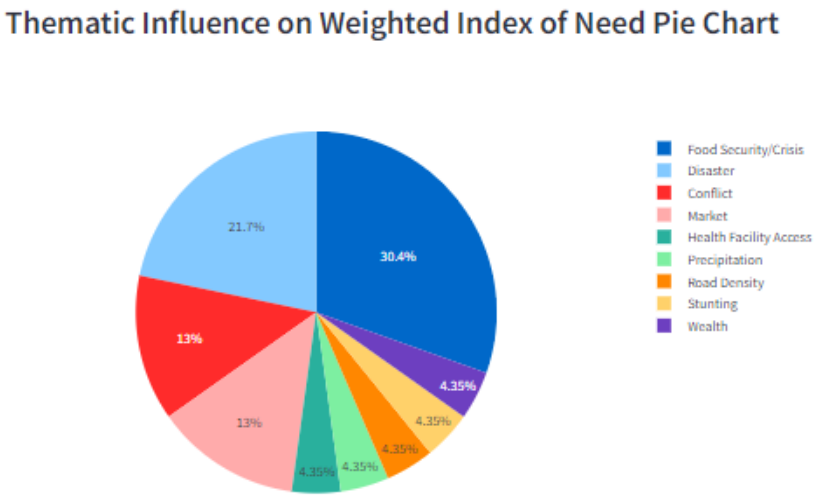
Figure 3: Example of Index Maker Dataframe

Index Maker Dataframe:

OBJECTID	ADM3_EN	INDEX_OF_NEED	INDEX_OF_NEED_percentile	ADM1_EN	ADM1_PCODE	ADM1_TYPE
1	Antondabe	0.0687	61	Atsimo Atsinanana	MG25	Region
2	Marovitsika Sud	0.4328	76	Atsimo Atsinanana	MG25	Region
3	Antaninarenina	0.1653	65	Atsimo Atsinanana	MG25	Region
4	Farafangana	-0.3896	32	Atsimo Atsinanana	MG25	Region
5	Vohimasy	-0.561	15	Atsimo Atsinanana	MG25	Region
6	Anosivelo	-0.646	11	Atsimo Atsinanana	MG25	Region
7	Anosy Tsararafa	-0.5284	20	Atsimo Atsinanana	MG25	Region
8	Vohitromby	-0.7431	4	Atsimo Atsinanana	MG25	Region
9	Ivandrika	-0.4841	23	Atsimo Atsinanana	MG25	Region
10	Manambotra Atsi	-0.5067	21	Atsimo Atsinanana	MG25	Region

5) **The Thematic Influence on Weighted Index of Need Pie Chart shows the influence of each theme on the Index of Need.** In this pie chart, the user-assigned weights are summed for each theme (for example, the weights assigned to the two indicators under the Disaster theme are added together) and then expressed as a percentage of the sum of weights for all themes and indicators. The goal of including this feature is for users to use this as a check to ensure that the relative weights that they have assigned to each theme are in proportion to their perceived influence on humanitarian need in this context. For example, without this check, a user might unintentionally over-weight themes with more indicators (such as Market and Conflict) and under-weight themes that could still be important drivers of need but have fewer indicators (such as Road Density and Stunting). **To download this chart**, hover your cursor over the pie chart. Click the camera icon to download a .png version of this chart.

Figure 4: Screenshot of pie chart



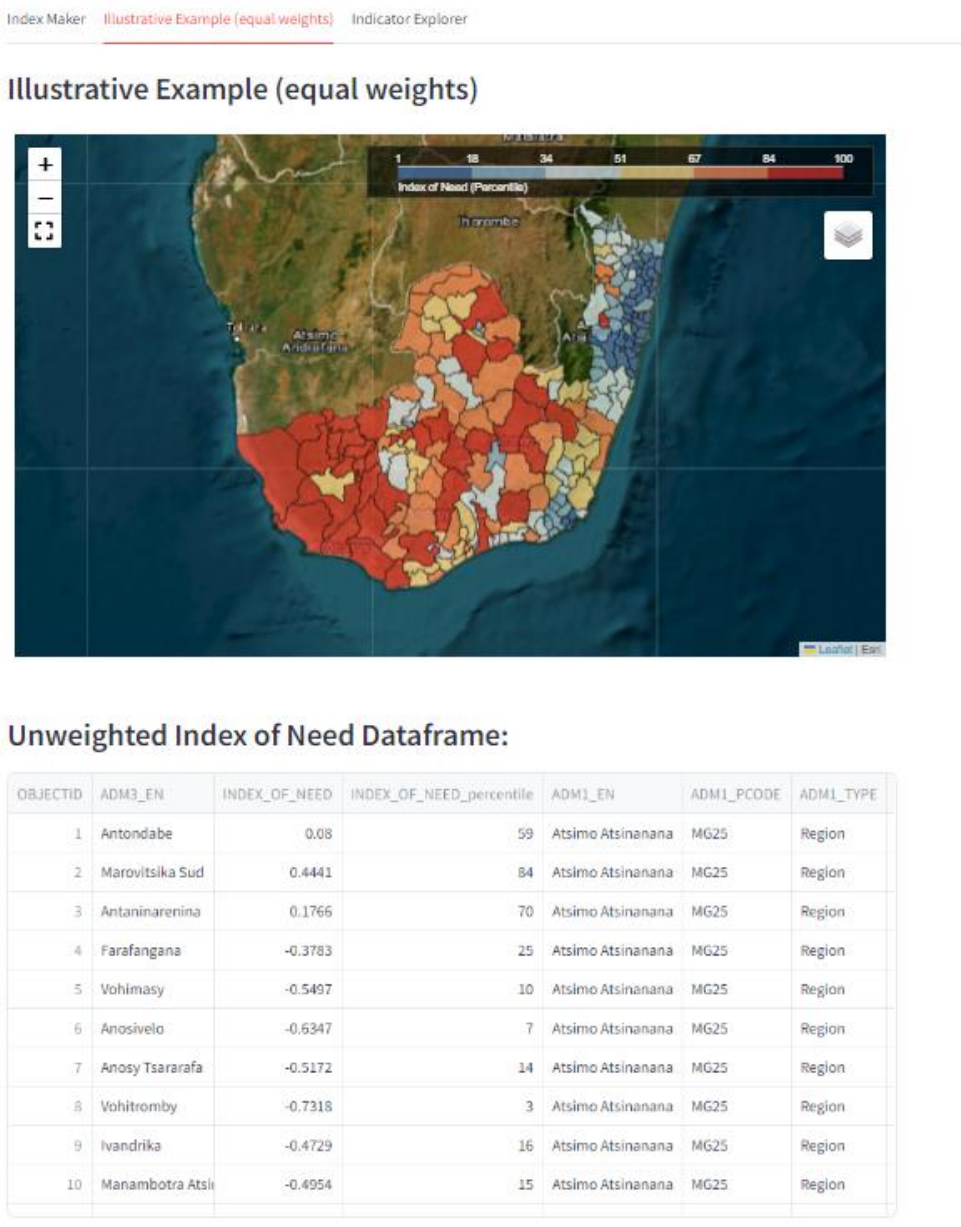
(Note: the application will refresh the screen after a period of time which will erase the map, table and chart.)

Illustrative Example (equal weights) Tab

The Illustrative Example (equal weights) tab calculates the Index of Need using equal weights for all indicators. This tab shows an unweighted version of the index which assigns equal weights to all sixteen indicators. This can provide a useful comparison for the custom weighted versions you might create. (*Note: This is not an endorsement of using equal weights for the indicators but is an illustrative example of what a map with equally weighted indicators looks like.)*

1) Clicking on the Illustrative Example (equal weights) tab displays a map and a table of Index of Need calculated by assigning a weight of one to all indicators.
NOTE: The Indicator Weight Slider will still appear on the left of the screen, but it will not affect the calculation of the unweighted index.

Figure 5: Screenshot of unweighted Index of Need map and table

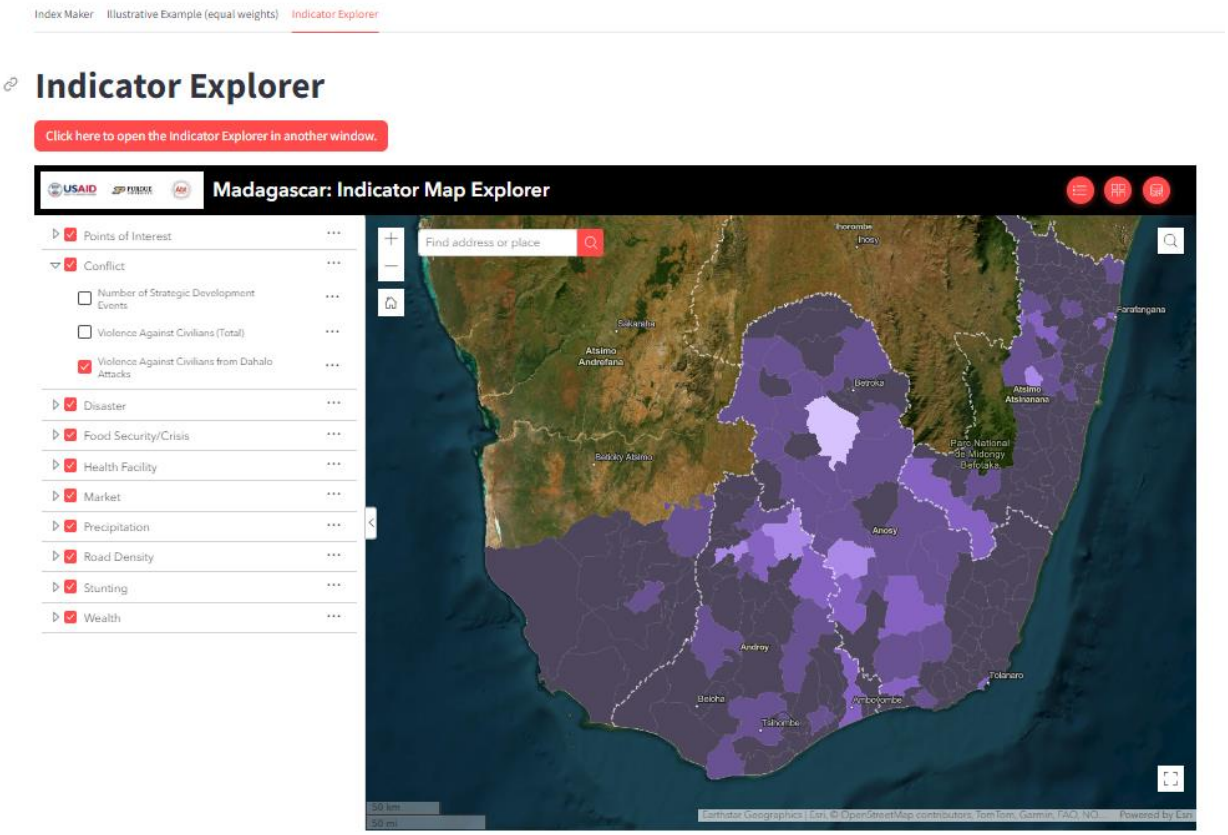


OBJECTID	ADM3_EN	INDEX_OF_NEED	INDEX_OF_NEED_percentile	ADM1_EN	ADM1_PCODE	ADM1_TYPE
1	Antondabe	0.08	59	Atsimo Atsinanana	MG25	Region
2	Marovitsika Sud	0.4441	84	Atsimo Atsinanana	MG25	Region
3	Antaninarenina	0.1766	70	Atsimo Atsinanana	MG25	Region
4	Farafangana	-0.3783	25	Atsimo Atsinanana	MG25	Region
5	Vohimasy	-0.5497	10	Atsimo Atsinanana	MG25	Region
6	Anosivelo	-0.6347	7	Atsimo Atsinanana	MG25	Region
7	Anosy Tsararafa	-0.5172	14	Atsimo Atsinanana	MG25	Region
8	Vohitromby	-0.7318	3	Atsimo Atsinanana	MG25	Region
9	Ivandrika	-0.4729	16	Atsimo Atsinanana	MG25	Region
10	Manambotra Atsi	-0.4954	15	Atsimo Atsinanana	MG25	Region

Indicator Explorer Tab

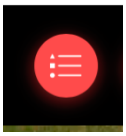
Use the Indicator Explorer tab if you would like to browse the underlying data used to create the indicators for this index.

Figure 6: Screenshot of Indicator Explorer tab



Displaying layers

To display layers on the map, click the check box next to the layer name. To view a data layer, click the arrow to the left of the relevant theme to reveal a dropdown menu and then click the checkbox next to the dataset you are interested in. Note that the first dataset in the list with a checked box will always appear as the top layer in the map and will cover any layers beneath it. You will only be able to view one layer – the first checked box in the list - at a time. To see the legend, click the first red button in the top right of the tab with the bulleted list icon. Clicking on the check box next to the layer will display it on the map.



Legend Icon found in upper right of the Indicator Explorer window

Please refer to the ReadMe file (linked in the app) for instructions on how to add additional data layers to the Indicator Explorer.

Background on Calculation Methodology

Index of Need

The drivers of humanitarian need in Southern and Southeastern Madagascar are complex, and include multiple factors such as conflict, food insecurity, and natural disasters. Furthermore, there is great diversity within this context and not all areas face the same risks. For instance, natural disasters may be a key risk factor in one area but in another area attacks against civilians may be more important. An Index of Need can be used to model the impact of different factors that can lead to increased need in some geographic areas relative to others.

Indicators used in Index of Need Calculation

This Index of Need includes the following indicators, grouped by theme. For more information on these indicators, please refer to the Data Dictionary linked on the main application.

Theme	Indicator	Source
Conflict	Violence Against Civilians from Dahalo Attacks (2018-2023)	Armed Conflict Location & Event Data (ACLED) Project
	Violence Against Civilians Total (2018 - 2023)	ACLED Project
	Number of Strategic Development Events (2018-2023)	ACLED Project
Food Security/Crisis	Average IPC Scores from (2020 – 2023)	Famine Early Warning Systems Network (FEWS NET)
	Average Prevalence of Insufficient Food Consumption (2022)	World Food Programme
Market	Distance to Nearest Market (2023)	World Food Programme
	Market Price Volatility Score (2018 - 2023)	World Food Programme
	Market Pricing Anomaly Score (2018 – 2023)	World Food Programme
Stunting	Percent Children Stunted (2021)	2021 Demographic and Health Surveys
Disaster	Number of People Affected by Natural Disaster (2004 – 2023)	Disater Information Management System (DesInventar)
	Hectares of Crops Damaged by Natural Disasters (2004 – 2023)	Disater Information Management System (DesInventar)

Health Facility Access	Average Walking Travel Time to Nearest Healthcare Facility (2019)	USAID GeoCenter Analysis using data from the Malaria Atlas Project
Precipitation	Average Cumulative Precipitation per Sq. KM during 2016-2023 growing season	Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS) Daily via Google Earth Engine (GEE)
Road Density	KM of Road per Commune Sq Km area (Reversed) (2023)	OpenStreetMap
Wealth	Relative Wealth Index (Reversed) (2022)	UC Berkeley Data Intensive Development Lab

This application provides users the ability to calculate an Index of Need for communes in four regions of Madagascar (Androy, Anosy, Atsimo Andrefana, and Atsimo Atsinanana).
The first step in creating the index is calculating a **z-score** for each indicator at the commune level. A z-score is a statistical measure that indicates how far a value is from the mean. A positive z-score tells us that a value is higher than average. A negative z-score tells us that a value is lower than average. The numerical value indicates the number of standard deviations from the mean. For example, a z-score of -1.5 indicates that the value is 1.5 standard deviations below the mean.

Note: for two indicators (precipitation and road density), the z-scores were reversed to indicate that a lower density of roads and a lower level of precipitation indicates a higher level of need.

Next, for each commune, we apply the user-defined weights to each indicator by multiplying each indicator's z-score by its assigned weight. For example, if a commune has a z-score of 0.5 for the stunting indicator and a user assigns a weight of 0.2, the weighted value of the stunting variable for this commune would be 0.5 * 0.2 = 0.1.

Finally, we sum together the values of all weighted z-scores for each commune to get the total Index of Need score for the commune. For each commune, the Index of Need score is converted into an Index of Need percentile by ranking the scores for all communes and then normalizing them to a score between 0 and 100. This allows for an easier comparison of different weighting schemes that a user might decide to experiment with. A higher percentile indicates that a commune may have higher levels of need according to the user-generated score. Each time the tool is used, the map renders the updated Index of Need percentile.

Below, please find a summary of the formula described in the text above.

$$\textit{Index of Need} = (w_{\textit{conflict var 1}} * z(\textit{Conflict Variable 1})) + \ldots (w_{\textit{conflict var n}} * z(\textit{Conflict Variable n})) +$$

$(w_{food\ security\ var\ 1} * z(Food\ Security\ Variable\ 1)) + \ldots (w_{food\ security\ var\ n} * z(Food\ Security\ Variable\ n)) +$

$(w_{market\ var\ 1} * z(Market\ Variable\ 1)) + \ldots (w_{market\ var\ n} * z(Market\ Variable\ n)) +$

$(w_{stunting\ var\ 1} * z(Stunting\ Variable\ 1)) + \ldots (w_{stunting\ var\ n} * z(Stunting\ Variable\ n)) +$

$(w_{disaster\ var\ 1} * z(Disaster\ Variable\ 1)) + \ldots (w_{disaster\ var\ n} * z(Disaster\ Variable\ n)) +$

$(w_{wealth\ var} * z(Wealth\ Index)) +$

$(w_{precipitation\ var} * z(Precipitation\ Variable)) +$

$(w_{health\ facility\ access\ var} * z(Health\ Facility\ Access)) +$

$(w_{road\ density\ var} * z(Road\ Density))$