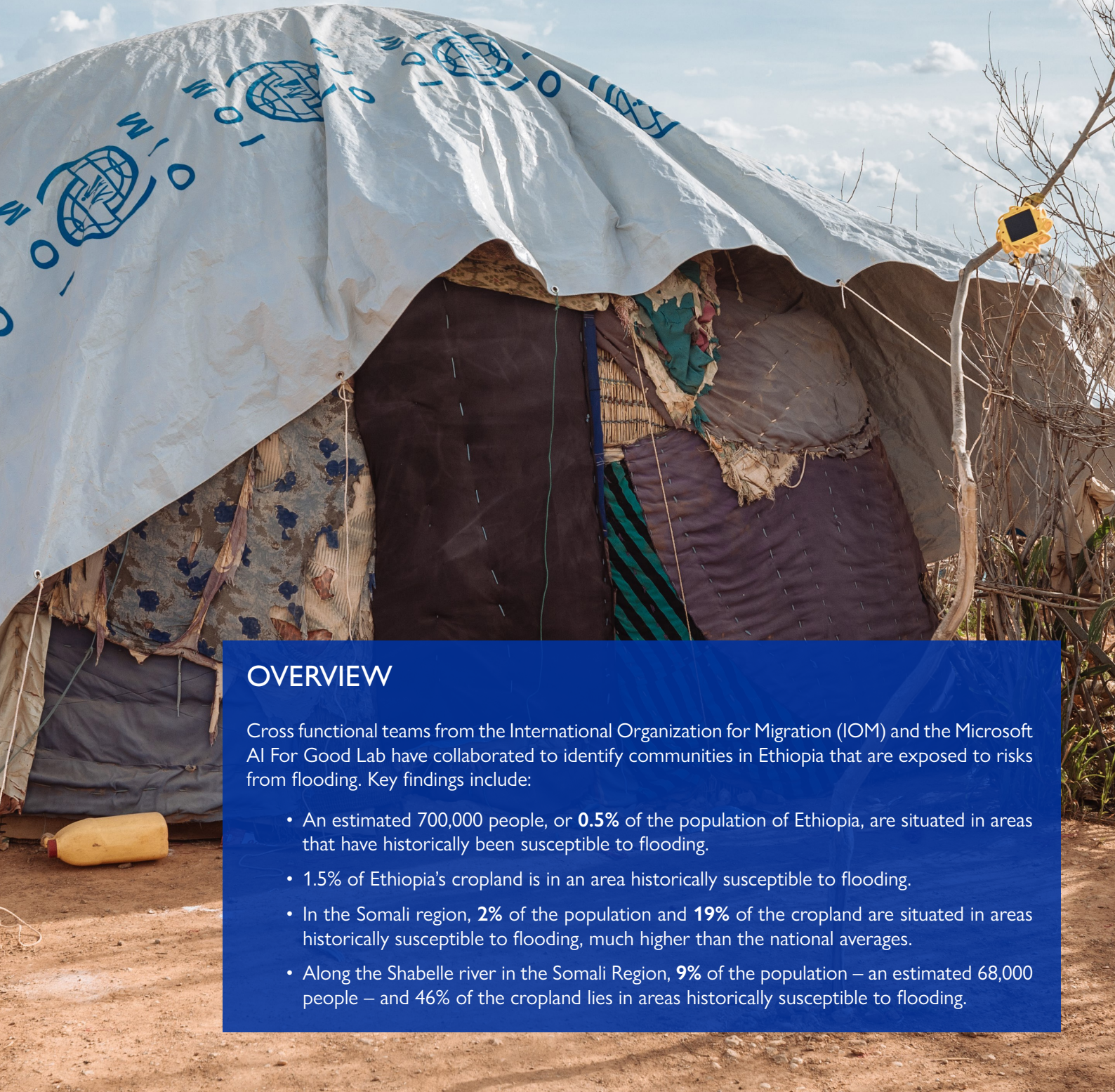


# VULNERABLE COMMUNITIES IN ETHIOPIA AT RISK OF FLOODING



## OVERVIEW

Cross functional teams from the International Organization for Migration (IOM) and the Microsoft AI For Good Lab have collaborated to identify communities in Ethiopia that are exposed to risks from flooding. Key findings include:

- An estimated 700,000 people, or **0.5%** of the population of Ethiopia, are situated in areas that have historically been susceptible to flooding.
- 1.5% of Ethiopia's cropland is in an area historically susceptible to flooding.
- In the Somali region, **2%** of the population and **19%** of the cropland are situated in areas historically susceptible to flooding, much higher than the national averages.
- Along the Shabelle river in the Somali Region, **9%** of the population – an estimated 68,000 people – and 46% of the cropland lies in areas historically susceptible to flooding.



## CONTEXT AND DATASETS

The research conducted during this collaboration centered on combining datasets to produce new, informative maps. These maps allow IOM analysts to identify potential population movements, prioritize locations for response, and plan those responses preemptively.

The AI For Good Lab provided data from a new machine learning model that uses imagery from the Sentinel 1 satellite to identify areas that have experienced flooding. IOM provided data on the locations of internally displaced persons (IDPs) and IOM offices.

Finally, open-source datasets were leveraged to map cropland and populations, allowing the research group to identify high-risk areas and communities residing in high-risk areas. Population data was sourced from Global Human Settlement (GHS) and the cropland map was sourced from Esri. More details on the datasets utilized can be found in the **Data Specifications** section.

**Figure 1** shows a map that combines several of these layers. Each green circle is centered on an IOM office in Ethiopia, and an 80km radius is included to represent, on average, the operational reach of each office for direct implementation. The blue areas show populations living in areas historically susceptible to flooding.

## FINDINGS

### Populations In Areas Susceptible to Flooding

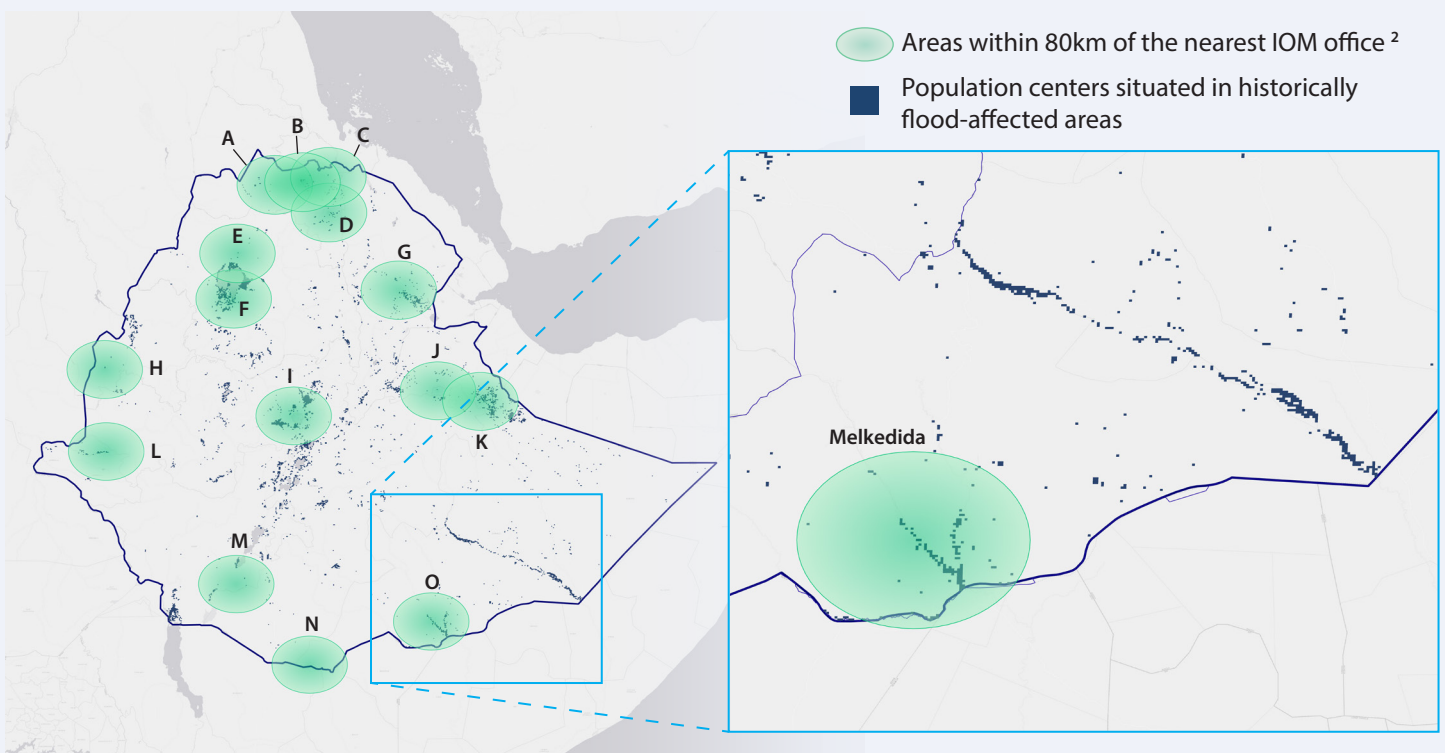
An estimated 700,000 people, 0.5% of the population of Ethiopia, are residing in areas historically susceptible to flooding.

One such area is the basin of the Shabelle river, Somali region, in the southeast of the country. **9%** of the population living along the Shabelle river is situated in areas susceptible to flooding, far greater than the national average of 0.5%. Recurrent flooding of the Shabelle river is a well-documented challenge, and this region has garnered attention from international aid organizations including IOM.<sup>1</sup> Our research shows that 22% of the populations that live along the Shabelle river in the Kelafo, Mustahil, and Ferfer woredas reside in areas with historical susceptibility to flooding.

<sup>1</sup> An OCHA Situation Report from August 2024 estimated that 112,000 people were affected by floods in the Ferfer, Kelafo, and Mustahil woredas, through which the Shabelle river flows (<https://www.unocha.org/publications/report/ethiopia/ethiopia-situation-report-23-august-2024>).

<sup>2</sup> A) Shire, B) Adwa, C) Adigrat, D) Mekelle, E) Gondar, F) Bahir Dar, G) Semera, H) Assosa, I) Addis Ababa, J) Dire Dewa, K) Jijiga, L) Gambella, M) Konso, N) Moyale, O) Melkedida

**Figure 1: Populations in Areas Historically Susceptible to Flooding**



Though flood risk along the Shabelle river is severe, some major urban centers in the region are positioned in areas that are not susceptible to flooding. For example, the city center of Gode – a town in Shabelle zone of Somali region – is situated in an area that has not been historically susceptible to flooding, as shown in Figure 2. Other towns have more significant overlap with the flood-affected areas. For example, **28%** of the populated area in Mustahil town sits on land that is susceptible to flooding (Figure 3).

### IDP Sites In Areas Susceptible to Flooding

Figure 3 also includes the locations of sites hosting internally displaced persons (IDPs). These locations, provided by IOM, represent especially vulnerable communities. A site in this context means a location hosting 20 or more IDP households and encompasses IDPs hosted both in and out of camp-like settings.

As shown in Figure 3, the IDP site just north of Mustahil town lies within an area that has been historically flood-affected.

This IDP site is an exception. Only 1% of IDP sites in Ethiopia are situated in areas that have been historically affected by floods.<sup>3</sup> An additional 2% are within 500m of historically flood-affected areas, and 97% lie in areas that have not been historically susceptible to flooding.

<sup>3</sup> The calculation utilizes the IDP site data collected by IOM's Data and Research Unit (DRU) utilizing the Displacement Tracking Matrix (DTM) methodology in locations accessible to in person data collection by the enumeration teams and should not be considered exhaustive.

### Cropland In Areas Susceptible to Flooding

The flooding of cropland can lead to significant food insecurity and displacement. Our analysis of flood-affected areas and croplands in Ethiopia revealed that 1.5% of Ethiopia's over 10M hectares of cropland are in areas with historical susceptibility to flooding.

Figure 4 shows cropland across all of Ethiopia. The green shading is cropland in areas that have not historically experienced floods, while the red shading shows cropland in areas that have been historically susceptible to flooding. Somali region, in the southeast of the country is outlined on the map.

Cropland is relatively sparse in Somali region, and most of the region's cropland is in the far north, far from populations to the south. Across the whole region of Somali, 19% of cropland lie in areas with historical susceptibility to flooding.

In the southern part of Somali region, nearly all the cropland lies along the Shabelle river, the Gestro River, or the Genale River. Figure 5 highlights the cropland around these three rivers. While only 1.5% of Ethiopia's cropland lies in historically flood-affected areas, that designation applies to 47% of the cropland along these three river basins.

Along the southernmost segment of the Shabelle river, extremely high proportions of cropland lie in areas with historical exposure to flooding. 41% of cropland along the Shabelle river in the Kelafo woreda, 71% of cropland along

Figure 2: Gode Town

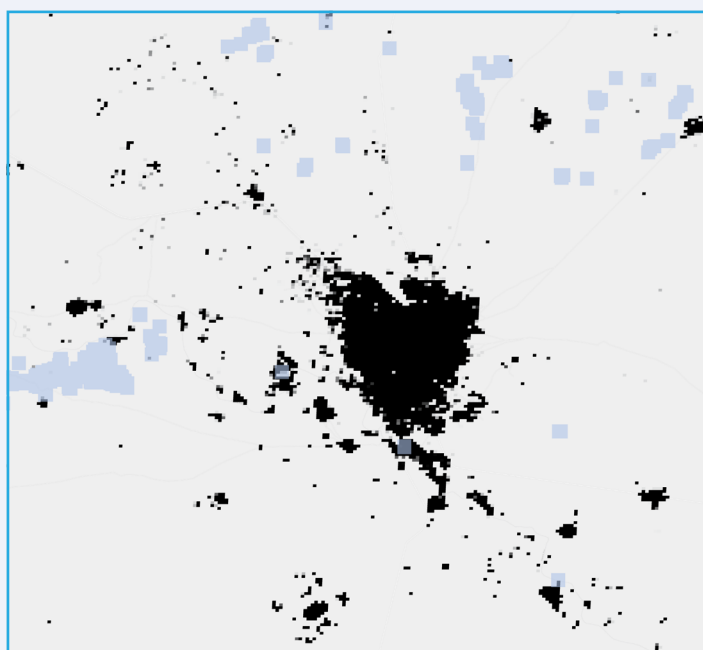
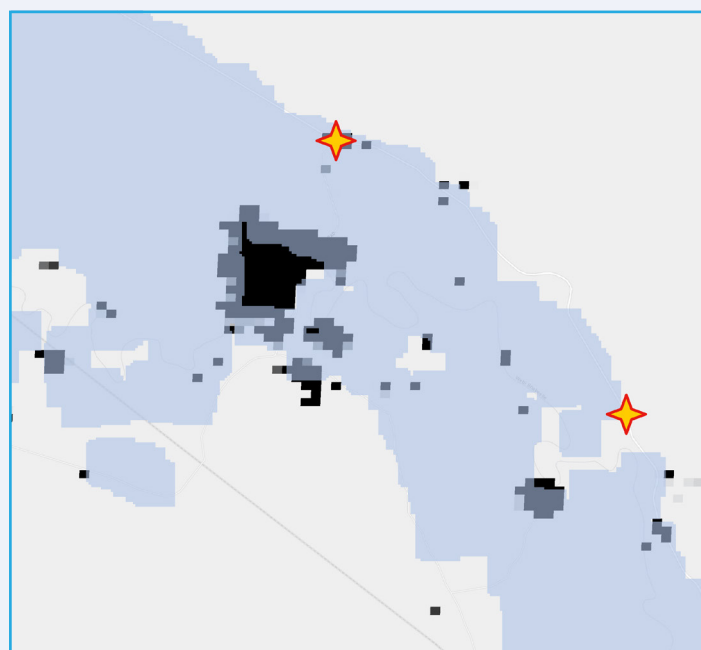


Figure 3: Mustahil Town



■ Areas historically susceptible to floods    ■ Populated areas    ★ Sites hosting internally displaced persons (IDPs)

the Shabelle river in Mustahil woreda, and 91% of cropland along the Shabelle river in the Ferfer woreda lie in areas that have historically experienced flooding, 13,000ha in total.

## POTENTIAL IMPACT AND USE CASES

This report demonstrates how vulnerable communities can be identified and visualized on maps that combine datasets on population centers, climate hazards, and IOM operations to support preparedness and response. Locations of IDP sites provided by the IOM's Data and Research Unit (DRU) and collected through the Displacement Tracking Matrix (DTM) methodology are a useful source of data which can be layered with other data sources to provide an overview of a location and identify mobile populations at risk.

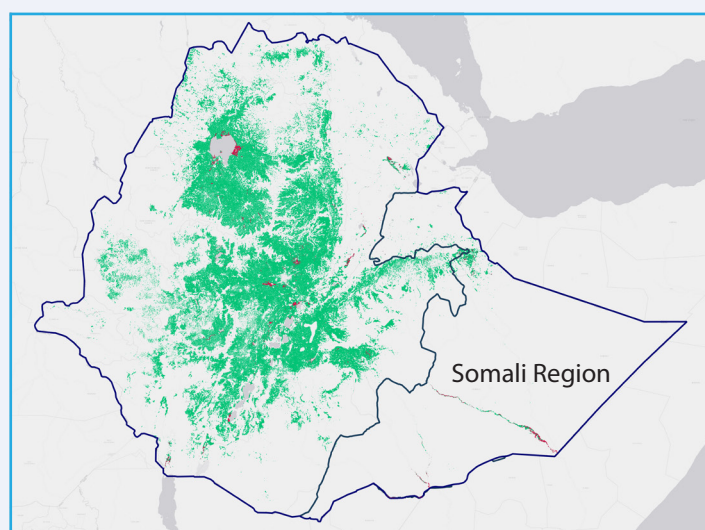
Analysts can use these datasets to map large swaths of the country, identifying, at a high level, regions with vulnerabilities to flooding. The maps can also be used to focus on towns within those regions, finding specific neighborhoods or IDP settlements at particularly high risk. This report will allow IOM's Preparedness and Response Unit (PRU) to ensure that aid is available where it is most needed, and prevent both shortages and excess, to ensure resources are used most efficiently. In addition, it also allows to determine the most efficient and effective modality for response in flood affected areas, either direct response or indirect response through IOM's Rapid Response Fund (RRF).

The RRF is a flexible and fast-acting funding mechanism managed by IOM designed to enable swift, targeted interventions in response to both sudden and slow-onset

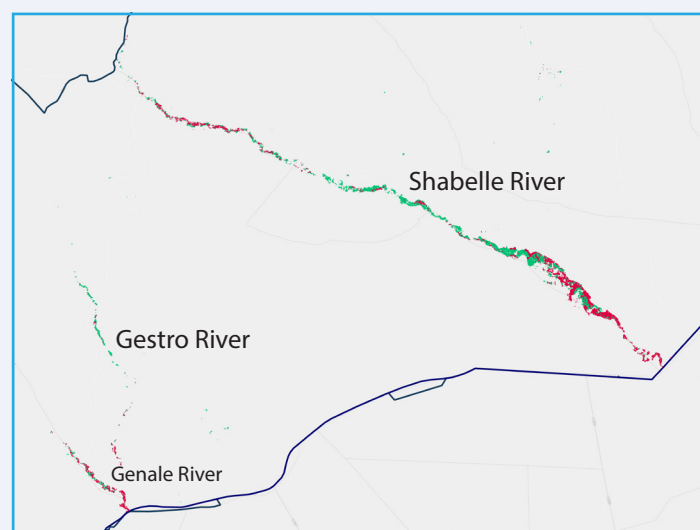
emergencies. It facilitates the rapid mobilization of resources through local partners, addressing immediate humanitarian needs such as displacement, shelter, water, sanitation, and protection. The RRF plays a key role in anticipatory action, allowing for the strategic pre-positioning of resources in high-risk regions identified through early warning systems. Additionally, the RRF supports early recovery efforts, helping communities rebuild their livelihoods and infrastructure in the aftermath of crises. Its agility and local partnerships ensure that essential assistance reaches populations swiftly, including in areas beyond IOM's direct operational reach.

The town of Mustahil lies more than 200km from the nearest IOM office in Melkadida. As noted above, 28% of the population in Mustahil town live in areas with historical exposure to floods, and the IDP site on the northern edge of the town is also situated in an area that has experienced flooding. To support an area like Mustahil, the RRF could collaborate with local actors to pre-position emergency shelter kits—such as plastic sheeting, poles, and repair materials. Pre-positioning shelter materials ensures temporary housing will be available immediately following flood events, reducing the vulnerability of affected populations and ensuring that displaced individuals have access to safe, dignified living conditions. Additionally, informed by the fact that Mustahil has an IDP situated in an area that has historically experienced floods, the RRF's Camp Coordination and Camp Management (CCCM) team could explore coordination with local government to assess potential flood defense measures or consider safer relocation options, if necessary. The RRF could also support towns like Mustahil by training local partners on flood preparedness and shelter setup, and advocating for improved disaster preparedness, infrastructure upgrades, and

**Figure 4: Cropland in Areas Historically Susceptible to Floods in Ethiopia**



**Figure 5: Cropland in Areas Historically Susceptible to Floods in the southern Somali Region**



early-warning systems for the community. The maps produced in this collaboration may benefit such advocacy.<sup>4</sup>

The mapping can also enable IOM's Peace and Development Coordination Unit (PDCU) and Migration, Environment, and Climate Change (MECC) programs to design targeted and context-specific resilience interventions. These interventions aim to address the unique challenges faced by communities and relevant authorities in a sustainable manner. Additionally, the mapping will serve as a critical tool for advocating for the needs and challenges posed by climate-induced mobility. It will help raise awareness among stakeholders and policymakers, highlighting the urgency of these issues, and will also play a key role in mobilizing resources to support communities that are recurrently impacted by climate-related challenges, including flooding. More information on the IOM units mentioned in this section can be found online at IOM webpages linked in the footnotes.<sup>5</sup>

## CONCLUSION

In this collaboration, teams from the International Organization for Migration (IOM) and the Microsoft AI For Good Lab combined first party and open source datasets to map vulnerable population at risk of flooding in Ethiopia.

Focus was given here to the Shabelle river, where recurrent flooding regularly displaces large populations. Local experts know this to be a high-risk area, and the region is currently receiving attention from the government and from aid organizations. By highlighting this area, this report shows how these maps can not only corroborate the knowledge of experts on the ground but also support the prepositioning and prioritization of locations at higher risk. Through flexible indirect implementation such as services offered by the RRF, IOM has an opportunity to provide targeted support along the Shabelle river.

While southern Shabelle zone certainly merits attention, this report was not exhaustive in its discussion of vulnerable communities. The South Omo Zone, for example, in the far southwest of the country, exhibits similar vulnerabilities. Areas along the Omo River and on the north side of Lake Turkana show historical susceptibility to flooding.

<sup>4</sup> The activities outlined in this document are potential actions based on the report's analysis. While they offer strategic ideas for planning and response, they do not represent an intervention plan. These recommendations are intended to guide future actions, contingent on available resources and further assessments, and to support advocacy for better preparedness.

<sup>5</sup> <https://dtm.iom.int/about-dtm>; <https://www.iom.int/preparedness>; <https://emergencymanual.iom.int/rapid-response-fund-rrf>; <https://www.iom.int/camp-coordination-and-camp-management>; <https://www.iom.int/peacebuilding-and-peace-preservation>; <https://environmentalmigration.iom.int/iom-and-migration-environment-and-climate-change-mecc>.

Analysts can leverage the analysis conducted here to identify regions of the country that would benefit from additional support and to pinpoint local communities with unique risk profiles. Finding vulnerable communities, through maps like these, can be a crucial first step towards providing aid.

## DATA SPECIFICATIONS

The map of flood-affected areas is based on an AI model applied to satellite imagery collected from Sentinel-1 Synthetic Aperture Radar (SAR) during the time period from October 2014 to June 2024. The model detects historical flooding by analyzing changes in the SAR images over time and removes false positives using additional data such as soil moisture and elevation. While not a direct prediction of future behavior, this model provides insight into areas that historically have been susceptible to floods.

The population map used in this report is the 100m resolution population grid made publicly available by Global Human Settlement (GHS).<sup>6</sup> This population grid relies on residential population estimates derived from the Center of International Earth Science Information Network's "Gridded Population of the World" product.<sup>7</sup> These estimates are then disaggregated from administrative regions to grid cells using GHS' own map of built-up structures.

Data on the locations of IOM operations were provided by the IOM Ethiopia's Data and Research Unit (DRU). The map with IDP sites was compiled by aggregating Round 32 and Round 33 of data collection by IOM Displacement Tracking Matrix (DTM) Site Assessment (SA). This data is publicly available on the website of the IOM DTM.<sup>8</sup> Rounds 32 and 33 were conducted in Q1 and Q2 of 2023.

Cropland masks for 2023 were obtained from the 10m Annual Land Use Land Cover (9-class) V2 dataset produced by Impact Observatory, Microsoft, and Esri. The dataset was accessed through Microsoft Planetary Computer.<sup>9</sup>

<sup>6</sup> Schiavina M., Freire S., Carioli A., MacManus K. (2023): GHS-POP R2023A - GHS population grid multitemporal (1975-2030). European Commission, Joint Research Centre (JRC) PID: <http://data.europa.eu/89h/2ff68a52-5b5b-4a22-8f40-c41da8332cfe>, doi:10.2905/2FF68A52-5B5B-4A22-8F40-C41DA8332CFE

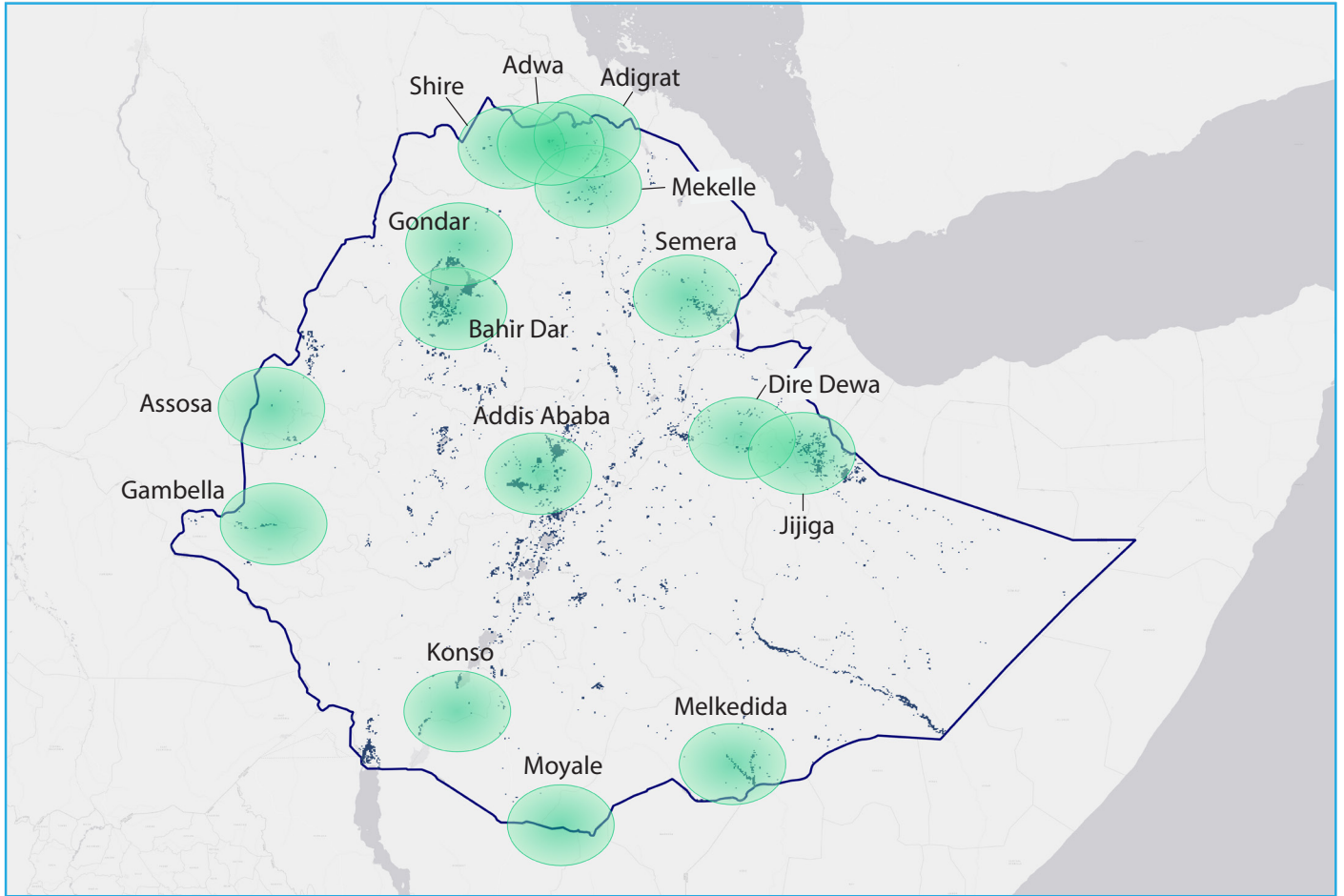
<sup>7</sup> Center for International Earth Science Information Network - CIESIN - Columbia University. 2018. Gridded Population of the World, Version 4.11 (GPWv4): Population Count, Revision 11. Palisades, NY: NASA Socioeconomic Data and Applications Center (SEDAC). <https://doi.org/10.7927/H4JW8BX5>

<sup>8</sup> <https://dtm.iom.int/datasets/ethiopia-site-assessment-round-32>; <https://dtm.iom.int/datasets/ethiopia-site-assessment-round-33>

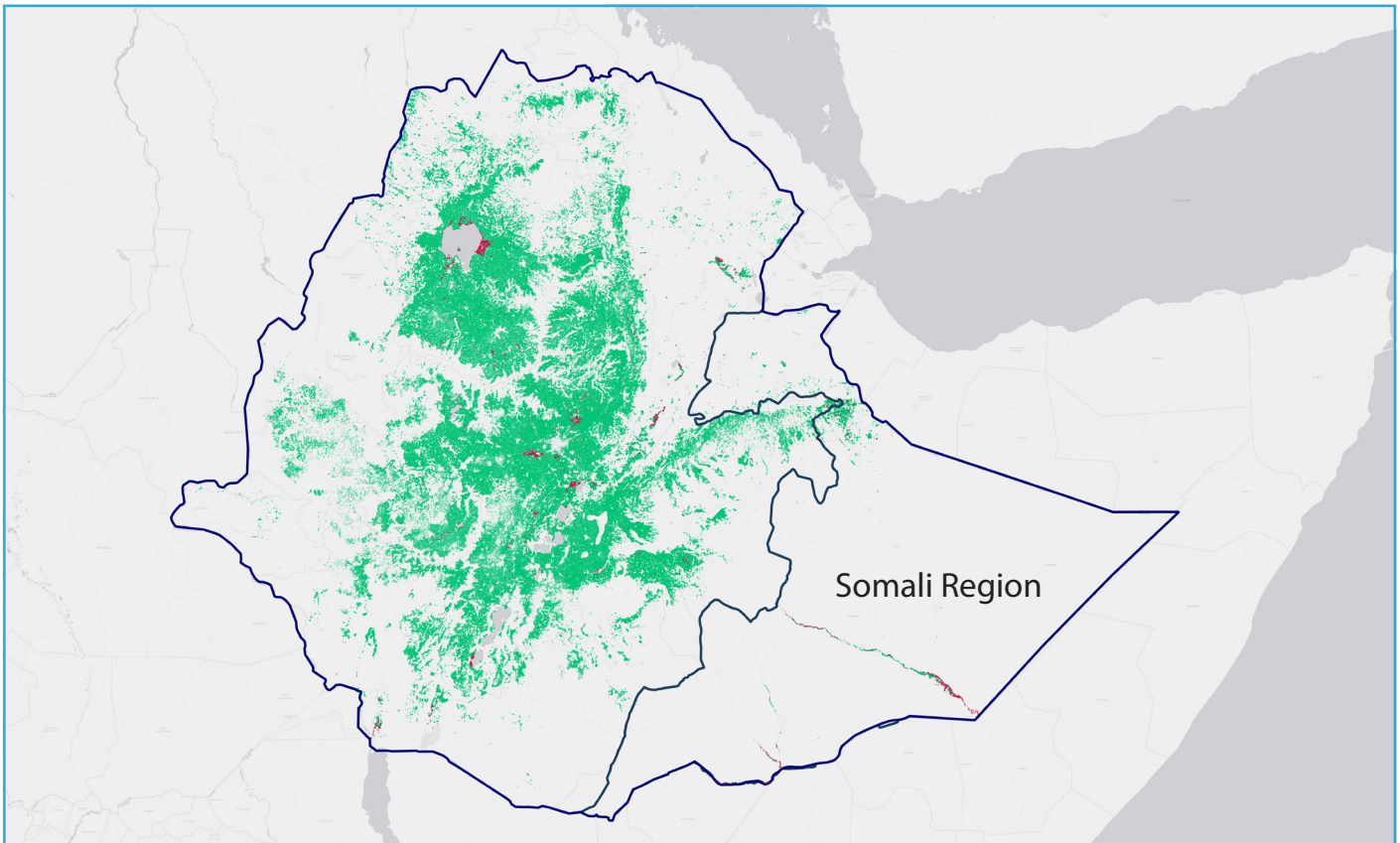
<sup>9</sup> <https://planetarycomputer.microsoft.com/dataset/io-lulc-annual-v02>



# APPENDIX



● Areas within 80km of the nearest IOM office    ■ Population centers situated in historically flood-affected areas



■ Cropland    ■ Cropland in areas historically susceptible to flooding

