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TECHNICAL BRIEF

Co-Creation of a Flood Risk Management Dashboard for Addis Ababa, Ethiopia

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Front cover photo: Participants of the co-design workshop – identifying dashboard content. (*photo*: IWMI)
Back cover photo: Participants of the co-design workshop. (*photo*: IWMI)

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Summary

This report assesses how the Addis Ababa Flood Risk Management Dashboard for the Akaki catchment, in which the city of Addis Ababa is situated, was collaboratively developed and utilized, emphasizing the contributions of multiple stakeholders throughout the co-creation process. Recognizing the complexity and data-intensive nature of flood risk management, the dashboard was developed through a participatory approach involving the Addis Ababa Fire and Disaster Risk Management Commission (AAFDRMC), Addis Ababa Water Governance Network and IWMI. The co-creation process involved four stages: co-identification, co-design, co-development, and co-delivery, ensuring that the dashboard aligns with institutional workflows, operational needs, and user priorities while addressing data gaps and coordination challenges.

The dashboard is structured across seven thematic sections: Home, Catchment Overview, Hydrometeorology, Flood Risk, Stakeholder Institutions, Flood Risk Responses, and Risk Reduction Measures, consolidating heterogeneous flood-related data into interactive maps, charts, and analytical tools. It provides spatially comprehensive insights into hydrometeorological patterns, flood frequencies, hotspot distributions, exposure, and institutional roles, serving as a stakeholder convening tool supporting evidence-based planning and multi-agency coordination.

The dashboard functionality can be enhanced through regular data updates, expanded technical capacity in GIS, remote sensing and programming, integration with flood forecasting and early warning systems, and broader institutional adoption. By progressively incorporating improved data collection – including citizen science contributions – and fostering city-wide digital engagement, the dashboard has the potential to evolve into a core tool for evidence-based flood risk management in Addis Ababa and its hinterland.

Introduction

Co-creation has become increasingly recognized as an essential approach in Disaster Risk Reduction (DRR), offering an alternative to traditional top-down methods. Rather than relying solely on expert-driven processes, co-creation actively engages diverse stakeholders from both the demand side (institutions, communities, decision-makers) and the supply side (technical experts, researchers, data providers). This collaborative model strengthens ownership, improves context-specific solutions, and enhances overall effectiveness (Suhari et al., 2022). The Sendai Framework for Disaster Risk Reduction[1] similarly emphasizes the need for enhanced cooperation among governments, civil society, academia, and businesses, and encourages the integration of risk information into all levels of planning and management.

Within this collaborative context, flood risk management is widely recognized as a highly data-intensive (Cea and Costabile, 2022) and complex (Awah et al., 2024) domain of DRR. Flood hazards evolve rapidly across space and time, and their effective management requires integrating diverse datasets such as hydrometeorological observations, exposure information, vulnerability indicators, and historical impacts. In most cases, much of this data has been scattered across institutions, stored in incompatible formats, or is accessible only to technical experts, creating barriers to coordinated action.

Digital platforms that bring multiple datasets together in an accessible format can significantly enhance flood risk management by supporting evidence-based planning and improving communication among stakeholders. Among these digital tools, interactive dashboards are powerful tools for strengthening decision-making across all phases of flood risk management. Dashboards provide a structured environment where heterogeneous data,

[1] Sendai framework for disaster risk reduction 2015- 2030 (2015) https://www.undrr.org/publication/sendai-framework-disaster-risk-reduction-2015-2030

such as flood extent maps, hydrometeorological observations, risk indicators, can be brought together, visualized, extracted and explored. They allow complex scientific information to be translated into more intuitive forms, enabling both technical and non-technical users to make informed decisions. Fundamentally, they are an asset in achieving greater policy and practice coherence in responding to flood risk in rapidly-growing urban areas. This aligns with the main aim of the Area of Work 3 of the CGIAR Science Program on Policy Innovations which is stated as "to apply transdisciplinary science and foster partnerships to generate and deliver evidence to inform policies and institutions related to food, land, and water systems."

Globally, dashboards are increasingly used in flood risk management, providing real-time access to hazard and exposure data to support decision-making. Examples include FloodMapp[2] for operational flood forecasting and FEMA's Risk Rating 2.0 dashboards[3] for community risk awareness, and ArcGIS-based Flood Risk Dashboards for local planning[4]. This report focuses on the co-creation process of the Addis Ababa Flood Risk Management Dashboard, developed for the Akaki catchment in which Addis Ababa is hosted.

Addis Ababa, home to some 4 million people (https://ess.gov.et), faces significant flood risks driven by rapid urbanization and encroachment into floodplains, inadequate drainage infrastructure, and climate change. Asfaw et al. (2025) reported that Flood susceptibility in Addis Ababa is primarily affected by a combination of rainfall, geomorphological, hydro-morphological, physiographical, and anthropogenic factors. Between 1993 and 2023, urban expansion has transformed large areas of agricultural land and green spaces into built-up areas, reducing natural water absorption and increasing surface runoff (Hailu et al., 2024). Studies using global datasets have shown that a substantial number of buildings, particularly in high-density and poorly serviced areas, are exposed to flooding (Carr et al., 2024; Asfaw et al., 2025). These risks are further amplified by drainage systems that are often overwhelmed by runoff from impervious paved surfaces. Downscaled climate projections for Addis Ababa (Feyissa et al., 2018) show that maximum temperatures could rise by around 1 °C by 2050 under high-emission scenarios, and annual precipitation could increase by about 8.7 %, with further increases toward the end of the century, which may exacerbate future flood risk (Jacobsen et al., 2024). The challenge is compounded by fragmented institutional responses and limited data sharing, which hinder coordinated flood management efforts.

The main objective of this study is to co-create the contents and functionalities of an interactive flood risk management dashboard that serves as a convening tool for stakeholders in Addis Ababa, supporting coordination before and after flood events. The report aims to:

- Document the participatory design process used to develop the dashboard
- Describe the structure and features of the dashboard
- Examine how the dashboard supports and strengthens operational flood risk management
- Outline next steps and wider implications for practice and policy

Description of the Study Area

The Akaki catchment, which includes Addis Ababa, spans about 1,500 km² and exhibits strong contrasts between its upstream and downstream areas (Figure 1). The upper catchment consists of steep, forested mountain slopes that generate rapid runoff, while the middle and lower sections are heavily urbanized, with dense settlements on flat terrain and floodplains. Over the past three decades, urbanization has expanded significantly, increasing

[2] https://www.floodmapp.com
[3] https://floodsciencecenter.org/projects/data-visualization-dashboards-for-fema-risk-rating-2-0-projected-premium-change-analysis/
[4] https://www.arcgis.com/apps/dashboards/058e984cde0b40369edb0387aec19777

impervious surfaces and accelerating the conversion of rainfall to runoff. As a result, exposure of buildings and people to flooding has intensified.

Rainfall in the catchment follows a bimodal pattern, with the main wet season (Kiremt) occurring from June to September and the shorter Belg rains from mid

February to April. Annual rainfall ranges from 900 to 1,470 mm, with peaks of about 300 mm in July and August. More frequent heavy rainfall events, combined with expanding urban development, continue to heighten flood hazards. Overflow from upstream reservoirs — Legedadi, Dire, and Gefersa-—and backwater from the Aba Samuel Reservoir have contributed to past flood events.

Addis Ababa faces increasing flood risks due to unplanned expansion into floodplains, inadequate drainage, and climate change. Projections of higher rainfall and rising temperatures underscore the need for coordinated, data-driven flood management.

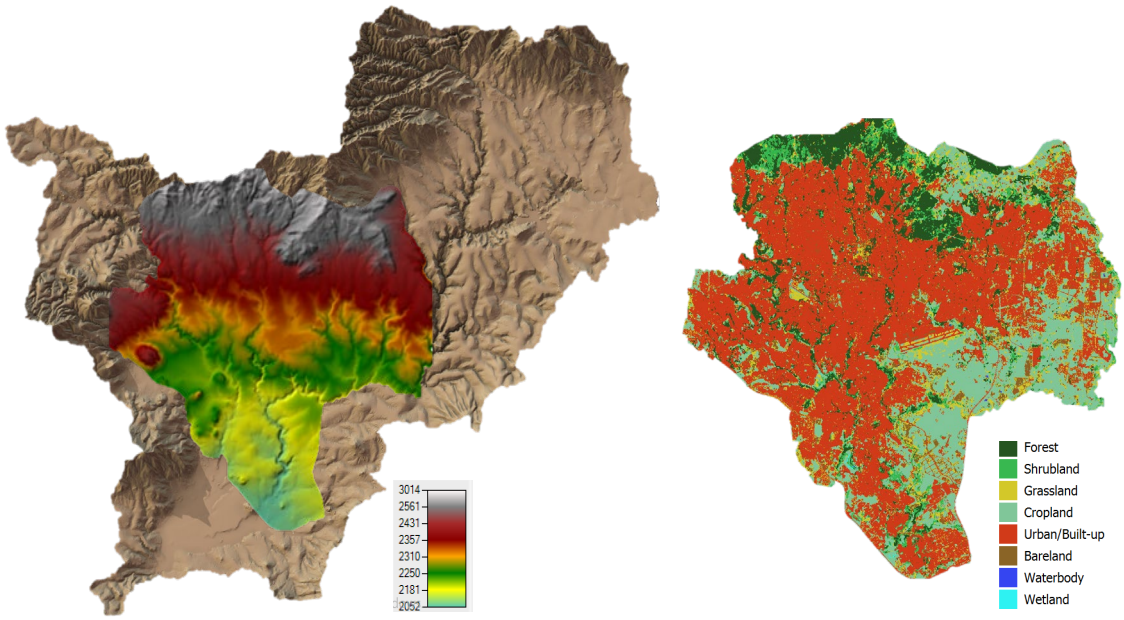

Figure 1. Variation of terrain elevation in Akaki catchment (Left) and land use land cover (2025) variation in Addis Ababa (right) (*Source*: Authors' creation)

Flood Risk Management Dashboard Co-Creation Process

The development of the Flood Risk Management Dashboard followed a multi-stage co-creation approach designed to ensure that the final dashboard was technically fit, user-centered, and aligned with the operational needs of the hosting institution. The process emphasized participatory engagement, iterative refinement, and continuous validation.

Co-Identify: In-Person Consultations and Problem Identification

The Addis Ababa City Administration consists of multiple sector offices, each managing different aspects of urban governance. Among them, the Addis Ababa Fire and Disaster Risk Management Commission (AAFDRMC) is mandated to strengthen the city's overall disaster risk management capacity. Therefore, the co-creation process began with a series of in-person consultations held with the AAFDRMC. These consultations involved four key units (risk reduction, disaster response, poster disaster response, disaster information technology),

within the commission, each responsible for different aspects of flood preparedness, response, and risk management.

The purpose of this stage was to:

- Understand existing workflows, data gaps, operational bottlenecks, and decision-making needs.
- Identify existing institutional challenges to support effective risk management and policy coherence.
- Assess the level of technical capacity and system integration requirements.

Based on feedback gathered during the consultation phase, an initial wireframe and layout for the dashboard was created. This stage focused on translating user needs into a preliminary system structure by outlining dashboard main tabs and specifying key data inputs and visualization requirements. The wireframe served as a conceptual blueprint, enabling stakeholders to visualize the structure of the dashboard before technical development began.

Co-Design: Workshop

A co-design workshop was held in Addis Ababa on May 20, 2025 (Figure 2). The workshop brought together a diverse group of stakeholders, including technical experts, and community representatives to collaboratively shape the contents, functionality, and priorities of the flood risk management dashboard. During the workshop, participants collaboratively refined the dashboard by:

- Reviewing and validating the initial layout of the dashboard.
- Prioritizing core functionalities and data layers.
- Discussing design principles such as usability, accessibility, and institutional relevance.
- Recommending additional features to enhance decision-support value.

This workshop ensured that the dashboard captured the perspectives of both technical experts and end users.

Figure 2. The workshop participants contributing to the design of the dashboard: Deputy Commissioner Tilahun Tola of AAFDRMC (left), and (ii) Estifanos Taye, Rainfall Forecaster at Ethiopian Meteorological Institute (right). (*photo*: Alemseged Tamiru Haile/IWMI)

Co-Development: Iterative Continuous Engagement

Following the workshop, the dashboard underwent iterative development through consecutive virtual meetings with AAFDRMC representatives. This phase included:

- Incorporating user feedback into the evolving dashboard.

- Refining user interface elements, overlays, and analytical tools.
- Ensuring compatibility with the commission's data systems and protocols.
- Aligning dashboard outputs with operational and emergency response procedures.

This iterative cycle allowed continuous adjustments to the dashboard based on real-time feedback.

Co-Deliver: Validation and Delivery

The final validation session was conducted on September 2, 2025, with participation from key units of AAFDRMC. During this session:

- The near-final dashboard was demonstrated and tested by end users.
- Data accuracy, system performance, and visualization outputs were verified.
- Final recommendations were incorporated into the system.

After successful validation, the dashboard was formally co-delivered to the hosting institution, marking the completion of the co-creation process and ensuring the tool was fully aligned with AAFDRMC's operational and technical requirements.

Dashboard Structure and Functional Overview

The Addis Ababa Flood Risk Management Dashboard is structured into seven main sections (Home, Catchment Overview, Hydrometeorology, Flood Risk, Stakeholder Institutions, Flood Risk Responses, Risk Reduction Measures) and a Resources tab (Figure 3). Each tab is designed to present specific thematic information, support interactive exploration of data, and provide actionable insights for diverse stakeholders including disaster managers, urban planners, researchers, and community representatives.

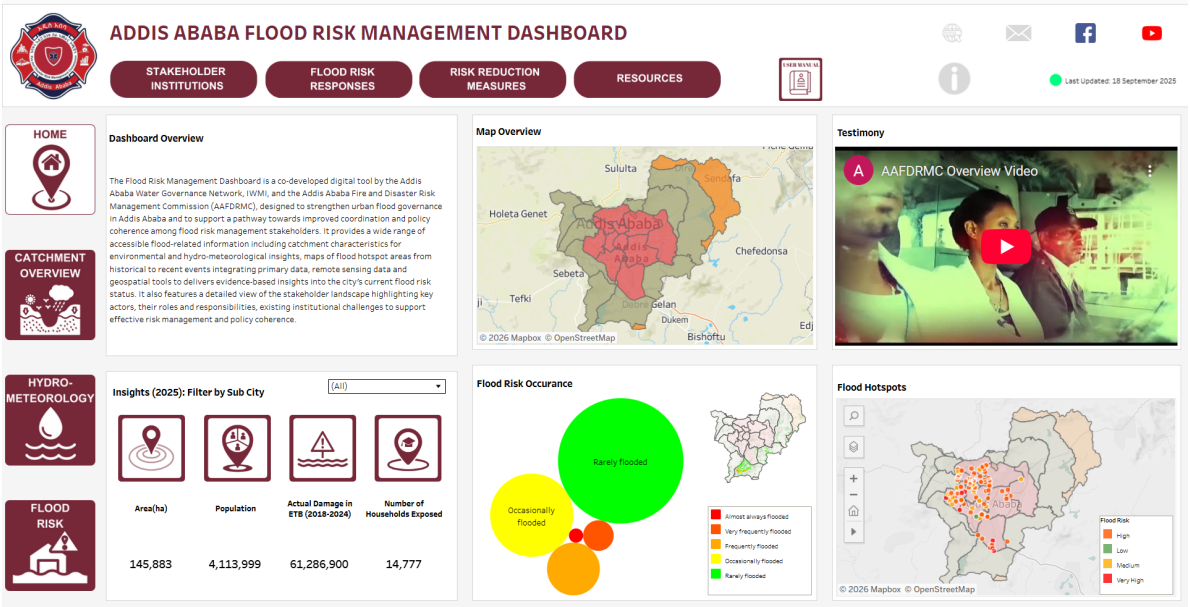

Figure 3. The main page of the Addis Ababa Flood Risk Management Dashboard.

Overview of Dashboard Tabs

i. Home / Introduction

The **Home** tab serves as the main entry point to the flood risk management dashboard, providing a high-level introduction to its purpose, functionality, and overall structure. Key features of this tab include:

- Summary Indicators: Quick statistics and key performance indicators that provide an at-a-glance understanding of flood risk across the study area.
- Catchment-Wide Map: A broad overview map showing the entire catchment, enabling users to contextualize flood risk geographically.
- Flood Frequency Inundation Map: A simplified spatial representation of flood-prone areas, highlighting regions susceptible to inundation based on historical and modeled data.
- Message from the Hosting Commission: A brief introduction video about the host institution – the AAFDRMC.

This tab is particularly useful for stakeholders who are new to flood risk data, offering a concise overview of the dashboard's purpose and functionality, and facilitating quick orientation before exploring more detailed analytical tabs.

ii. Catchment Overview

The Catchment Overview section provides a spatial and physical context for the Akaki catchment, visualizing boundaries, topography, water bodies, and land-use dynamics over time. It highlights how urban expansion and land cover changes influence flood risk.

iii. Hydrometeorology

The Hydrometeorology tab provides a comprehensive view of rainfall, streamflow, and seasonal forecasts, including both official and citizen-collected monitoring data. The Seasonal Forecast sub-tab links to the Ethiopian Meteorological Institute's official forecasts, allowing planners to anticipate potential flood events. It allows users to understand temporal and spatial patterns of rainfall and river flow, supporting flood prediction, early warning, and preparedness planning.

iv. Flood Risk

The Flood Risk section provides detailed insights into both observed (historical) and remotely-sensed flood risk. The Characterization sub-tab summarizes flood frequency from 2017 to 2023 obtained and processed from Sentinel 1 observation, allowing users to filter by administrative units and visualize frequency of occurrence across the catchment. The Flood Hotspot sub-tab identifies the spatial distribution and primary causes of flood-prone areas for different years. The Actual Impact Summary presents verified flood impacts from 2018 to 2024 and the Estimated Impact Summary sub-tab presents the exposure estimates of the flood hotspot areas, highlighting areas likely to be affected. Interactive maps, charts, and filtering tools enable users to quickly identify areas most affected by flooding and evaluate potential impacts, supporting evidence-based emergency response and long-term urban planning.

v. Stakeholder Institutions

This section highlights the roles, relationships, and challenges of institutions involved in flood management. It provides a concise picture of coordination structures and institutional capacities, helping decision-makers understand governance arrangements and policy coherence challenges, and to identify areas for improved collaboration and coherence building.

vi. Flood Risk Responses

The Flood Risk Responses section focuses on operational tools for flood preparedness. The Response Thresholds sub-tab presents rainfall thresholds linked to flood risk levels, allowing disaster risk managers to filter by station and assess areas of potential alert. The Emergency Routes sub-tab maps shortest evacuation paths and branch locations, aiding planners in route optimization during flood events. Although the Evacuation Centers sub-tab is currently a placeholder, it will eventually provide critical information for relocation and sheltering when the data is available. This tab can be expanded into a standalone dashboard if the Commission is ready to host fully operational tools for flood early warning.

vii. Risk Reduction Measures

This section presents ongoing mitigation efforts and community resilience, including structural interventions, coping capacity, and implementation challenges. It allows stakeholders to assess the effectiveness of measures, identify gaps, and plan future investments to reduce flood vulnerability.

Finally, the Resources tab consolidates external documentation and datasets, providing stakeholders with centralized access to supporting materials. Interactive features such as filtering, map navigation, and on-hover tooltips are consistent across all tabs, enhancing usability and ensuring that both technical and non-technical stakeholders can extract actionable insights from the dashboard. Export options and quick-access help icons further support transparency, reporting, and data sharing.

Implementation

The current implementation of the Addis Ababa Flood Risk Management Dashboard provides AAFDRMC with a foundational digital tool for organizing, visualizing, and understanding flood-related information across the Akaki catchment. Although the dashboard is not yet a fully real-time system, its development marks an important step toward building a culture and appetite for digital tools within the Commission and other offices under the Addis Ababa City Administration. Information technology experts from the Commission and the Addis Ababa City Administration Innovation and Technology Development Bureau will be responsible for updating the dashboard, having gained the necessary skills through in-person training organized by IWMI.

At this stage, the core strength of the dashboard is its ability to present a spatially comprehensive overview of flood risk across the entire catchment. Instead of relying on fragmented reports or disconnected datasets, the dashboard brings together rainfall patterns, flood frequencies, hotspot distributions, and impact summaries into a single set of dynamic, interactive maps. This spatial clarity helps AAFDRMC quickly identify areas of recurring vulnerability, emerging risks, and clusters of flood-prone locations. Such insights strengthen preparedness by guiding pre-event inspections and planning targeted mitigation works. As a result, the dashboard enhances situational awareness even without real-time data feeds.

Beyond internal use, the dashboard also serves as a convening and coordination platform for stakeholders engaged in flood risk management. By integrating updated flood risk information, exposure maps, institutional responsibilities and gaps in collaboration, the dashboard provides a transparent and evidence-based foundation for multi-agency discussions. During multi-agency planning meetings, the dashboard helps stakeholders collectively examine risks, verify information, and identify gaps in monitoring, infrastructure, and institutional collaboration. By making these gaps visible, the dashboard supports discussions on how to strengthen coordination mechanisms, clarify roles, and improve information-sharing practices across agencies. It also provides a practical basis for identifying where policy misalignments and incoherence exist and how policy coherence can be strengthened to ensure that flood risk management actions are harmonized rather than

fragmented. This shared visual foundation reduces misunderstandings, improves communication between technical and administrative teams, and supports joint prioritization of interventions. It is also a public-facing resource, which helps in supporting a more accountable governance environment in Addis Ababa. The current plan is to ensure an Amharic language version of the site can be shared as soon as possible.

Way Forward

To move towards a nearer real-time flood risk management tool, regular updating of the dashboard is essential. Timely integration of new hydrometeorological data and flood observations, coupled with proactive sharing of information with affected communities and stakeholders, will enhance its operational value.

Capacity development is another critical priority. Strengthening the technical skills of the existing AAFDRMC team in GIS, remote sensing, and programming, alongside recruiting additional technical personnel, will enable the Commission to maintain, update, and further develop the platform on its own. Building internal expertise ensures sustainability and reduces reliance on external support as the system evolves.

Improving the quantity and quality of data feeding into the dashboard is equally important. Expanding ground-based monitoring networks, strengthening the integration of citizen science observations, and ensuring standardized and high-quality datasets will increase the reliability of analyses and support more accurate assessments of flood risk and exposure. IWMI's citizen science program in Addis Ababa and the upstream Akaki catchment engages community volunteers in collecting rainfall and river water-level data. Through the interactive dashboard, these citizen scientists can also play a vital role in two-way early-warning communication—providing real-time local observations to the Commission while receiving timely flood alerts and sharing feedback that strengthens community preparedness and response.

Adding new functionality to the dashboard may slow down its performance. Therefore, a major future opportunity lies in developing a standalone dashboard for flood forecasting and an early warning component. Incorporating outputs from hydrodynamic flood models would allow the platform to display predictive scenarios and near-real-time alerts. Achieving this will require the successful implementation of the first two steps, as well as establishing strong operational linkages with the Ethiopian Meteorological Institute (EMI). Access to official rainfall forecasts will enable the dashboard to integrate seasonal and short-term flood predictions, supporting proactive risk mitigation and rapid response efforts.

Finally, fostering a city-wide appetite for digital technologies is essential for long-term impact. Institutional commitment from the Addis Ababa City Administration such as exploring the development of a city-scale Digital Twin, would create a supportive environment for innovative tools within a smart city concept. Continued collaboration with partners like IWMI can further promote advocacy, capacity building, and investment in digital solutions, ensuring that the dashboard becomes a central pillar within a modern, data-driven flood risk management system. The dashboard enables the commission and its stakeholders to track progress in addressing key institutional challenges by visually presenting how each issue is being managed over time. By updating the diagram that maps the commission's relationship with its stakeholders, the dashboard highlights improvements, remaining gaps, and areas requiring further coordination. This allows stakeholders to regularly assess institutional performance and strengthen risk management and policy coherence.

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