Report:
King-size Testbed
June 2025

WISER
Weather and Climate Information Services

Supported by:
UK International Development
Partnership | Progress | Prosperity

REPORT

King-size Testbed

June 2025

Author(s)/ delivery person (lead first) and their institute(s)

Itzel San Roman Pineda (UoL), Katharine Vincent (Kulima), Willem Colenbrander (Kulima), Gilda Monjane (Kulima), Marita Monjane Saraiva (Kulima), Miriam Murambadoro (SAWS), Cynthia Nemutudi (SAWS), Alex Roberts (UoL), Jannie Stander (SAWS), Simon Ageet (KIT), Estelle de Conning (WMO), Denise Groves (UoL), John Marsham (UoL), Hellen Msemo (WMO), Douglas Parker (UoL), Gregory Dritschel (UoL), Júnior Gonçalves (INAM), Nico Kroese (SAWS), Micah Namukoko (ZMD), Kasia Nowakowska (UoL), Joseph Smith (UoL).

How to cite this report:

Itzel San Roman Pineda, Katharine Vincent, Willem Colenbrander, Gilda Monjane, Marita Monjane Saraiva, Miriam Murambadoro, Cynthia Nemutudi, Alex Roberts, Jannie Stander, Simon Ageet, Estelle de Conning, Denise Groves, John Marsham, Hellen Msemo, Douglas Parker, Gregory Dritschel, Júnior Gonçalves, Nico Kroese, Micah Namukoko, Kasia Nowakowska, Joseph Smith (2025): WISER EWSA King-Size Testbed Report. White Rose Libraries. https://doi.org/10.48785/100/394

WISER Weather and Climate Information Services

Supported by: UK International Development Partnership | Progress | Prosperity

Executive Summary

This report outlines the activities and outcomes of the **Weather and Climate Information Services Early Warning for Southern Africa (WISER-EWSA)** King-Size testbed. This second WISER EWSA testbed ran from October 1st, 2024 to April 30th, 2025, covering the Southern Africa rainy season in its entirety. It was the world's first extended forecasting and nowcasting testbed, integrating daily operational activities with deep, sustained community engagement. The King-Size testbed enabled the project team and partner national meteorological and hydrological services (NMHS) -INAM, SAWS and ZMD- to better understand the operational capacity required to sustain long-term nowcasting, generating lessons that will influence future operationalisation. This initiative was also a major undertaking that involved 42 forecasters, 122 community observers and directly benefitted 795 people (381 women and 414 men), across Mozambique, Zambia and South Africa.

The King-Size testbed included two in-person periods, referred to as intensive phases; T2-Z (Zambia and Zuid Afrika) held in Lusaka from January 30 to February 7, 2025, and T2-M (Mozambique), held in Maputo from March 22 to 27, 2025. The periods before and after these intensive testbeds, are referred to as the extended phases. During the extended period, the testbed operations centre (TOC) operated online, with a team meeting daily to assess the weather conditions and activate the nowcasting process when necessary.

For the sustainability of a prolonged testbed format, during the extended phases, 44 members of the WISER EWSA team (from SAWS, INAM, ZMD, University of Leeds, and WMO) participated in a rotating roster. The active team held daily briefing meetings to analyse the outlook forecast, declare intensive nowcasting events (INEs), and evaluate nowcasts. During the extended phase, nowcasts were issued only when necessary, specifically when weather events were expected to surpass the following thresholds: 20 mm/3hr during October-November, 10 mm/3hr during January-April, and 30 mm/6hr for night or weekend shifts. In such cases, the lead forecasters declared INEs, activating the nowcasting process. A total of 74 INEs were covered among the three National Meteorological and Hydrological Services (NMHS).

Throughout the King-Size testbed, approximately 120 community observers from vulnerable urban communities susceptible to flooding (Boane, Matutuine and Namaacha [Mozambique], Katlehong [South Africa], and Kanyama [Zambia]), along with WP1 community engagement leads, actively provided feedback on nowcasts and led activities to raise awareness on weather information within their communities. Feedback on nowcasts and verification of weather impacts were shared through Google forms, and WhatsApp groups, via text, photos and videos. During this period, community observers participated in diverse activities with community engagement leads and forecasters, which increased their confidence and understanding of weather information. This empowered them to lead weather-awareness activities, disseminate information in high-traffic community hubs and add new contacts to the WhatsApp groups. Observers also identified households with members with disabilities to ensure they received timely weather information and support when necessary. Through these activities, community observers became "weather influencers" within their communities. Community observer feedback significantly informed the daily briefings and testbed operations. The close link established between community members and forecasters fostered mutual trust, and deepened forecasters' motivation and commitment to providing inclusive and actionable weather information.

The first intensive phase, T2-Z, brought together 73 participants from 9 countries—Zambia, South Africa, Mozambique, Zimbabwe, Malawi, Germany, the UK, Switzerland and Finland—including forecasters, researchers, community engagement specialists, and representatives from regional and international organisations. Activities were hosted at the Zambia Air Force (ZAF) facilities, with ZMD and INAM forecasters leading operations on-site. Although SAWS forecasters were unable to join in person due to the impact of a cyberattack, they engaged

remotely when possible. Community observers from Zambia, South Africa, and Mozambique actively participated, providing structured feedback using a Google form.

Daily Operations ran continuously over a nine-day period, with 24-hour nowcasting conducted for Kanyama, Zambia. Nowcasts were issued every two hours, resulting in approximately 150 nowcasts and synoptic forecasts. These were disseminated to community observers through WhatsApp, with structured feedback collected via Google Forms and chat messages three times a day. When needed, unscheduled updates were also issued in response to evolving weather conditions. Nowcasts for Boane (Mozambique) and Katlehong (South Africa) were only issued when necessary.

Evaluation of nowcasts was conducted during the 9-day testbed using a case study methodology co-led by forecasters and researchers. Daily review meetings supported reflection on nowcast accuracy, communication methods, and the practical utility of alerts. Feedback from observers and user engagement teams confirmed improved community understanding of forecasts and increased capacity to respond to warnings.

A number of special events were held during the testbed:

- **Open Day (February 5, 2025):** Over 60 visitors from different Zambian government offices, disaster management agencies, NGOs, and media visited TOC in Lusaka. Attendees learned about the testbed, observed live nowcasting operations, and interacted with forecasters, community observers and technical leads.
- **Cross-Project Reflection Day (February 7, 2025)**: Teams from across WISER-EWSA work packages to share learnings, challenges, and recommendations to refine future testbed operations.

T2-M was a smaller intensive effort due to budgetary constraints but it was paramount in consolidating the learnings from T2-Z and the broader King-Size testbed. A total of 25 people, predominantly from Mozambique, and international team members from South Africa, Zambia, the UK, and Finland, met in the Maputo TOC. Over six days, INAM issued nowcasts every 2 hours between 08:00 and 17:00, and on one occasion extended the nowcasting schedule from 16 to 00 hours, to cover an INE and issue timely alerts. During this intensive phase, forecasters from SAWS and ZMD participated online, presenting their outlook forecasts, nowcasts and verification efforts. Nowcasts were disseminated via the Community Observers WhatsApp group, and community observers provided feedback daily. T2-M also encompassed special events, such as:

- **World Meteorological Day Celebration (March 24):** WISER-EWSA leadership in Maputo presented the project to the media, highlighting its role in the Early Warnings 4 All initiative.

- **Community Engagement Day (March 25):** Part of the team in Maputo met 69 community mobilisers and media in Boane, to gather feedback on nowcast formats. The team also visited the Pequenos Libombos Dam, and discussed the potential to use the community observers network to disseminate dam-discharge warnings. The day ended with a lunch with 110 residents of Umpala, including leaders and people with disabilities, who emphasised the value of weather information.

Overall, the King-Size testbed was a success, as INAM, SAWS and ZMD were able to operationalise nowcasting throughout the rainy season. Their forecasters not only developed and strengthened their nowcasting capabilities but also learned to critically assess the different nowcasting products through the verification processes introduced. It brought together forecasters with researchers developing new machine-learning nowcasts, allowing real-world evaluation of these new ML tools, and demonstration of how these could benefit warnings, allowing user feedback to inform research. The King-Size testbed created a space for substantial progress in international collaboration, user engagement, and co-production of early warnings. The intensive phases (T2-Z and T2-M) also provided a platform for the entire WISER EWSA team to consolidate knowledge and significantly enhance nowcasting skills of forecasters.

Deep community engagement shaped the King-Size Testbed operations and drove innovation in how nowcasts were communicated to make them more inclusive, accessible and usable. Feedback from community observers prompted improvements to the nowcasting template and communication formats, including: an SMS-style nowcast for dissemination to contacts without smartphones; voice notes in English/Portuguese and local languages to reach people with low literacy or vision disabilities; and adding pictorial icons with advisories to broaden accessibility.

Through the WISER EWSA testbeds, INAM, SAWS and ZMD gained valuable experience in testbed design and implementation. The King-Size consolidated these learnings and provided a foundation for future nowcasting initiatives in Southern Africa that include testbeds, to be led by our African partners.

Table of Content

Table of Figures:

Table of tables:

1. Introduction

King-Size Testbed

Dates: October 1st, 2024 - April 30th, 2025
Venues:
Testbed Operational Centre (TOC): Online
Mozambique Testbed Office: Instituto Nacional de Meteorologia (INAM), Maputo.
South Africa Testbed Office: South African Weather Service (SAWS), Pretoria.
Zambia Testbed Office: Zambia Meteorological Department (ZMD), Lusaka

In-person testbeds:
Testbed Zambia and Zuid Afrika (T2-Z)
Dates: January 30th - February 7th, 2025
Venues:
TOC: Zambia Air Force (ZAF), Lusaka.
South Africa Testbed Office: SAWS, Pretoria.
Testbed Mozambique (T2-M)
Dates: March 22nd - 27th, 2025
Venues: TOC: Residencial Kaya Kwanga, Maputo.
South Africa Testbed Office: SAWS, Pretoria.
Zambia Testbed Office: ZMD, Lusaka

Contact:
WISER-EWSA Project Office (wiser-ewsa@ncas.ac.uk)

The WISER-EWSA Testbed 2 (T-2), also known as the "King-size Testbed," represents a significant step forward in the development and implementation of early warning systems (EWS) for severe weather in Southern Africa. The King-size testbed was designed to cover the entire Southern African rainy season, from 1st October 2024 to 30th April 2025. This innovation was based on feedback given by community observers and forecasters during the first WISER-EWSA testbed, who collectively remarked that a two-week nowcasting testbed will not achieve its full potential if the testbed coincides with a dry spell (Ageet, et al., 2024). Therefore, the objective of this extended period was to ensure that testbed operations capture a wide range of weather conditions, understand how operational nowcasting could be “responsive” to weather to reduce costs, provide valuable insights into the effectiveness of early warning systems, and the sustainability of nowcasting processes within National Meteorological and Hydrological Services (NMHS).

1.1 Outputs and outcomes

The testbed contributed to delivering the outcomes initially set for testbed 1 (Ageet, et al., 2024):

a. Early Warning Systems (EWS) which have been co-produced between forecast providers (in a network of agencies and countries) and users and tested and evaluated in the testbed.
b. Standard Operating Procedures (SOPs) of the EWS, which have been tested and evaluated.

c. Documentation of other good practice as part of Knowledge Management and Applied Learning.
d. Training and practical experience of forecasters and users in use of nowcasting as a part of EWS.
e. End-to-end evaluation of the value-chain associated with urban EWS.

Additionally, the King-Size testbed due to its extended mode allowed covering additional outputs:

f. Increase the reach of nowcasts by building on what was achieved in testbed 1. This involved understanding how to upscale and make use of our existing contacts in the expansion, for example, in Zambia; differentiate between feedback and upscaling; and possibly add more communities.
g. Bridging the gap between testbed activities and operations at the NMHSs. This fostered learning between the two groups and assessing if it is possible to transmit nowcasts publicly using the existing NMHS communication channels.
h. Increase engagement with intermediary organisations and end-user organisations by strengthening existing and creating new contacts.
i. Utilise other communication platforms besides WhatsApp, for example, community radio, direct communication between the NMHSs and disaster agencies, explore webpages for communication (the starting point is establishing what the NMHSs are doing).

The King-Size testbed directly contributed to **WISER-EWSA Outputs**:

- Urban populations who know how to access, understand and use EWSs.
- Improved capacity to generate EWSs and co-produce alerts in 3 countries.

The King-Size testbed was used to provide evidence to support the other WISER-EWSA outputs:

- Business models for co-produced EWS sustainability.
- Regional awareness of nowcast potential for Disaster Risk Reduction (DRR).

In turn this contributed to four **WISER-Africa Outputs:**

Output 1: Strengthened co-production between producers, intermediaries and users to improve the uptake and use of weather and climate information services across weather to climate timescales.

Output 2: Strengthened networks, partnerships and regional and national coordination mechanisms that support the generation, uptake and use of enhanced weather and climate information services.

Output 3: Strengthened designated producers' capacity to deliver enhanced user-led weather and climate information services.

Output 5: Better evidence and learning, continually strengthening co-produced weather and climate information services and programme decision-making.

1.2 Phases Overview

The King-size testbed was divided into two main phases: the extended (or king-size mode) and intensive phases.

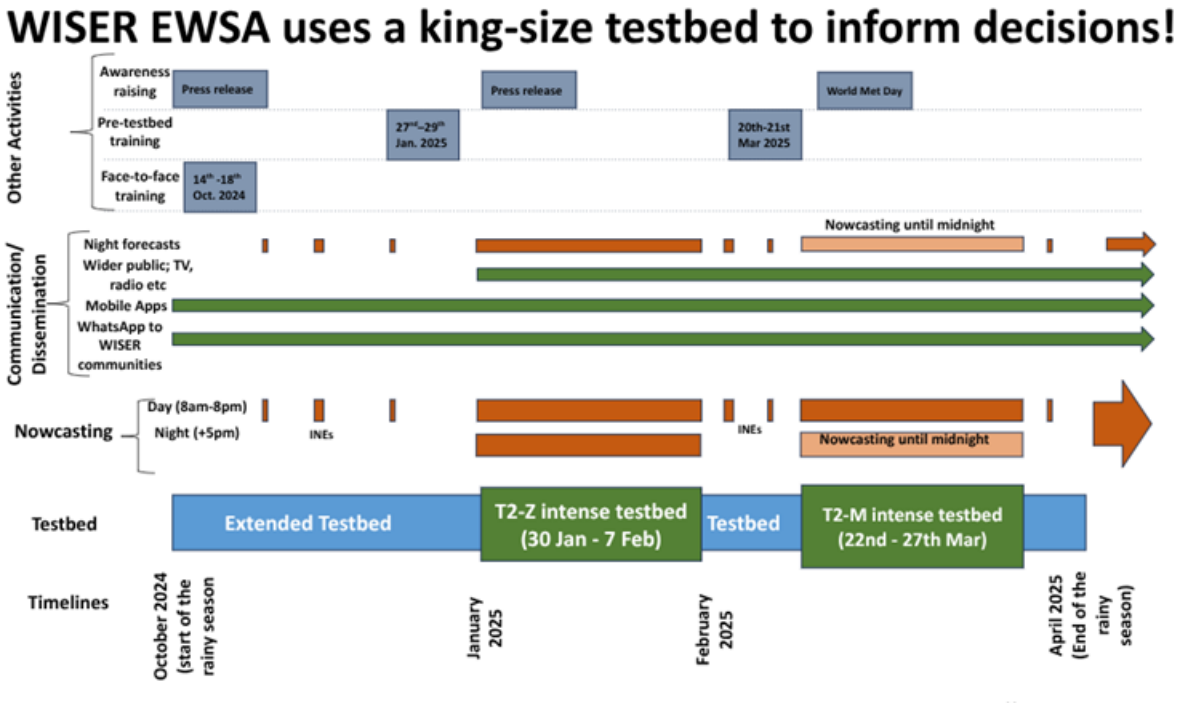


Figure 1: Timeline of the WISER EWSA King-Size Testbed

During the extended phase, nowcasting activities were conducted on an as-needed basis, triggered by the anticipation of severe weather events. If severe weather was expected to impact these partner communities, it would be classified as an Intensive Nowcasting Event (INE). The lead forecaster from the NMHS with an INE issued nowcast messages using the WISER EWSA Community Observers WhatsApp group of the corresponding community, and the NMHS institutional channels if deemed necessary.

In the intensive phases, the WISER EWSA team met in person to issue nowcasts intensively, and evaluate the nowcasting processes using a case study methodologies, which was informed with feedback from community observers in each community. Initially, the plan was to have a single intensive phase where the WISER EWSA team would gather in Maputo, Mozambique, to conduct an in-person two-week intensive period of nowcasting and user engagement in the peak of the rainy season in 2025. However, due to political instability that followed the presidential elections in October, 2024, this plan was restructured into two separate intensive phases:

1. **T2-Z (Zambia and Zuid Afrika):** Held in Lusaka, Zambia from 30th January to 7th February 2025, with a pre-testbed training from 27th-29th January. This intensive testbed included full-scale 24-hour nowcasting operations.
2. **T2-M (Mozambique)**: Conducted in Maputo, Mozambique on a reduced scale from 22nd to 27th March 2025, with 2-day pre-testbed training on 20th-21st March, 2025, in Maputo. Operational activities were limited to standard working hours, with evening nowcasting (up to midnight) activated only when required.

This adjustment allowed the project to continue in Zambia and South Africa while providing time to prepare for a safe and effective testbed in Mozambique once conditions had stabilised.

The extended period of operations, combined with the two intensive phases, provided a comprehensive framework for testing and refining short-range early warning systems across Southern Africa, while maintaining flexibility to adapt to unforeseen challenges. The involvement of a wide range of participants, including community observers from our partner communities, highlights WISER EWSA's commitment to co-production and inclusivity in reducing disaster risks rendered from high-impact weather events.

1.2.1 Extended Phase

The extended phase (the King-Size testbed) entailed an unprecedented seven months of daily activities that involved close collaboration between WISER EWSA team members and community observers (residents of the partner communities in each country). These activities included weekday online meetings (Monday to Friday), daily updates to databases (Outlook forecast and King-Size Evaluation tables), and the issuance of nowcasts to the communities, mainly via community observers WhatsApp groups.

Throughout the seven months, daily activities were spearheaded by a rotating roster that included forecasters and focal points from each NMHS, a daily coordinator (PhD researchers based at the University of Leeds); one WP2 scientist, and WP4 leadership. The online meetings were open to all the WISER EWSA team members and regional partners as participant observers and in advisory capacity. Among the attendees we had researchers from UKCEH, the University of Leeds, SAWS, the UK Met Office, WP1 community engagement leads in each country, and forecasters from Botswana, Malawi and Zimbabwe.

A hallmark of the King-Size testbed was its profound user engagement. Community observers and community mobilisers (known as SDMCs as they integrated into the Satellite Disaster Management Committee in Zambia) not only submitted daily feedback through Google Forms and WhatsApp messages, (validating nowcasts, reporting impacts, asking questions, and sharing videos and photos) but also played an active role in disseminating weather information within their communities. Dissemination efforts extended to large community hubs, such as schools and churches, as well as household visits to support people with disabilities. These visits aimed at understanding persons with disabilities' needs regarding the presentation and usability of weather information, and vulnerabilities in face of impactful weather events. As part of WP1, community observers participated in training and briefing workshops with community engagement leads, and co-led activities to raise awareness of weather forecasting's role in protecting lives, property and livelihoods. These included poster campaigns, information sessions, and even community waste clean-up efforts. Further details are detailed in section 5.

During the extended phase, nowcasting was conducted only when necessary. Although INAM and ZMD initially agreed during the pre-testbed co-production workshop in Lusaka, to nowcast for their entire national territories, implementation was ultimately limited to the project's partner communities: Boane, and from December 2024, Matutuine and Namaacha (Maputo province, Mozambique), Kanyama (Lusaka, Zambia), and Katlehong (Ekurhuleni, South Africa).

Days with severe weather expected to impact these communities were classified as Intensive Nowcasting Events (INEs). To recommend an INE for Maputo, Lusaka, and Pretoria, forecasters should anticipate at least 20 mm/3hr during October-November, 10 mm/3hr during January-April, and 30 mm/6hr for night or weekend shifts. These thresholds were established during the co-production workshop in Lusaka and could be adjusted during the course of T-2

for each location. For example, in Zambia the thresholds were reviewed after floodings in Kanyama that were not nowcasted, however these remained unchanged.

If severe weather was forecasted to affect areas beyond the partner communities, it would be considered a Responsive Nowcasting Event (RNE), with thresholds assessed on a case-by-case basis. However, no RNEs were issued during T-2, and nowcasting remained exclusively focused on the partner communities.

1.2.2 Intensive Testbed Zambia and Zuid-Afrika (T2-Z)

T2-Z brought together the WISER-EWSA team in Zambia at the Zambia Meteorological Department's (ZMD) testbed hub, located at the Zambia Air Force (ZAF) base in Lusaka. The team comprised forecasters, meteorologists, researchers, academics, economists, social scientists, and user-engagement specialists from South Africa, Zambia, Mozambique, Switzerland, Finland and the UK.

Additionally, community observers from Kanyama which are now part of the Satellite Disaster Management Committee (SMDC), played a critical role during T2-Z. In parallel to the operations in the testbed hub, the WP1 team organised community-based activities in Kanyama, which were led by SDMC. The 'technical team' (forecasters, meteorologists, researchers, and academics) joined SDMCs in Kanyama, in activities that include:

- Raising awareness about weather information among community residents
- Developing critical feedback on the nowcasting templates and providing specific recommendations to improve clarity of nowcasts
- Demonstrate how SMDCs disseminate weather information among their neighbours, including households with members with disabilities.

Through these activities, WISER-EWSA technical teams worked alongside Kanyama community members, gaining valuable insights into how weather information is received and used at the local level. This direct engagement helped forecasters and researchers better understand community needs, which led to improvements in early warning communication and accessibility.

1.2.3 Intensive testbed T2-M (Mozambique)

Conducted on a smaller scale than T2-Z, the Mozambique testbed (T2-M), brought together members of the WISER EWSA team in Maputo, hosted in a conference room at the Residencial Kaya Kwanga. The team comprised INAM forecasters, along with meteorologists, researchers, academics, economists, and user-engagement specialists from South Africa, Zambia, Finland and the UK. SAWS and ZMD forecasters joined remotely to the online briefing meetings.

T2-M included active participation from community observers based in Boane, Matutuine and Namaacha. One of the testbed days was dedicated to community engagement in Boane and Umpala communities, where the technical team presented an overview of the project. Community observers described their roles in disseminating the weather information, and community leaders shared how valuable weather information has become for improving resilience and preparedness in their communities.

During T2-M, INAM integrated seven new forecasters to the WISER EWSA project, thereby enhancing Mozambique's nowcasting capabilities. Over the six-day in-person testbed, the technical team deepened their capabilities in nowcasting and the subjective evaluation of nowcasts. Collaboration between the technical team and community observers reinforced understanding of the real-world value and use of weather information, and reaffirmed the knowledge and practices established during T2-Z.

2. Training

2.1 Summary of Pre-testbed Training T2-Z

The training workshop was hosted from the 27th to the 29th of January 2025, at the Zambia Air Force (ZAF). The training was led and delivered by Ms. Cynthia Nemutudi. The official opening of the workshop was done on behalf of the Ministry of Green Economy and the Environment and the Zambian Meteorological Office PR Office, by the Office of the Chief Director. The total number of forecasters targeted for the 3 (three) day training programme was 40 (forty), from the Mozambican and Zambian Met Offices, with the support of the SAWS Regional Training Centre and Research and Development departments, respectively.

The aim was to enhance forecaster nowcasting skills whilst also making sure that the impact-based forecasting and Common Alerting Protocol (CAP), capabilities were adequately imparted to all trainees to issue the necessary nowcast warnings. Existing gaps in nowcasting and Impact based forecasting were addressed.The Nowcasting Standard Operating Procedure (SOP) was reviewed. The focus and emphasis were on the guidelines for issuing 6-hour and 2-hour risk maps, operationally. Participants were also refreshed on CAP knowledge, of which it was noted that the ZMD and INAM were constantly issuing CAP messages as previously trained in October 2024, in Maputo.

They created the impact-based warnings for various regions in the two study countries, which were later subjected to in depth verifications of the reports on observational data and presented imagery work.

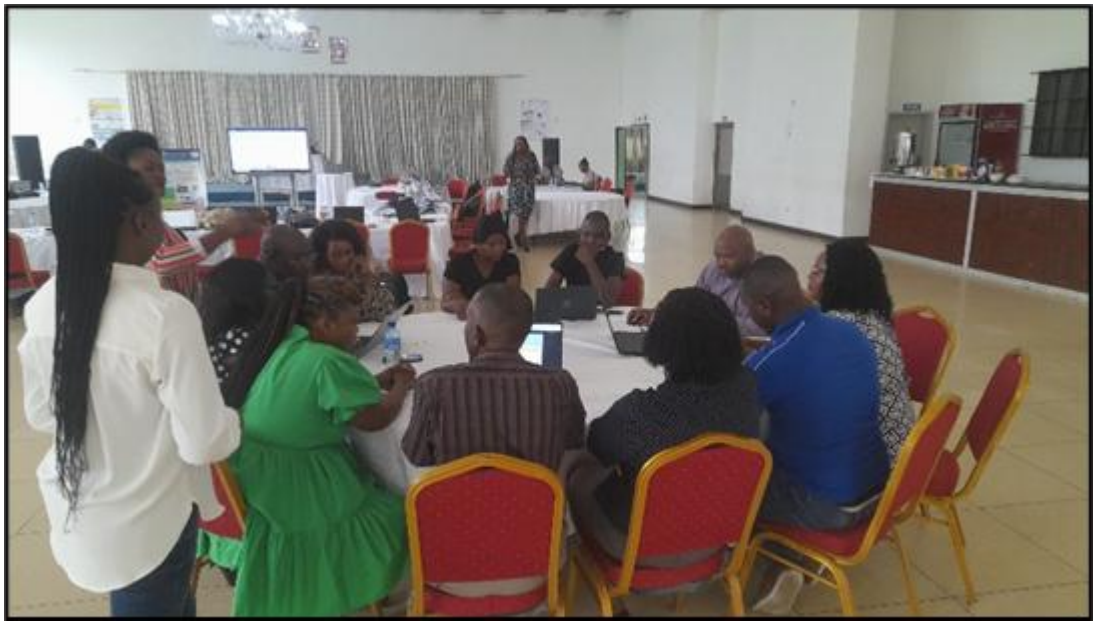


Figure 2: ZMD and INAM Forecasters, Group Work Session

University of Leeds presented new nowcasting products earmarked for the Testbed. The CEH portal was presented. The forecasters reviewed the products and provided positive feedback on the products after being introduced to this portal. The training concluded with a comprehensive case study presentation, outlining the participants' roles, responsibilities, and expected outcomes to get the Certificate of Achievement.The testbed case study preparation was a key task for the 3rd day. The Moodle Exam scheduled for day 3 was cancelled due to the SAWS Cyber-attack. All SAWS servers were encrypted and the backups of these servers at another backup site were damaged. The process is still ongoing to salvage them.

	Trainee Organisations	Number of Officers Trained	Guests
1	Zambian Met Department (ZMD)	34	
2	Mozambique Met Office (INAM)	6	
3	University of Zambia	2	
4	Tomorrow IO (Kenya)		2
5	Leeds University (UK)		7
6	Germany		1
7	WMO (Geneva)		1
	Total attendees:	42	11

Table 1: Training Workshop Trainees and Guests

Summary of Pre-testbed Training T2-M

The training workshop was hosted from the 20th to the 21th of March 2025, at the Residencial Kaya Kwanga, Maputo (Mozambique). The training was led and delivered by Ms. Cynthia Nemutudi from the South African Weather Service and Dr. Alex Roberts from the University of Leeds.

The total number of forecasters targeted for the 2 (two) day training programme was 16 (sixteen), from the Mozambique Met Office, with the support of the SAWS Regional Training Centre and University of Leeds.

The aim was to enhance forecaster nowcasting skills whilst also making sure that the impact-based forecasting and Common Alerting Protocol (CAP), capabilities were adequately imparted to all trainees to issue the necessary nowcast warnings. Existing gaps in nowcasting and Impact based forecasting were addressed. The Nowcasting Standard Operating Procedure (SOP) was reviewed. The focus and emphasis were on the guidelines for issuing 6-hour and 2-hour risk maps, operationally.

The forecasters were tasked to create the nowcasting products for Mozambique which was later verified by the observations.

Figure 3: INAM Forecasters, Group Work Session

University of Leeds presented new nowcasting products and the CEH portal earmarked for the Testbed. Dr Chris Taylor from The UKCEH joined online to demonstrate how the CEH portal drawing tool works. The forecasters were also tasked to review the products and to familiarise themselves with a CEH portal drawing tool.

Figure 4: INAM training, presentation session

	Trainee Organisations	Number of Officers Trained	Guests
1	Mozambique Met Office (INAM)	16	
2	South African Weather Service (SAWS)		1
3	Leeds University (UK)		2
	Total attendees:	16	3

Table 2: Training Workshop Trainees and Guests

2.2 Evaluation of training (case studies, exams)

WISER Test (EXAM):

The program's objective was to enhance the forecasting skills and expertise of participants. The following. The online training 7 sessions, designed to explore the following topics:

(1) Basic satellite imagery and products and introduction to Meteosat Third Generation (MTG)
(2) Satellite application course
(3) Satellite interpretation and Aviation hazards
(4) Common Alerting Protocol
(5) Satellite interpretation and marine hazards
(6) MTG True colour RGB and Weather hazards
(7) Question and answer session

A WISER online test was scheduled to assess the participants on the content covered during the online training session. The Test was conducted on the 21st of March 2025 from 14:00 - 15:00 SAST. Thirty (30) forecasters from Mozambique and Zambia wrote the online test. Twenty four (24) forecasters passed the test and seven(7) did not pass the test.

A Re-exam, or second test, was arranged for participants who had already participated in the case studies. This was done to give people another opportunity to improve their grades, as the ultimate mark was calculated using the test and case study marks. Four(4) forecasters wrote the second test on 6 June 2025, including one(1) forecaster from South Africa who was attempting the test for the first time. They all completed the test successfully.

WISER Case study:

During the testbed participants were expected to create groups of 2 to 3 (no larger than 3). Each group was assigned to a mentor from University of Leeds, South African Weather Service and UKCEH. The participants were instructed to write up a case study of a weather event that occurred during the testbed and how it was handled. The main aim was to showcase EW4all in action from the production to community level.

The Final Case studies were presented on 16 May 2025. Five groups presented their case studies online and feedback was shared with the groups.

Certificates:

The WISER Certificate of attainment was awarded to the forecasters who have successfully completed the test and the case study. The Case study Final mark is an average of the test mark and the Case study mark. Twelve(12) forecasters were awarded the WISER-EWSA

certificate of Attainment signed by Mr. Jannie Stander(Acting Senior Manager: SAWS RTC) and Professor Douglas Parker (Science Coordinator NCAS, University of Leeds)

2.3 Conclusions and Recommendations

Conclusions:

The training was successful, and the forecasters have acquired the following skills:

- Interpret basic satellite imagery for nowcasting applications across aviation, marine, and public weather sectors, with an emphasis on Meteosat Third Generation (MTG) data.
- Apply nowcasting products to support timely and informed decision-making for issuing nowcasting alerts.
- Implement impact-based forecasting techniques to craft effective warning messages and visual products such as maps.
- Utilize the Common Alert Protocol (CAP) to issue structured, timely, and standardized nowcasting alerts.
- Compile and present a comprehensive nowcasting case study, integrating satellite image interpretation, impact-based forecasting, and CAP alerting to demonstrate end-to-end nowcasting capabilities.

Recommendations:

- **Language Accessibility:** Future training programmes should anticipate potential language barriers. For Mozambican forecasters, English as a second language, and in some cases limited proficiency, posed challenges during training and technical discussions. While this was overcome thanks to informal support from bilingual colleagues, it highlighted the need to increase language accessibility. Future testbeds should consider bilingual training resources (e.g. Portuguese/English glossaries of technical terms, dual-language slides) and translators or facilitators with both meteorological knowledge and language proficiency. This would ensure that all forecasters can fully engage with the training content and reduce reliance on informal translation
- **Participation:** Online session attendance was inconsistent, with several forecasters attending occasionally. This was largely due to competing responsibilities and limited time allocated to training. In future programmes, NMHS should be encouraged to provide forecasters with dedicated time to participate in the online sessions and assessments. In-person sessions maybe more effective in ensuring consistent attendance and engagement.

3. Technical Details: Key Personnel, Locations and Infrastructure

This section provides an overview of the roles and responsibilities of the WISER EWSA team members that actively contributed to the King-Size testbed, in both extended and intensive phases. It also outlines the supporting infrastructure that enabled daily operations and collaborations across countries and institutions.

3.1 Key Personnel & Roles: King-Size testbed

The effective operations of T-2, the King-Size testbed, in both extended and intensive modes, relied on the collaboration and coordination of a transdisciplinary and international team. This team included multiple work packages (WP1, WP2, WP3, WP4) and institutions in Africa and Europe. Below is an overview of the core team and their responsibilities:

Leadership & Strategic Oversight

- Doug Parker (NCAS, University of Leeds) – Overall scientific and technical leadership, ensuring alignment with WISER-EWSA objectives.
- Katharine Vincent (Kulima Integrated Development Solutions) – Co-leadership, focusing on stakeholder engagement and impact integration.

Testbed Planning, Coordination and Support

- **Testbed Leadership**: Itzel San Roman Pineda, Hellen Msemo, Simon Ageet. Their roles include day-to-day planning, agenda design, and facilitation of testbed activities.
- **Testbed Coordinator**: Denise Groves, Jabulani Khumalo, Thato Masithela, Nomie Mbuli. Logistical coordination, scheduling, and liaison between teams.
- **Regional NMHS Leads**: Nico Kroese (SAWS, South Africa); Micah Namukoko (ZMD, Zambia); Goncalves Junior (INAM, Mozambique).
- **User engagement leads:** Willem Colenbrander (Zambia), Gilda Monjane (Mozambique), Marita Monjane Saraiva (Mozambique), Miriam Murambadoro (South Africa)
- **Technical & IT Support**: Alex Roberts, SAWS, ZMD and INAM's IT teams. Managing IT infrastructure, data platforms, and troubleshooting.

3.1.1. Extended mode

During the extended phase, activities were led by a rotating roster to ensure the sustainability of testbed operations over the seven-month rainy season. Approximately forty-four WISER-EWSA team members were active in the roster, based in Mozambique, South Africa, Zambia, Switzerland and the United Kingdom. The roster included NMHS forecasters, regional NMHS leads, PhD researchers based at the University of Leeds and WP2 scientists. Their roles are described in more detail in section 4.1.1.

Roster King-Size / Extended mode		
Institution/Organization	**Participants**	**Key Roles**
ZMD	8	Forecasters, focal point
SAWS	15	Forecasters, research, leadership, focal point
INAM	9	Forecasters, focal point
University of Leeds	10	Coordinators, leadership, researchers, support
WMO	2	Leadership, research
Total	**44**	

Table 3: Total participants during the extended phases of the King-Size testbed

Although WP1 community engagement leaders were not part of the roster, WP1 leads consistently participated in briefing meetings to provide critical feedback and ask questions on behalf of community observers regarding nowcasting. WP1 leads also gave additional insights on the reception of nowcasts updated on the activities carried out by the community observer. WP1 leads were key in maintaining community engagement and ensuring consistent provision of feedback from community observers. Throughout the King-Size testbed, WP1 leads engaged 4 number of community mobilisers (who were observers during testbed 1), and new community observers recruited during T-2. It is worth noting that community observers in Kanyama, were later integrated into the Disaster Management and Mitigation Unit (DMMU) and formed part of the Satellite Disaster Management Committee in Kanyama.

WP1 King-Size Testbed		
Community engagement	**Participants**	**Key Roles**
WP1 team	4	WP1 community engagement leadership in the 3 countries
Mozambique	76	Community mobilisers and community observers in Boane, Matutuine and Namaacha
South Africa	32	Community mobilisers and community observers in Katlehong
Zambia	22	Community observers later integrated into the Satellite Disaster Management Committee (SMDC), Kanyama
Total	134	

Table 4: Total WP1 participants during the extended phases of the King-Size testbed

3.1.2 Intensive testbeds: T2-Z & T2-M

T2-Z brought together 73 in-person participants from 10 countries, with a strong international presence (47 attendees, 64%) complementing Zambia's core team (26 participants, 36%). In addition to those attending T2-Z in-person, several partners, including forecasters and researchers from INAM, SAWS, and international institutions like WMO and UK Met Office, joined the daily meetings remotely, contributing to evaluation, and learning processes throughout the testbed.

T2-Z in-person participants		
Institution/Organization	**Participants**	**Key Roles**
ZMD	23	Forecasters, IT team, focal point
SAWS	9	Forecasters, researchers, coordination
INAM	6	Forecasters, focal point
University of Leeds	14	Leadership, researchers, technical support
Kulima	6	WP1 engagement, communications
Karlsruhe Institute of Technology (KIT)	1	Testbed leadership
UKCEH	2	Nowcasting research
TomorrowNow	2	Visitors
WMO	1	Testbed oversight
University of Birmingham	1	Visiting researcher
University of Zambia (UNZA)	2	Postgraduate researchers
Malawi Dept of Climate & Met.	2	Forecasters
Zimbabwe Met Dept	2	Forecasters
Finnish Meteorological Institute	1	Economic analysis, WP1
Tyrsky Consulting	1	Economic analysis, WP1
Total	**73**	

Table 5: Total participants during T2-Z

The Mozambique testbed was conducted on a reduced scale, involving 25 participants, with strong leadership from the Mozambique team. International support comprised 32% of participants, with representatives from South Africa, Zambia, Finland, and the United Kingdom. Similar to T2-Z, members of the WISER EWSA team who were unable to attend in-person, joined the daily meetings remotely, making valuable contributions, including forecasters from SAWS and ZMD who presented their outlook forecasts and evaluation of nowcasts.

T2-M in-person participants		
Institution/Organization	**Participants**	**Key Roles**
INAM	15	Forecasters, IT team, focal point
Kulima	2	WP1 community engagement
SAWS	3	Training, forecaster, WP2 leadership
Tyrsky Consulting	1	Economic analysis, WP1

University of Leeds	3	Leadership, research, technical support
ZMD	1	Focal Point
Total	**25**	

Table 6: Total participants during T2-M

3.2 Locations, Infrastructure and Technical Considerations

To facilitate access to data and tools, a central online platform was created: WISER EWSA Testbed Portal, which provided easy access to forecast products and operational documentation. In addition, a shared Google Drive folder hosted all reports, alerts, and operational files. Access was managed by the WP4 coordination team, and participants could request access with the logistics coordinator.

3.2.1. Extended mode

During the extended phase of the testbed, a Zoom meeting link was created for daily online meetings, which were also recorded. A Google group was set with WISER EWS team members that chose to receive the daily reports sent by the coordinators. It was expected that forecasters on duty in the roster would join from their respective NMHS offices to ensure access to essential infrastructure, including laptops, internet connectivity and stable power. To support this, the project procured 10 laptops (5 per country) for INAM and ZMD, ensuring that participating forecasters had the necessary equipment to nowcast throughout T-2. However, these devices were delivered until January 2025, prior to T2-Z.

It was agreed at the co-production workshop in Lusaka that when INEs occurred outside of regular office hours (nights or weekends), forecasters, particularly those from INAM and ZMD (which do not operate 24-hours), would work from home. SAWS, by contrast, was able to cover such shifts through its existing operations. While no major expenses were expected, there may be need for transportation, especially during the night and weekend shifts. NMHS could request support from the project to ensure that forecasters working remotely had access to equipment and internet. However, no formal requests were made, and there were instances where forecasters either used personal resources or were unable to nowcast or join the daily testbed activities due to lack of access.

Additional infrastructural challenges included internet disruptions and safety concerns in Mozambique during a period of political instability (October 2024 to January 2025). During this time, INAM forecasters often worked from home, where limited internet access (partly due to restrictions and service interruptions) limited their full engagement in some testbed activities. In Zambia, frequent power cuts related to droughts-related impacts on hydropower generations affected ZMD forecasters, particularly during night and weekend shifts when they worked from home. Lastly, SAWS experienced a cyberattack on January 26th, 2025, which caused a widespread disruption to computational and communications infrastructure. This affected access to NWP modelling outputs, the RSMC website, observation and data collection, internet connectivity and operational systems. SAWS gradually recovered access to many of the affected systems in the following months. Despite disruption to the RSMC website, forecasters were able to use alternative tools, including new nowcasting products available through the testbed portal.

3.2.2 Intensive mode

For the intensive testbed periods, the technical setup was carefully planned based on previous experience by staff at the University of Leeds, ZMD, INAM and SAWS. T2-Z required reliable backup systems given Zambia's ongoing power instability—exacerbated by drought-related challenges affecting hydroelectric generation. The relocation of operations to the Zambia Air Force (ZAF) facilities provided a more spacious and better-equipped environment. The project procured a backup power system with solar panels to reduce the risk of outages. Most participants worked from battery-powered laptops, minimising the impact of any short-term power drops.

The initial plan to procure a Starlink system for ZMD was reconsidered and ultimately not pursued. Instead, the University of Leeds loaned a Starlink system to ensure consistent internet connectivity. Additionally, the project procured an internet router with local SIM cards for ZMD as a backup, to maintain stable internet access throughout the testbed.

The technical setup for T2-M was similar to Zambia's testbed. The testbed hub was located at Residencial Kaya Kwanga, instead of INAM's offices to ensure a similar layout to T2-Z. The University of Leeds also loaned the Starlink system to secure a reliable internet source. Although Starlink was initially considered for INAM, the focal point decided not to pursue it because it was not financially feasible long-term for the institute. Instead, 4G routers with local sim cards were purchased as a back-up internet system.

This proactive approach to logistics, which covered the internet, power, and facilities, ensured uninterrupted forecasting and nowcasting operations during the two intensive testbed periods.

4. King-Size testbed: Forecasting and Operational Activities

The WISER EWSA team developed two operational procedures for each phase of the King-Size testbed, the extended and intensive modes. The plan for the extended mode was developed in the co-production workshops in Mozambique (20-24 May 2024), Zambia (6-9 August 2024) and South Africa (13-16 August 2024), and refined during an online planning meetings ahead to T-2's launch, as well as prior the intensive testbeds T2-Z and T2-M.

In this report, the description of operational activities is separated into two sections: section 4, focused on the technical processes led by researchers and forecasters, and section 5 dedicated to the community engagement work led by WP1 and the community observers in our partner communities. This structure aims to reflect the distinct but interrelated components of the testbed.

This section outlines the operational activities carried out by the WISER EWSA team, including researchers and forecasters from INAM, SAWS and ZMD. While these activities form the core nowcasting and evaluation processes, these were co-designed with WP1 and community observers.The success of these processes relied not only on meteorological expertise but also on the active participation of community observers, as their feedback shaped real-time decision-making and post-event analysis throughout the testbed.

4.1 King-Size Testbed Extended mode

During the extended mode, nowcasting activities were only done when necessary, if a weather event surpassed the established thresholds. To decide when an INE would be activated, a decision tree protocol was followed, based on daily outlook forecasts produced by lead forecasters from Instituto Nacional de Meteorologia of Mozambique (INAM), South African Weather Service (SAWS) and Zambia Meteorological Department (ZMD). These forecasts were reviewed during online daily briefing meetings with forecasters, meteorologists, academics and user engagement specialists from Mozambique, South Africa, Zambia, the UK and Switzerland. In these meetings, the lead forecasters of each NMHS called in INEs when severe weather was expected to impact the partner communities in Mozambique (Boane, Matutuine and Namaacha), Zambia (Kanyama), or South Africa (Katlehong). If the INEs occur before 16:00 CAT, the INEs were analysed in an online review meeting. The extended period also included weekly handover meetings each Monday to ensure smooth transitions between forecasting teams and to review weather conditions from the previous week.

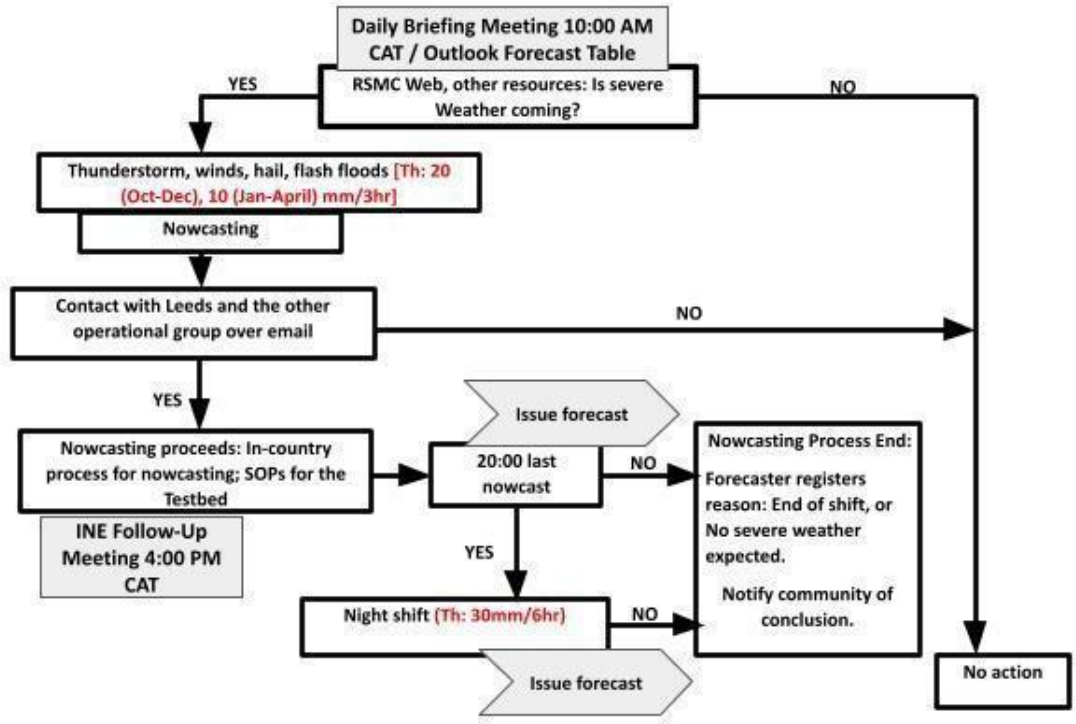


Figure 5: Nowcasting decision tree

Over seven months of operations, the King-Size testbed encompassed approximately one hundred briefing meetings, where forecasters from INAM, SAWS and ZMD presented their three-day outlook forecasts. During this period (excluding the intensive testbeds), the three NMHS called 74 INEs and issued 92 nowcasts using the WISER EWSA nowcasting template. During T2-Z, forecasters from INAM and ZMD started issuing nowcasts in SMS-style text and voice note formats to the community observers WhatsApp groups.

Country	INEs	Nowcasts
Zambia	31	33
Mozambique	20	26
South Africa	23	33

Table 7: Total Intensive Nowcasting Events (INEs) called during the King-Size Testbed

4.1.1 Team Structure

A rotating roster allowed sustaining testbed operations to cover the entirety of the rainy season, from October 1st, 2024 to April 30th, 2025. This roster involved 44 WISER-EWSA team members from Mozambique, South Africa, Zambia, Switzerland and the United Kingdom. The roster included the following roles:

- **Lead forecasters**: Each NMHS (INAM, SAWS and ZMD) designated a lead forecaster responsible for producing a daily the three-day synoptic outlook forecast, presenting it

during the online briefing meetings, and calling INEs when necessary (or monitoring evolving weather conditions).

- **Regional NMHS Leads:** Focal points at each NMHS who ensured that lead forecasters had the necessary resources to carry out testbed activities and initiate INEs.
- **Coordinator**: A PhD researcher from the University of Leeds who oversaw daily operations, chaired meetings, documented activities, disseminated daily reports, and archived nowcasts and community feedback.
- **WP2 Scientist**: Researchers based at the University of Leeds, UKCEH, UK Met Office and SAWS among others, took part as observers and advisers in the briefing meetings and may use the occurrence of the INE to trigger other activities, such as an intercomparison of nowcasting methods. The WP2 scientists are expected to play a significant role in post-INE analysis and evaluation.

These roles comprised the outlook and nowcasting teams:

- **Outlook team:** Encompassed the lead forecasters, the coordinator, and one WP2 scientist.
- **Nowcast team**: In the case of an active INE, this team included the forecaster from the NMHS with the active INE, the coordinator, WP4 leadership, a WP2 scientist, and other WISER EWSA members interested in following up the nowcasting process.

In the co-production workshops, it was determined that community observers would engage in the testbed activities when nowcasting occured. In such cases, community observers provided feedback via Google forms to validate the nowcast and report structured feedback. Community observers were encouraged to submit photographs and videos through the established WhatsApp groups. The testbed coordinators archived this feedback, which was subsequently analysed by forecasters during the daily meetings.

4.1.2 Extended Testbed Activities

The king-size testbed mode operations included online activities encompassing from archiving information in data-bases and meetings.

Archiving activities:

- **Daily Outlook Forecast Updates:** Each lead forecaster updated the **Outlook Forecast Table**, providing forecasts for **Day+0, Day+1, Day+2, and Day+3**. The forecast stated the recommendation for calling an INE (e.g. No (widely suppressed weather), Maybe (uncertain or lower probability of significant weather activity); Yes (high probability of significant weather expected) along with a brief description of why it was issued, (i.e., weather systems dominating at the time).

	Country A			
	Day+0	Day+1	Day+2	Day+3
1st Oct. 2024	No – *Widely suppressed; …..*	No – *Widely suppressed; ….*	Maybe – *Possible; ECMWF forecast shows ….*	M – *Possible; ECMWF forecast shows ….*
2nd Oct. 2024	No – *Widely suppressed; …..*	Y - *Upgraded to Y as storm forecast affecting Lusaka*	Maybe	Maybe
3rd Oct. 2024	Yes - *Forecast*	No - *Downgraded*	Maybe	Maybe

	unchanged; ……	*to N as ….*		
4th Oct. 2024	Yes - *Upgraded to Y es from maybe*	Maybe	Maybe	Maybe - *Though high uncertainty*

Colour code:
N: No significant weather activity expected (widely suppressed).
M: Maybe or possible weather activity (uncertain or low probability).
Y: Yes, significant weather activity expected (likely or confirmed severe weather).

Table 8: Format of the outlook forecasts table and colour code key, to be issued for each country daily during the entirety of the King-Size testbed

- **Weather Event Database:** The on-duty coordinator documented the INEs called and missed. This included comparing nowcasting products (propagation and observations) for each event and including feedback from community observers collected via dedicated Google forms and WhatsApp groups. The coordinator also archived the nowcasting messages issued, along with photos, videos and messages shared by community observers to verify nowcasts and report impacts.

- **King-Size evaluation table**: This table was developed and updated by the team of coordinators. This database combines information from different sources that makes it unique and innovative in the field

Meetings:

- **Daily Briefing Meeting**: Held at 10 AM CAT/SAST during periods of severe weather or when forecast conditions require closer monitoring. These meetings were suspended during dry spell periods impacting the three countries. During these meetings, the outlook team discussed weather outlooks and assessed if conditions met the threshold for declaring an INE. The lead forecasters from each NMHS presented the synoptic forecast for the upcoming 3 days, focusing on areas of concern. Although the weather events were discussed by all meeting attendees, the lead forecaster was the decision-maker to call an INE. The forecaster with a potential or active INE would indicate an approximate time for updating the team or issuing nowcasts to the respective community Whatsapp Groups. The coordinator issued a daily report summarising the meeting discussions. These reports were sent to all WISER-EWSA members subscribed to daily updates via the Google Group.

- **INE Review Meeting**: Conducted at 4 PM CAT/SAST if nowcasting activity had taken place. INEs occurring after 4 PM were reviewed during the following briefing meeting. In these meetings, lead forecasters and the nowcasting team reviewed the nowcasting process, including the evolution of the forecasts, nowcasting outputs, dissemination channels, and community feedback. Led by the WP2 scientist, coordinators and forecasters conducted intercomparison of nowcasting products and post-INE analysis and evaluation. The coordinator documented each INE in the Weather Event Database.

- **Weekly Handover/Briefing Meeting:** Every Monday, the team held a handover meeting instead of the regular briefing. In this meeting, the coordinator presented the

climatology and anomalies for the starting and following week, along with a summary of previous week's INEs including community feedback. Lead forecasters also provided a summary of any weekend nowcasting activities and shared the weekly outlook and any decisions to call and INE. This meeting served for discussions on improvements or changes to testbed operations.

Special Meetings:

- **Testbed 2 Briefing meeting**: Held on September 10th, 2024, this meeting served to present and refine the operational plans set during the co-production workshops for the king-size testbed. The meeting focused on coordinating the three NMHS on meeting times and thresholds for calling INEs. WP1 re-confirm the activation plans for community observers during INEs.
- **WP4 King-Size Testbed Review Meetings:** To ensure smooth operations and identify areas of improvements, the team held three review meetings throughout the King-Size testbed. In each meeting, focal points from each NMHS, as well as leads from WP1, WP2 and WP4 assessed ongoing activities, sharing lessons learned, strengths, and challenges:
    - November 28th, 2024 - First review (extended mode)
    - March 6th, 2025 - Review of King-Size testbed, including T2-Z
    - May 8th, 2025 - Final review and reflections of King-Size testbed and T2-M.
- **WP4 Intensive Testbed Planning Meetings**: Ahead of each in-person testbed, the team convened to refine logistics and operations, building on experiences from T1:
    - December 12th, 2024 - Initial planning meeting for the first in-person testbed.
    - January 16th, 2025 - Final planning session for T2-Z.
    - March 10, 2025 - Review and adjustments for T2-M.

Coordination activities for the King-Size testbed were temporarily suspended during key holiday periods and around the in-person testbeds to accommodate logistical constraints and team availability. Activities paused over the Christmas and New Year break (December 22, 2024 – January 6, 2025), in the week following T2-Z (February 10–14, 2025), Easter break (April 18-21, 2025) and after T2-M (March 28, 2025). Despite these suspensions, forecasters continued to monitor weather conditions and issue nowcasts if needed during these periods.

4.2 Intensive phase: T2-Z

The testbed operational centre (TOC) for T2-Z, centred its forecasting operations at the Zambia Air Force (ZAF) facilities, and community engagement activities in Kanyama. At T2-Z TOC, forecasters from INAM, ZMD, and SAWS, and researchers and academics from the UK, Switzerland, Zambia and South Africa, collaborated across three core teams—synoptic forecasting, nowcasting, and evaluation—working in rotating shifts to generate synoptic forecasts and nowcasts, and validate outputs. These teams engaged in rigorous discussions to refine the accuracy and clarity of disseminated weather information, using products like CRR, RDT, and AI-driven models being tested.

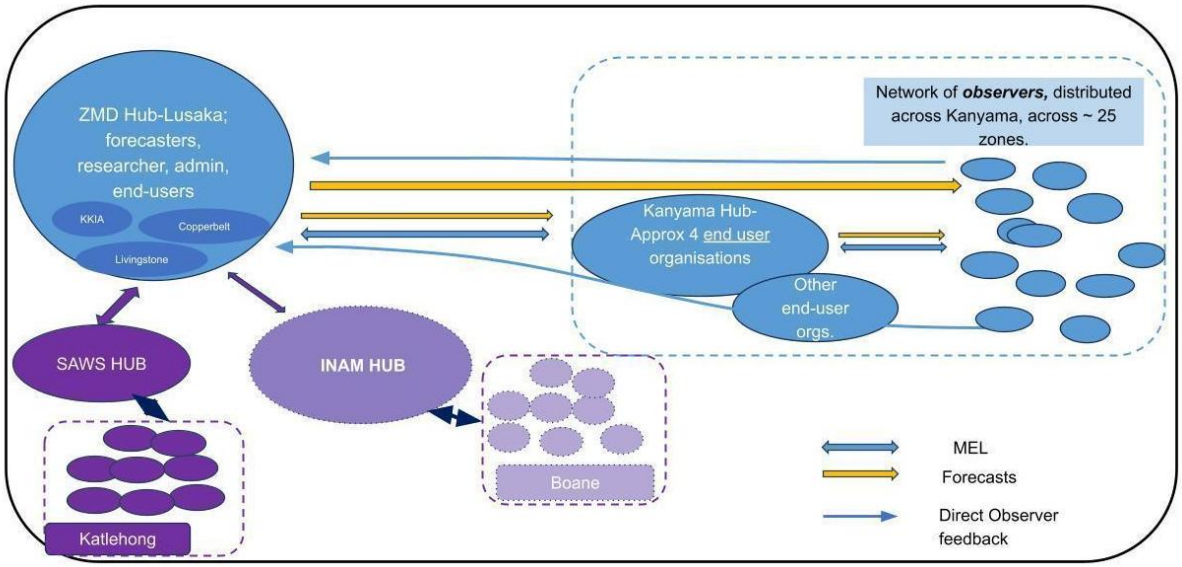


Figure 6: T2-Z simplified multi-sited schematic and information flow

The TOC was located at the ZAF, where most of the testbed activities happened. From the TOC, nowcasts were sent to the community observers in each partner community, ZMD nowcasted intensively, while SAWS and INAM only sent nowcasts if an INE was expected. Community observers in Kanyama sent feedback to the TOC three times a day via the Google Form and the WhatsApp group; observers in Katlehong and Boane only reported feedback when they had rain.

At Kanyama, members of the Satellite Disaster Management Committees (SDMCs) led community engagement activities for residents in Kanyama with the participation of the WISER-EWSA team. T2-Z's final three days were characterised by the integration between the community and technical teams: SDMCs joined the technical hub to observe forecasting processes firsthand, gaining insight into the "behind-closed-doors" work of meteorologists. This interaction allowed forecasters and community observers to jointly evaluate communication gaps, with SDMCs offering actionable feedback to improve nowcasting templates, to enhance the accessibility of weather information among people with disabilities.

Figure 7: Testbed Operational Centre and Community Observers in Kanyama

4.2.1 Team Structure and Operational Shifts

The T2-Z organised its technical team - comprising meteorologists, forecasters, and researchers from ZMD, INAM, SAWS, and UK institutions - into specialised teams working in coordinated shifts. Additionally, forecasters from Zimbabwe and Malawi joined the testbed operations from Monday, February 3rd to Friday, February 7th. Daytime operations took place from 08:00 to 17:00 CAT, while nowcasting operated continuously through three overlapping shifts: the main daytime shift (08:00-17:00 CAT), evening coverage (16:00-01:00 CAT), and overnight monitoring (00:00-09:00 CAT).

The **Synoptic Team**, consisting of ZMD, INAM and SAWS forecasters, carried the responsibility for generating 12-48 hour NWP forecasts to contextualize nowcasting operations.

The **Nowcasting team**, consisting of forecasters from INAM, ZMD, SAWS, Malawi and Zimbabwe, with UK and South Africa researchers, produced and disseminated nowcasts every two hours. They used nowcasting products available in the Testbed portal. Nowcasts were disseminated via WhatsApp to Kanyama's SDMC group, using the WISER-EWSA nowcasting template, SMS-like messages and voice notes in English and local languages. A key innovation in T2-Z was the inclusion of an observer in the nowcasting team, typically a PhD researcher from the University of Leeds. The observers watched the nowcasting process, documented the decision-making process of the forecasters during nowcasting to support the evaluation team.

The **Evaluation Team**, composed of forecasters from all three NMHSs and our visitors from Malawi and Zimbabwe, alongside Zambian, South African and UK researchers, implemented a case-study methodology to validate nowcast performance, using satellite observations, rain gauge data and community observers (SMDCs) feedback sent three times a day via a Google Form and WhatsApp messages, photos, and videos.

To facilitate the smooth execution of activities during the intensive testbed period, two key daily **Management Roles** were established. The **Floor Leader and Deputy** were assigned each day to chair meetings, guide the schedule, oversee decision-making, and ensure the overall progress of operations. Supporting them, the **Scientific Secretary** was responsible for documenting meeting notes, maintaining and updating shared folders, managing digital outputs such as daily highlights and summaries, and ensuring effective internal communications.

Community Engagement & Evaluation: WP1 and SDMCs led a range of activities to raise awareness about the WISER-EWSA project, weather information, and the services provided by ZMD in Kanyama. These included gathering critical feedback from the community on weather information, particularly on nowcasting templates, to improve their usability, clarity and accessibility.

The T2-Z Intensive Testbed operated over nine consecutive days, including one weekend. Operations ran on a 24-hour basis through three coordinated nowcasting shifts, overlapping one hour to facilitate smooth transitions between shifts:

- **Day Shift** (08:00–17:00 CAT): Synoptic, Nowcasting I, and Evaluation Teams conducted primary forecasting, nowcast production and dissemination, and verification of nowcasts.

- **Evening Shift** (16:00–01:00 CAT): Nowcasting Team II maintained nowcast operations.
- **Night Shift** (00:00–08:00 CAT): Nowcasting Team III provided overnight nowcasting coverage.

The evening and night nowcasting shifts were exclusively maintained by ZMD forecasters. INAM forecasters participated in the day shift across all three teams (synoptic, nowcasting and evaluation). While INAM's forecasting team produced nowcasts every two-hours during this period, they only issued them if intensive nowcasting events (INEs) would affect Boane, Mozambique. SAWS team faced operational constraints due to the January 2025 cyberattack, which prevented their forecasters in South Africa from joining the meetings online. However, the SAWS forecasting team attending T2-Z produced, disseminated, and evaluated nowcasts only when INE's affected Katlehong. The SAWS team also supported the synoptic forecasting, nowcasting, and evaluation teams.

In parallel with the forecasting hub, a community hub was hosted in Kanyama. It was facilitated by WP1 and the Zambia user engagement lead, and attended by SDMCs and other community members who had been invited, with a particular focus on persons with disabilities. For more information see section 5.

4.2.2 T2-Z TOC Activities

Daily activities consisted of hybrid meetings, enabling remote participation by partners that could not join the testbed in person.

- **All-Testbed Meeting** (12:00 CAT): In this meeting, the evaluation team selected nowcasts issued by the Nowcasting II and/or Nowcasting III teams from ZMD and assessed the quality of the nowcasts issued. In the case of INAM they would present the validation of the last nowcasts issued by INAM forecasters in the previous day.Then the Synoptic forecasting team presented the outlook forecasts
- **Daily Review Meeting** (16:30 CAT): In this meeting the evaluation team presented their analysis regarding the nowcasts issued
- A **weekly review** was held on February 3rd, and a closing **Final Review Meeting** on February 7th, both at 16:00 CAT.

Additional to the daily meetings, during the T2-Z we had special events and sessions including the following:

- **Kick-off Briefing Meeting** (January 30th): In this meeting, the T2-Z was launched with opening remarks from ZMD's PR Edson Nkonde and WMO's Hellen Msemo, followed by Prof. Douglas Parker outlining key objectives of WISER-EWSA. Country perspectives were presented by INAM and SAWS, while work package leads covered testbed operations, user engagement, evaluation, and training outcomes.
- **Open Day** (February 5th): This event bridged science and practice by connecting SDMCs, media representatives, government ministries, and intermediate organisations (FAO, WFP, GIZ, Red Cross, People Living with Disabilities, and the Farmers Union of Zambia) with forecasters and scientists. Following opening remarks from ZMD, the Ministry of Green Economy, and WMO (emphasizing the Early Warnings for All initiative), Prof. John Marsham provided an overview of the WISER-EWSA project. University of Leeds PhD students then provided a 'tour-guide' through the testbed. This interactive session allowed direct dialogue between forecasters in

the synoptic, nowcasting, and evaluation regarding the production of weather information, and fostered discussion about enhancing warning communication among forecasters and stakeholders.

Figure 8: During the Open day community observers and relevant stakeholders participated in the testbed

- **Cross-Project Day** (February 6th): This day, representatives from different work packages presented their progress. For WP4, PhD students from Leeds leading the King-Size evaluation presented preliminary findings and future actions. WP1 shared reflections and progress made during the king-size testbed. Adriaan Perrels presented preliminary findings of the cost-benefit analysis of nowcasting for Zambia. Nico Kroese and WMO's Daniela Cuellar linked the WISER-EWSA efforts to the global EW4ALL framework. The hybrid format enabled dynamic discussions between Lusaka-based teams and international partners on refining early warning systems through interdisciplinary collaboration.
- **Closing day** (February 7th): The testbed concluded with Lightning Research Talks featuring postgraduate researchers from the University of Leeds, Zambia, and UKCEH presenting cutting-edge nowcasting research to operational forecasters. The SDMCs presented their key reflections and lessons learned from T2-Z and their plans for the remainder of the King-Size Testbed. Throughout the day, WP2 gathered feedback from both in-person and online participants using Padlet, which was then discussed during the final reflection session to identify improvements for the remainder of the King-Size testbed and future testbeds.

- **Special Presentations:** In addition to the dedicated event days, the testbed featured several technical presentations throughout the nine-day period. These included: ‘Case Study: Supercell Storms’ and ‘Nowcasting Research at SAWS’ by SAWS forecaster; and the SDMC presented their aggregated feedback on nowcasting templates and their ideal nowcast template. These sessions provided valuable opportunities for knowledge exchange between forecasters, researchers, and community representatives. The feedback session led by the SMDC was key in the modification of the nowcasting template, as features suggested as ideal were added to the template that was used for the remainder of the King-Size testbed.

Figure 9: Community mobilisers presenting suggestions to improve the nowcasting template

4.3 Intensive phase: T2-M

The T2-M TOC was located at Residencial Kaya Kwanga, in Maputo. Forecasting and nowcasting activities focused on Maputo, and the communities of Boane, Matutuini and Namaacha. SAWS and ZMD forecasters will participate remotely and issue nowcasts only when necessary to their communities.

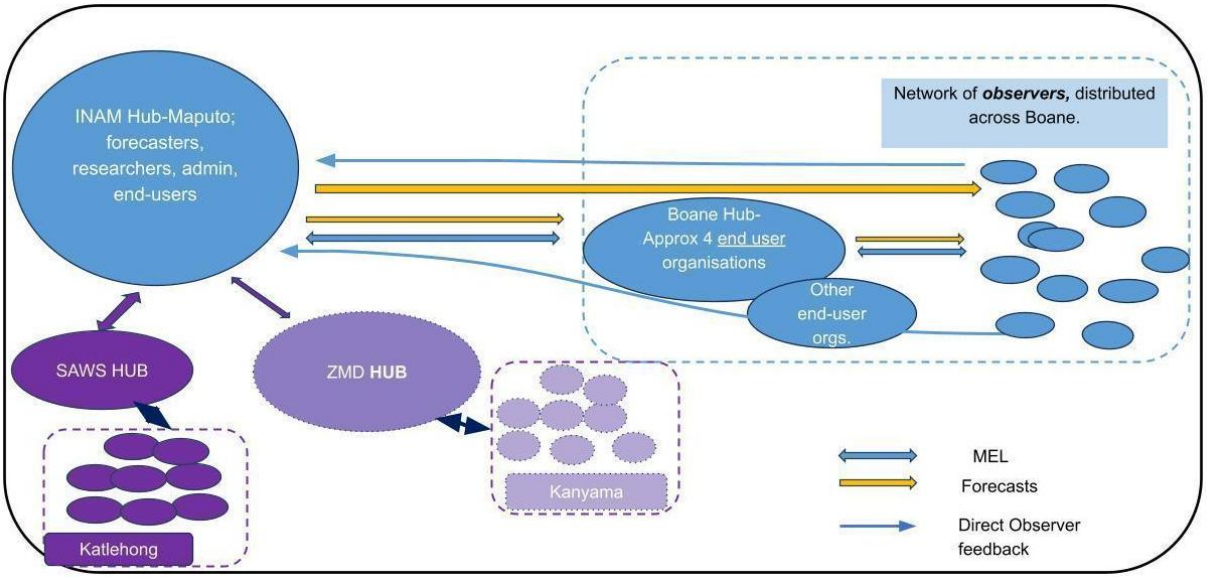


Figure 10: T2-M simplified multi-sited schematic and information flow

4.3.1 Team Structure and Operational Shifts

The TOC in Maputo hosted **25 people**, plus collaborating organisations and users. The 6 days of testbed operations took place from 08:00 to 17:00 hours CAT/SAST. If an INE was expected for the evening, the Nowcasting II team (16:00-00:00 hours) would be activated. Like in T2-Z, INAM's 12 forecasters were organised into three teams: Synoptic, Nowcasting, and Evaluation. The activities each team carried out were as described in the section 4.2.1

- **Synoptic forecasting team**: Responsible for 12-48h forecasts using NWP models.
- **Nowcasting teams (I, II)**: Includes meteorologists and impact specialists. Due to the reduced number of participants, the nowcasting I team did not have an observer on the roster.
- **Evaluation and Engagement team**: Validates forecasts and assesses EWS effectiveness.
- **Community Engagement & Evaluation**: WP1 will lead user feedback collection.

Due to the reduced number of participants, adjustments for T2-M included the elimination of the Observer role in the Nowcasting Team. Nowcasts for Maputo were issued every 2 hours. SAWS and ZMD forecasters only engaged remotely, issuing nowcasts only when required.

Figure 11L Testbed Operational Centre in Maputo (left) Community Observers in Boane (right)

4.3.2 T2-M TOC Activities

Daily activities consisted of hybrid meetings, enabling remote participation by partners that could not join the testbed in person.

- **All-Testbed Meeting** (12:00 CAT-SAST): In this meeting, the evaluation team assessed the quality of selected nowcasts issued by INAM's Nowcasting I and/or Nowcasting II teams. Then the Synoptic forecasting team presented the outlook forecasts. SAWS and ZMD joined INAM forecasters remotely and presented their outlook forecast for the next days and in case of an INE, the evaluation of the nowcast too.
- **Daily Review Meeting** (16:30 CAT/SAST): In this meeting the evaluation team presented their analysis regarding the nowcasts issued During the review meetings, the synoptic team made decisions about activating the Nowcasting II team based on forecast conditions. This occurred once, on Tuesday, March 25th, when a cold front approaching southern Mozambique raised the potential for strong winds and heavy rainfall.
- The **final review meeting** (16:00 CAT/SAST) took place on March 27th, 2025. Activities are described below in the reflection day bullet point.

During T2-M, the team also held special events:

- **Kick-off meeting (March 22):** Which included an introduction to WISER EWSA by Nico Kroese and a testbed briefing by Alex Roberts.
- **World Meteorological Day Celebration (March 24):** The leadership team in Maputo presented WISER-EWSA to the media and relevant stakeholders to raise awareness of the importance of the project and its contribution to the initiative Early Warnings for All.
- **Community Engagement Day (March 25):** Part of the international team and INAM forecasters visited Boane to meet 69 community mobilisers and media representatives. The session included an overview of the WISER EWSA project and presentation of INAM's forecasting products and communication channels.Community members provided valuable feedback on preferred formats to increase accessibility and usability of nowcasts and impact warnings. The team visited Pequenos Libombos Dam, where the director, Mr. Jaime Timba, shared challenges in communicating emergency discharges to nearby communities and expressed interest in collaborating with WISER EWSA community observers to enhance warning dissemination. The day concluded with a lunch in Umpala attended by 110 community members, including leaders and people with disabilities, who highlighted the benefits of daily weather information in improving preparedness and reducing weather-related impacts.
- **Reflection day and final review meeting (March 27):** On this day, community observers joined the T2-M hub to take part in the technical activities. In addition to the daily activities, the team had special presentations included a cost-benefit analysis by Adriaan Perrels showing the economic value of nowcasting in Mozambique, and Junior Goncalves made a soft-launch of the FASTA app to the community observers. Additionally, three international forecasters teams mentored by UK researchers presented their advances on the case studies prepared as part of their training. WP1 leads and community mobilisers shared how access to weather information has improved preparedness and increased confidence in disseminating nowcasts and weather information. Community observers noted an improved understanding of forecast language and appreciated direct engagement with INAM. The day concluded with the final review meeting and breakout discussions reflecting on the testbed's impact, nowcasting products, community engagement, and improvements needed.

Figure 12: Tested Operation Centre in Maputo

5. King-Size Testbed: Community engagement and Co-Production

This section depicts the community engagement activities, which were a central part of the King-Size testbed, not a parallel process. Community observers played a central role in verifying nowcasts, sharing feedback on INE, providing critical feedback on weather information and early-warning information templates, and facilitating dissemination of weather information in their communities. Their participation represents a key innovation of the King-Size testbed, enabling co-production throughout the testbed that strengthened the relevance, usability and impact of nowcasts and forecast products across the three countries.

5.1 King-Size Testbed: Extended Mode Activities

The aim of the king-size testbed from a user perspective served the purposes of (a) ensuring ongoing verification feedback on nowcasts, (b) providing feedback on the content and presentation of nowcasts and forecasts and (c) raising community awareness on weather information.

A small group of community members in each target urban location played the role of community “mobilisers”. The majority of these had been community observers in the first intensive testbed in January-February 2024, when they had provided regular verification feedback on nowcasts. However at that time, nowcasts were being issued experimentally and thus they had been advised not to forward the information to the community. For the king-size testbed, the decision was made by all of the met services to issue nowcasts formally as an addition to their existing suite of weather services. Thus the decision was made in the co-production and testbed preparatory co-design workshops in 2024 to upgrade the role of community observer to that of community mobiliser. The role of community mobilisers was to provide verification feedback and feedback on the content and presentation of nowcasts, but also to play a key role in sharing weather information among their communities.

In Mozambique, some of the community observers had been integrated into relevant local disaster management committees in 2024. Prior to the king-size testbed, Zambia held its co-production and testbed preparatory co-design workshop and participants included the 2024 testbed community observers and newly designated members of the Satellite Disaster Management Committees (SDMCs). SDMCs are the lowest governance level of disaster management in Zambia, reporting to District Disaster Management Committees (which then report to province, and then to national level). Given complementarities in the roles of WISER EWSA community observers and SDMCs, it was decided that community observers would be integrated into the SDMCs. They and a small number of SDMC members from each of the three target wards played the role of community mobilisers for the king-size testbed but are typically referred to as SDMCs since this is the permanent role that they have.

As was the case in other WISER EWSA activities, the specific ways in which community mobilisers carried out their duties varied slightly from country to country. In Mozambique and Zambia they met together and with the WISER EWSA community engagement leads at least twice a month. In South Africa, the face to face engagement was once a month but the team maintained remote contact by cellphone and when needed ad hoc meetings were held at the Isaac Mokoena community library or Nokulunga Primary School with varying numbers of attendees.

Community mobilisers/SDMCs were provided with a small amount of airtime per month for the duration of the king-size testbed to enable them to receive nowcasts and provide feedback. They were also provided with t-shirts with weather awareness-raising information on the back. These t-shirts served the purpose of conferring some credibility and legitimacy among community members when mobilisers shared weather information and advisories with them. Meetings were facilitated in all three countries where community mobilisers/SDMCs came up with their own code of conduct which also included standard safeguarding practices. They were also all trained on ethics of photos, and reminded to obtain permission before taking photos, and to never take photos with children.

Awareness raising posters were also produced to support community mobilisers in their role of sharing weather information among their communities. The posters provided examples of weather information that appears in forecasts and provided advisories on how to respond in case of that weather being forecast. The content and presentation was developed with inputs from the community mobilisers/SDMCs in all three countries through the co-production and testbed preparatory co-design workshops prior to the start of the king-size testbed. Each country's poster was bilingual (English and Nyanja for Zambia, English and isiZulu for South Africa, and Portuguese and Changana for Mozambique), contained local contact information for the meteorological services and disaster management agencies, and was highly visual, containing the weather and advisory icons that were commissioned by the project for use in forecasts and nowcasts, in response to early feedback from communities that written information was not accessible to everyone. Locations for posters in each community were proposed by mobilisers/SDMCs who then led the process of distributing them and ensuring that they remained intact throughout the king-size testbed. In the case of Mozambique, this meant waiting until after the November election, as all posters in public areas were removed at that time.

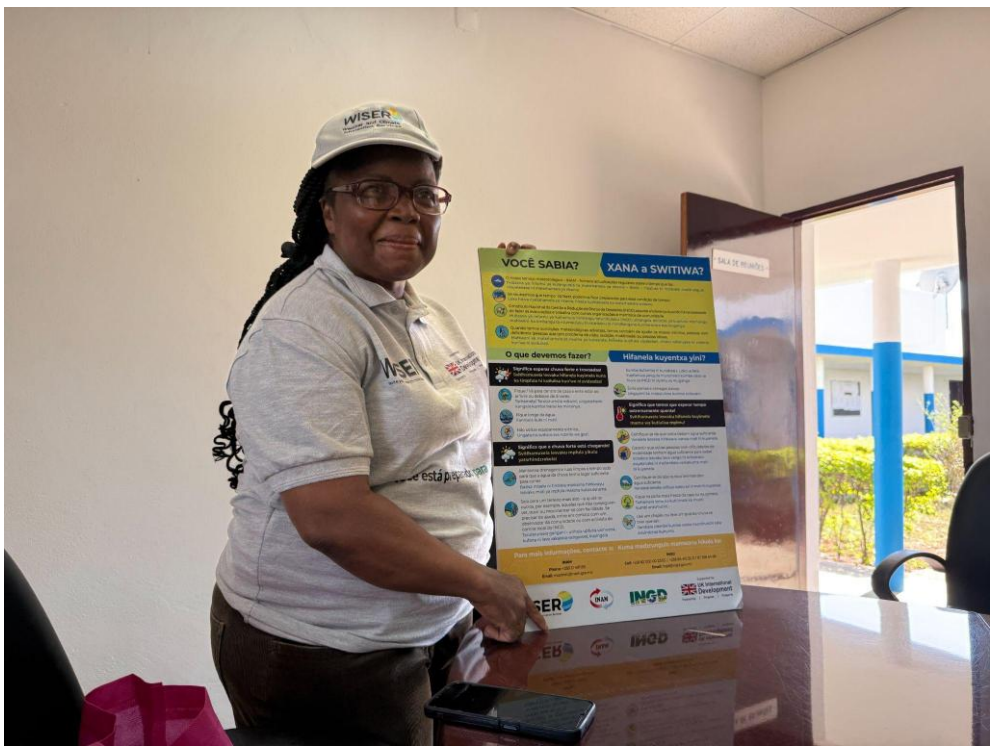


Figure 13: Mozambique user engagement lead Gilda Monjane uses the awareness-raising poster in a meeting

The feedback process differed from the intensive testbeds. Since nowcasts were only being issued when severe impacts of thunderstorms were expected, they were requested to provide

feedback on rain at the end of any day in which rain had fallen (this was in contrast to the intensive testbeds, where feedback was requested at three set times per day, regardless of rain).

The mechanism of feedback also differed. During the 2024 testbed, then-community observers had provided feedback three times per day by whatsapp in response to a push reminder sent individually to their phones, and shared brief information and photos on the collective whatsapp group. This process worked when the number of community observers was small, and the duration of the testbed was short, as it required compilation at the scientific testbed site. Cognisant that human resource capacity is often stretched, a less effort-intensive approach was required for the kingsize testbed. In order to streamline the feedback process, a simple Google Form was established and mobilisers were trained in providing feedback through the form. The form contained the same questions as used in the 2024 testbed, about the timing, duration and location of rainfall and any impacts.

The process of the electronic verification feedback through the Google Form worked well, after a short “break in” period as mobilisers/SDMCs got accustomed to the system. However, the disadvantage relative to the earlier system was that mobilisers themselves were not able to see feedback and photos shared by their peers. This had been deemed interesting and also served as a reminder to others. Thus mobilisers then decided to submit the googleform feedback officially but also continued to share verification information and photos on the collective whatsapp group.

5.1.1 King-Size testbed activities in Kanyama

In addition to SDMCs providing verification feedback on the googleform, a number of other activities took place in Kanyama during the king-size testbed. After the decision to integrate 2024 community observers into the SDMCs, the project facilitated training of the SDMCs for Chinika ward 11, Kanyama ward 13 and Makeni ward 14 by the Disaster Management and Mitigation Unit. All SDMCs country wide are supposed to be trained in their roles and duties but, with the structures having recently been revitalised after the 2024 drought, this had not yet been done. The training also provided an opportunity to highlight how nowcasting and weather information aligns with disaster risk reduction efforts.

SDMCs in Kanyama put a lot of emphasis on raising awareness of weather information within their community. As well as distributing the posters, this entailed each ward conducting door to door visits to identify people with disabilities and understand more about the specific nature of their needs. This information is helpful to the SDMC role in identifying needs after a disaster, and was also important for the WISER EWSA component as it identified people with special needs who could not access information directly. With this knowledge, SDMCs were able to pass on weather forecast and nowcast information personally.

In the course of community engagement, SDMCs also identified that churches would be a powerful vehicle to efficiently spread information about weather forecasts. There are many churches in Kanyama and most residents are members of one. SDMCs themselves led the process of contacting churches and arranging visits during services, where they were often given space within the agenda to speak with the congregation. Examples of churches that were visited include various branches of the Seventh Day Adventist (SDA) church, New Apostolic Church (Makeni Villa), Jesus Pentecostal Church (Makeni Villa), Wells of Salvation, Reformed Church of Zambia, Presbyterian Church, Bethany New Apostolic Church and

Pilgrim Wesleyan Church. They highlighted the services that ZMD provides and how to access it, adding people with smartphones directly to the whatsapp group. A sign language interpreter was typically in attendance to ensure the information was accessible to those with hearing disabilities.

Figure 14: SDMC in Kanyama raises awareness of weather in a church

In Kanyama, the SDMC members (community observers before incorporation into the SDMC structure) visit churches to talk about the project and the importance of weather information. The team visited St Mary's Anglican Kanyama Parish on 4 May 2025. Mr Elias Chihinga from the church shared [unedited], "... On behalf of Anglican Church I say thank u for coming and pls don't stop but educate others as well."

SDMC members in Kanyama participated in a procession to commemorate International Women's Day on 8 March 2025. The team's banner proclaimed, "Share the umbrella!", emphasising one of the project's main tenets: Inclusivity. It spread the word that WISER EWSA supports the Kanyama SDMC to ensure that women and persons with disabilities are getting early warnings for severe weather.

Rain gauges were also distributed in Kanyama. This was to close the data gap on tangible observations of rainfall and cross-reference with observational data provided by SDMCs. Five were distributed to schools: Shalom School, John Laing Primary School, Chinika Secondary School, Twashuka Primary School and Kanyama Central School, and an additional one to St Daniel Comboni Social Development Centre (which was the location of the community hub in the 2024 testbed). ZMD provided training to teachers on how and when to take readings, and provided hard copy books for records. This had variable success. Readings from St Daniel Comboni Social Development Centre were taken daily and shared on the whatsapp group, which provided useful and rapid information to forecasters. These readings were key parameters for the evaluation of the King-Size testbed efforts. The consistency and reliability of the readings was enabled by the fact that staff live full time on the property. The same is not the case in the schools, meaning that during holidays there would be gaps in the readings. In addition, not all of the schools were trained to provide the readings electronically to ZMD, which impeded their utility in the testbed. However, having them in schools meant that they could provide a useful learning opportunity in science and geography classes.

The Kanyama king-size testbed site also trialled a hub-and-spoke network of feedback gathering. In this case the SDMCs acted as the spokes, and were occasionally asked to seek feedback from 5-10 neighbours on a simple set of questions, and report back through the regular meetings. This served to expand the range of people from whom feedback was sought, and also ensured that feedback was still obtained from novices (because as a result of the process, SDMCs themselves were becoming more discerning consumers of weather information). In the middle of the rainy season this was not ideal for nowcasts because of the time lag that occurred through briefing SDMCs to give them time to ask the questions to get the feedback (i.e. this took 2 weeks and in that time there may have been more than one nowcast). An example for which feedback was sought include the seasonal forecast, where questions were:

Have you received news of the seasonal forecast?
From where did you receive the seasonal forecast?
What do you understand from this information?
How have you used this information so far?
What would make this information more useful to you?

Feedback was also sought on whether people had seen the weather awareness raising posters posted in the neighbourhood, and if they had any feedback on them.

5.1.2 King-size testbed activities in Boane

In addition to community mobilisers providing verification feedback on the googleform, a number of other activities took place in Mozambique during the king-size testbed. Regular meetings were held with community mobilisers as part of the ongoing co-production process, and to support and gain feedback from their interactions with the community members. Early in the season (October), meetings were held focusing on the seasonal forecast and providing training around the use of traffic light-coloured flags. This is a communication mechanism already used by the Instituto Nacional de Gestão e Redução do Risco de Desastres (INGD), such that INGD disaster management committee members change the flag colour (green, yellow, red) depending on the disaster early warning alert levels. During the king-size testbed, flags were also changed depending on the nowcasts that were issued, given that nowcasts were only being issued when rainfall was anticipated that would lead to severe impacts.

Raising awareness of the importance of early warning through song

The king-size testbed saw the launch of the Early Warnings for All song by Rafael Bata. Mr Bata is visually impaired and has lent his expertise to the Mozambique user engagement team throughout the king-size testbed training sessions to raise people's awareness of how to communicate effectively with people with disabilities.

The Early Warnings for All song warns a friend, Fabião, to get out of a risky place, because it is going to rain. This friend, the lyrics caution, will cry and lose his belongings. Fabião is exhorted to get to a safe place with his family. "Early warning for all" is a refrain throughout the song as Fabião and his family are urged to run to a high area because heavy rain is coming. And as he runs, the lyrics say, he must remember the disabled, the elderly, and children.

The song has been widely used throughout the king-size testbed in community meetings in Boane, Matatuine and Namaacha, and was officially launched during testbed 2-M.

Contact was maintained with relevant district authorities throughout the king-size testbed, and this led to requests from two other districts to train observers (as the primary stage of training). Training exercises similar to the one conducted in Boane in the co-production and testbed preparatory co-design workshop were conducted for Namaacha and Matatuine. Namaacha is a hilly district that borders Eswatini, whilst Matatuine is to the south of Maputo, on the banks of a river that flows into Maputo Bay. Flooding in 2024 provoked the district authorities to seek ways of reducing risk, and they recognised that access to weather and early warnings would be a critical first step. Training sessions included sessions from INAM forecasters about weather and forecasts and how to interpret them, together with participatory group exercises to identify risk and how weather information could be used to reduce risk. Matatuine and Namaacha observers were then added to the whatsapp group and received the forecast and nowcast information. Altogether, 7 people were trained in Namaacha (three women and four men) and 10 people were trained in Matatuine (five men and five women). They also shared information with other community members. Further meetings were held with both communities throughout the king-size testbed, and representatives from all three communities participated in the testbed 2-M.

Additional mobilisers were trained in Boane through building on synergies with a small community-led waste management project funded by GIZ. This project was conceived as a result of community work within WISER EWSA which identified that poor waste management was contributing to flood risk because of blocking of drains. The twelve women who have been trained in waste management techniques through the GIZ project have also participated in weather awareness training and, in reverse, some of the other community mobilisers have been able to take advantage of waste management training opportunities.

Capitalising on the community mobiliser network for risk reduction

As well as flooding from thunderstorms, Boane is exposed to riverine flooding from the Pequenos Libombos dam, which is under the management of water agency ARA-Sul. Management of water levels in the dam requires careful monitoring and decision making, not least because its inflows are contingent on the neighbouring countries. Often decisions to open the dam gates have to be made at short notice. Although ARA-Sul advertises potential flood risk on the radio, this is only available in one timeslot per day, and not everyone has access to radio. After meeting the user engagement team, links were brokered between the dam managers and the community mobilisers by adding them to the whatsapp group. This means that there is now direct communication between them. Dam managers are already sharing daily information on dam levels, and they have provided some training to some of the community mobilisers on how they obtain this information and use it to make decisions. This direct line of communication also enables the dam managers to capitalise on the community mobilisers' networks that they have developed to share weather information. This means that even marginalised community members without access to radio or cellphones can receive warnings of dam discharge and flood risk, passed on personally by community mobilisers.

5.1.3 King-Size testbed activities in Katlehong

While South Africa was not the main hub for the testbed activities, the community mobilisers and community observers also received nowcasts and impact based warnings from SAWS, which were shared through the WhatsApp group. As the number of community observers grew, particularly at the start of the testbed activities, it was necessary to provide training to new members and provide a refresher for the mobilisers who had expressed interest in additional knowledge-sharing workshops. To meet this need, multiple workshops were arranged by SAWS in collaboration with the Ekurhuleni Disaster Management and other civil society organisations working in Katlehong. The presentations included the basics of weather and climate, the SAWS Alert communication process, and platforms for accessing weather warnings, interpreting warnings, the WISER project, nowcasts and impact-based warnings, and disaster risk reduction and management. In one of the workshops, the mobilisers and observers were also given sample nowcasts and impact-based forecasts from South Africa, Zambia and Mozambique, to compare these and provide feedback on which formats were most informative and useful for decision-making. This exercise also provided them with valuable insights into how citizens were informing the project outputs in other countries.

The mobilisers and observers also used these workshops to clarify in person any information that they had received through the WhatsApp group and questions that they had received from their community. Below are some of the images from the various workshops held during the kingsize testbed. Not all mobilisers and observers could attend all the workshops but effort was made to ensure the information shared during the workshop was also shared in their WhatsApp group.

Figure 15: Workshops held during the kingsize testbed in Katlehong

The Ekurhuleni Disaster Management team also organised a community disaster awareness raising campaign on 9 October 2024 which was held at the Nokulunga Primary School in Katlehong. The objective of the campaign was to raise awareness on extreme weather events affecting the community, the roles and responsibilities of the different departments in the municipality who can support communities to be prepared for extreme weather including the Storm and Water department who can clear storm water drains to reduce localised flooding in the community.

Figure 16: Community awareness event held in Katlehong

(Left)Ekurhuleni Metropolitan Municipality Disaster Management fire management demonstration; (centre) with the WISER-EWSA community mobiliser in attendance; (right) stakeholder engagement lead team with community mobilisers and an official from the fire department at the Community Awareness Event held in Katlehong on 9 October 2024.

In addition to the awareness raising event at Nokulunga Primary School during the kingsize testbed, information was also shared with other schools in the metropolitan including those supporting learners living with disabilities. These include the Monde Stimulation Academy Day Care for Severe and Profound Children with Physical and Intellectual Disabilities, Ekurhuleni School for the Deaf both in Katlehong and the JS Malaza Primary School in Etwatwa.

Community mobilisers also demonstrated their improved confidence and knowledge by organising amongst themselves to distribute project posters and pamphlets at schools, shops and local businesses in Katlehong. This enabled the project to contribute towards addressing knowledge gaps identified during the co-production workshop in August 2024 regarding a lack of disaster risk preparedness and response information.

Figure 17: Community mobilisers going around Katlehong sharing WISER-EWSA pamphlets in their community

The team also posted the project posters in public places around Katlehong including the community library, police station, clinics, schools, hair salons and spaza shops. These posters were in English and IsiZulu and were also deemed useful by educators at Nokulunga Primary who also integrated these into their educational activities.

Figure 18: Posters placed in public places around Katlehong. Left image is a community mobiliser nicknamed as "Mr WeatherMan" placing the poster at the police station

5.2 Intensive testbed community engagement activities

During the in-person testbeds in Zambia and Mozambique, the WP1 team and community mobilisers/SDMC created a special programme of activities aimed at: verifying nowcasts, gathering feedback on content and presentation of nowcasts, and raising awareness of weather information among wider community members who had not been exposed to it. The results of these programmes enriched the King-Size testbed findings and influenced the nowcasting templates and the operations of the remainder of the testbed.

5.2.1 T2-Z Community engagement activities in Kanyama

A varied programme of activities was developed for the community hubs to serve the purposes of ensuring continued nowcast verification from SDMCs, feedback on presentation from SDMCs and community members, and awareness raising to community members, with a particular focus on persons with disabilities.

Each of the three Kanyama wards in which the project operates (Kanyama ward 13, Makeni Villa ward 14 and Chinika ward 11) had a half day session attended by community members (with SDMCs placing particular focus on women and people with disabilities) at which ZMD provided an overview of the weather information products available, and then feedback was gathered in a comparative exercise of different impact-based forecast and nowcast presentations from South Africa, Mozambique and Zambia.

Field visits were undertaken to each of the three wards to see the flood risk context, and to visit and interact with members of the community; and also to Chinika Secondary School to

raise awareness of weather information with advanced level geography students. Experiences of community mobilisers in South Africa and Mozambique were shared, and Zambia SDMCs developed a presentation of their own approaches to be shared in return.

On the final three days of the testbed, Satellite Disaster Management Committee (SDMC) members joined the main testbed site at the Zambia Meteorological Department in Lusaka. During that time they received demonstrations from the forecasting and nowcasting desks so they could better understand the upstream process that goes into generating the information that they receive. They were able to present “model” nowcasts and lists of recommendations for how to present nowcasts in a way that would be accessible to their communities (and the diverse needs within them). A social network mapping exercise was also conducted to track the onward reach of forecasts and nowcasts that are received by SDMCs.

For the remainder of the kingsize testbed, SDMCs continued regular meetings and visiting individuals in their communities to identify people with disabilities and their particular weather information needs. They will also try to increase the number of people who receive information directly from ZMD (e.g. through getting people to sign up directly to ZMD’s whatsapp group and SMS list) to free up their time to transmit information by word-of-mouth to those who cannot follow these options. They will also endeavour to provide daily verification feedback through the GoogleForm, whether or not there has been rain (this is in contrast to the period October-January, when feedback was only requested on days when there had been rain). They will also continue - and expand - their engagement with key community leaders, including councillors, Ward Development Committees and chairpersons.

Figure 19: SDMCs reflect on the kingsize testbed thus far, and plan for the remaining months

5.2.2 T2-M Community engagement activities in Maputo

Community mobilisers in Boane, Namaacha and Matatuine all provided verification feedback on nowcasts throughout T2-M. Small group discussions were also used to identify challenges of accessing and understanding weather information in such communities. Challenges identified included lack of awareness about forecasting institutions, limited availability of technical terms in the local language, and restricted communication channels.
Effective methods highlighted for forecasting to disadvantaged groups include Braille, sign language interpreters, flags, voice notes, and text messages. Educating communities on impact tables helps translate forecasts into actionable information.

There was one designated community day, where forecasters and international project team members travelled to Boane to participate in the community hub, which was attended by 69

people (community mobilisers and other community members) from Boane, Namaacha and Matatuine. The day included a presentation from INAM meteorologists that recapped and consolidated knowledge on different forecast types and how to interpret the visual symbols that are used in forecasts, as well as a reminder of how to interpret the impact table that is used in nowcasts. There were also groupwork exercises for community mobilisers to assess forecasts and nowcasts from South Africa and Zambia as well as from Mozambique for them to highlight ways of presenting information that are accessible and useful to community members. In the afternoon, the project team members visited the nearby Pequenos Libombos dam, which causes flooding in Boane when dam gates are opened (see above story of change box).

For the final days of the testbed, a small group of community mobilisers participated in activities at the main testbed site. They worked with INAM forecasters to reflect on the nowcasting process and identify how to best support its sustainability. As it had been throughout the king-size testbed, the novel interactions between forecasters and community members were widely appreciated on both sides. Prior to the project, few community members knew about INAM and its services, but the continued engagement built capacity to be able to interpret and use information. On the other side, INAM forecasters reinforced their willingness to engage more with the community in the future, recognising that feedback received was helpful for them to improve accessibility of their products.

5.3 User Feedback and Evaluation

5.3.1 User Feedback and Evaluation T2-Z

An online Google Form to evaluate T2-Z was completed by 15 SDMC members: 8 females and 7 males, in the age ranges 18-30 to 51-60. None of them report having a disability.

All reported that involvement in the testbed has improved their knowledge of weather and climate information; 60% to a great extent and 40% to some extent. All of the sessions were reported to be useful. However notably four sessions were unanimously evaluated as very useful: the ward-specific community sessions, the sharing of experiences of South African and Mozambican community mobilisers, preparing a fictional nowcast with presentational aspects that they like, and visiting the ZMD team to learn more about nowcasts and forecasts and present the fictional forecasts

In terms of what they learned, participants spoke of learning how weather information is generated, how to explain weather information to their community, the role of feedback in improving accuracy, the importance of timely and clear communication in disseminating weather alerts, and communication skills for working with the community, especially persons living with disabilities. One person's answer was notable for covering all of these aspects, “Being an SDMC and participating in the testbed has given me valuable insights into community engagement, early warning systems (EWS), and disaster preparedness. Specifically, I have learned: The importance of timely and clear communication in disseminating weather alerts, how to mobilize communities effectively, ensuring that people understand and act on forecasts, the challenges of last-mile communication, especially in vulnerable areas like Kanyama, the role of real-time data collection and feedback in improving forecast accuracy, collaboration with local disaster management teams enhances

preparedness and response strategies and the need for continuous capacity building to strengthen community resilience."

In terms of how they intend to use the information learned, all said they would share information with their community (specifying family, friends, church and people with disabilities), whilst two people also mentioned providing feedback to meteorological services on forecast effectiveness and areas for improvement. All said they are willing to continue providing feedback even after the end of the project.

In additional comments, many participants expressed happiness to be part of the project, and that they want to continue receiving information to be able to give it to their community. One person noted how they would like to be able to spend more time at ZMD. Another summarised the impact of the information by saying "The project has helped me and my community at large in a good way".

5.3.2 User Feedback and Evaluation T2-M

17 community mobilisers participated in the end-of-testbed 2-M reflection and learning session: 9 males and 8 females. This was held as an open and collective discussion at the end of testbed 2-M at the forecaster site, following presentations from different groups. The community mobilisers made a presentation to provide the WP1 perspective. In it they expressed that they feel very happy to be part of this project, especially because it changed the approach within the community when extreme weather is approaching. They appreciated having training from the forecasters who explained technical terms and the functioning of weather phenomena, such as the difference between local rains and widespread rains. They also highlighted that, as community mobilisers, they have an opportunity to speak in the community meetings, and take opportunities to raise awareness of the importance of weather information among their neighbours.

6. Nowcasting and Verification Processes

6.1 Nowcasting

Throughout the King-Size testbed, forecasters generated outlook forecasts that facilitated decision-making for calling INEs and initiated the nowcasting process. Outlook forecasts and nowcasts were produced and disseminated in accordance with the Synoptic and Nowcasting Standard Operating Procedure (SOPs), which were refined before the start of the King-Size testbed and reviewed prior to T2-Z. The refinement of the SOPs was based on feedback gathered during T1, particularly from forecasters.

Forecasters and testbed participants had access to a range of forecasting and nowcasting resources hosted in different platforms, which were linked to a central testbed web portal that was continuously updated as new products became available (Ageet et al. 2024). Forecasting resources included numerical weather prediction (NWP) products and synoptic forecasts outputs available on partner-managed platforms, including SAWS' RSMC website and the NCAS data catalogue. Resources used during the testbed also included trusted online model sources available at Windy.com, the UK Met Office African Web Viewer and the US National Center for Environmental Prediction (NCEP) webpages. Forecasters used these resources to produce their daily outlook forecasts for the next three days, following the Synoptic SOP, and recorded these daily updates in the collaborative Outlook Forecast Table document.

Date	Mozambique - INAM			
	Day+0	Day+1	Day+2	Day+3
07/01/2025	a blocking at the surface, allowing frontal systems to pass from below and in upper air also and similar, convergence at lower levels and divergence at upper levels. In the northern zone, air masses from Congo influence atmospheric instability, with light to moderate rain expected locally.	the passage of the frontal system in the ocean and the continuation of low pressure systems on the continent and in the upper air the trough is over Maputo and aligns with the frontal system on the surface creating strong instability, heavy to very heavy rain is expected with severe thunderstorms in Maputo and Gaza	the passage of the trough in upper air still continues to create instability in Maputo, light to moderate rain locally heavy with thunderstorms.	the low pressure system on the surface creates a convergence that influences light to moderate rain with local thunderstorms in almost the entire country.
08/01/2025	the passage of the frontal system in the ocean and the continuation of low pressure systems on the continent and in the upper air the trough is over Maputo and aligns with the frontal system on the surface creating strong instability, heavy to very heavy rain is expected with severe thunderstorms in Maputo and Gaza	the passage of the trough in upper air still continues to create instability in Maputo, light to moderate rain locally heavy with thunderstorms.	the low pressure system on the surface creates a convergence that influences light to moderate rain with local thunderstorms in almost the entire country.	continuation of locally moderate light rain with thunderstorms in the south zone due to instability influenced by a low pressure system on the surface.

Table 9: Example of INAM Outlook Forecast Table Entries

Date	South Africa - SAWS			
	Day+0	Day+1	Day+2	Day+3
20/10/2024	Y-The cut of low pressure system is developing over the south-western parts of the country with some pertubation ahead of it, resulting in a band of showers and thundershowers over the region. Some thunderstorms will become severe and the SAWS has issued a Yellow Level 2 warning, severe thunderstorms over the region (Katlehong, Thokoza, Voslorus, Hiedleberg, Phumula and Tsakane) which may lead to localised damage to property and infrustructure, settlements, vehicle and livelihood due to small large amount of hail and heavy downpour as well as possible strong damaging surface wind.	Y-A cut off low will move eastwards over the southern parts of the country with a band of showers and thundershowers still expected to develop west of the region and move into the area of Gauteng Province. This will result in Yellow Level 4 warning: Severe the thunderstorms expected in the region which may lead to damage to structures due hail and wind, damage or loss of infrastructure, settlements(formal and informal). property, vehicle and livelihood.	M-As a cut of low pressure move to the south-east of the country, a band of thundershowers still expected in the region but with a decrease of precipitation significant during the day. Only scattered showers and thundershowers are expected in the morning but becoming isolated towards midday and the afternoon. Therefore, the SAWS will monitor the weather conditions and developing on this day and give advise when is necessary.	N- The cut off low presssure system will be existing the country over the eastern parts and therefore a band of isolated to scattered showers and thundershowers will be outside the region as a result, No rain or No preciptation predicted for this day.
21/10/2024	N- The cut-off low is situated on the western region of South Africa; some instabilities with minimal wind shear are modelled over Gauteng. Therefore ordinary thundershowers are expected across Katlehong.	M- The cut-off low is expected to move eastwards to the central region of South Africa with notably increased instabilities and wind shear over Gauteng. Therefore thunderstorms with strong wind, hail and flash-flooding are possible across Katlehong.	N- The cut-off low is expected to move off the eaatern refion of South Africa including countries to the east. The upper ridge is expected to invade Gauteng, clearing the morning showers.	N- Under the influence of upper ridge with increasing subsidence. Therefore, dry and rainless conditions are expected across Gauteng (Katlehong)

Table 10: Example of SAWS Outlook Forecast Table Entries

Date	Zambia - ZMD			
	Day+0	Day+1	Day+2	Day+3
27/12/2024	A relatively moist and unstable airflow from the North East is affecting most parts of Zambia leading to partly cloudy with isolated thunder showers. FORECAST FOR KANYAMA: Partly cloudy with isolated thundershower.	Most parts of Zambia will be under a low pressure system, this system will bring about mainly cloudy conditions with isolated rain and occassional thunder. FORECAST FOR KAYAMA: Mainly cloudy with rain and occassional thunder.	A low pressure system continues to affect most parts of Zambia inducing moist and unstable airflow from the North West, this will lead to mainly cloudy with scattered rain and occassional thunder. Forecast for Kanyama: mainly cloudy with rain and occassional thunder.	The country will continue being under the low pressure system that will lead to partly cloudy with isolated thunder showers. Forecast for Kanyama: partly cloudy with isolated thundershowers.
28/12/2024	Most parts of Zambia will be under a low pressure system, this system will bring about mainly cloudy conditions with isolated rain and occassional thunder. FORECAST FOR KAYAMA: Mainly cloudy with rain and occassional thunder. heavy rains may cause flooding	A low pressure system continues to affect most parts of Zambia, this system will bring about mainly cloudy conditions with scattered rain and occassional thunder. Forecast for Kanyama: mainly cloudy with rain and occassional thunder. heavy rains may cause flooding	Moist and unstable airflow from the North West will affect most parts of Zambia leading to mainly cloudy with rain and occasion thunder. Forecast for Kanyama: mainly cloudy with rain and occassional thunder. heavy rains may cause flooding	Moist and unstable airflow from the North West continues to affect most parts of Zambia leadind to cloudy with scattered rain and occasional thunder. Forecast for Kanyama: mainly cloudy with Scattered rain and occassional thunder. heavy rains may cause flooding that may result to lose of life

Table 11: Example of ZMD Outlook Forecast Table Entries

In the extended phases, when severe weather was anticipated to surpass the predetermined thresholds for rainfall (20 mm/3hr in October-November, 10 mm/3hr in January-April, and 30 mm/6hr for night or weekend shifts), lead forecasters would call an INE and initiate the nowcasting process. During the intensive phases (T2-Z and T2-M), local forecasting teams (ZMD for T2-Z and INAM for T2-M) continuously nowcasted and issued nowcasts every two hours.

The nowcasting resources available were primarily satellite-based products using data from the Meteosat Second Generation (MSG). These included NWCSAF products such as the

Convective Rainfall Rate (CRR) and Rapidly Developing Thunderstorms (RDT) products, along with single and multichannel red-green-blue (RGB) satellite imagery available via the NCAS data catalogue, the ADAGUC viewer and the RSMC website. The NCAS-developed Forecasting African STorms Application (FASTA) mobile application and a renewed website, which integrates CRR and RDT, were also available, and forecasters provided feedback on its skill and functionality. Additional nowcasting products were available via the CEH portal including CEH and University of Leeds developed nowcasting products highlighting the location of convective cores and the likelihood of deep convection in the near future, the Chalmers University of Technology (Sweden) developed Rain over Africa rainfall retrieval (machine learning approach) and the Hydrology Satellite Application Facility (HSAF) rainfall rate retrieval. The CEH portal allowed these products to be displayed on interactive maps providing greater capacity to interact with the data and customise the nowcasting experience for forecasters.

Since the first testbed, WISER EWSA team members heavily used the SAWS RSMC website to access synoptic and nowcasting products. The SAWS cyberattack in January 2025, prior to T2-Z, temporarily disabled the website and rendered its hosted resources inaccessible. In response, the team diversified the products normally used by turning to 'alternative' platforms such as the CEH portal and utilising new products such as the CRR, RDT, RoA and FASTA. This underscored the importance of diversifying platforms, flexibility and innovation in real-time forecasting operations to reduce disruptions.

In both the extended and intensive phases, forecasters followed the Nowcasting SOP, which outlined the activities illustrated in figure 20.

On the day of a potential INE, the lead forecaster initiated the nowcasting process. During the extended phases, they acted as the nowcaster themselves, while in the intensive phases, they handed over to the nowcasting team a synthetic analysis highlighting key weather features and potential changes across the region. The nowcaster or nowcasting team would then gather the latest forecast information, including synoptic charts, upper air maps, NWP model outputs, observational data, and AI/ML-based resources, to identify areas where high impact weather was likely or possible.

Based on this information, nowcasters created **outlook risk maps** for the next 6 hours, and **short-term risk maps** for the next 2 hours. To produce these, nowcasters use forward extrapolation tools to indicate storm movement and predicted growth, using satellite imagery, AI tools, indices, NFLICS and other nowcasting tools available. Nowcasters identified areas of interest, deemed important due to their population density or vulnerability, and generated **risk timelines** to show the evolving risk for specific communities or sectors. These timelines were accompanied by a risk matrix to help users differentiate between events with low likelihood but high impact consequences, and those moderate but high likelihood.

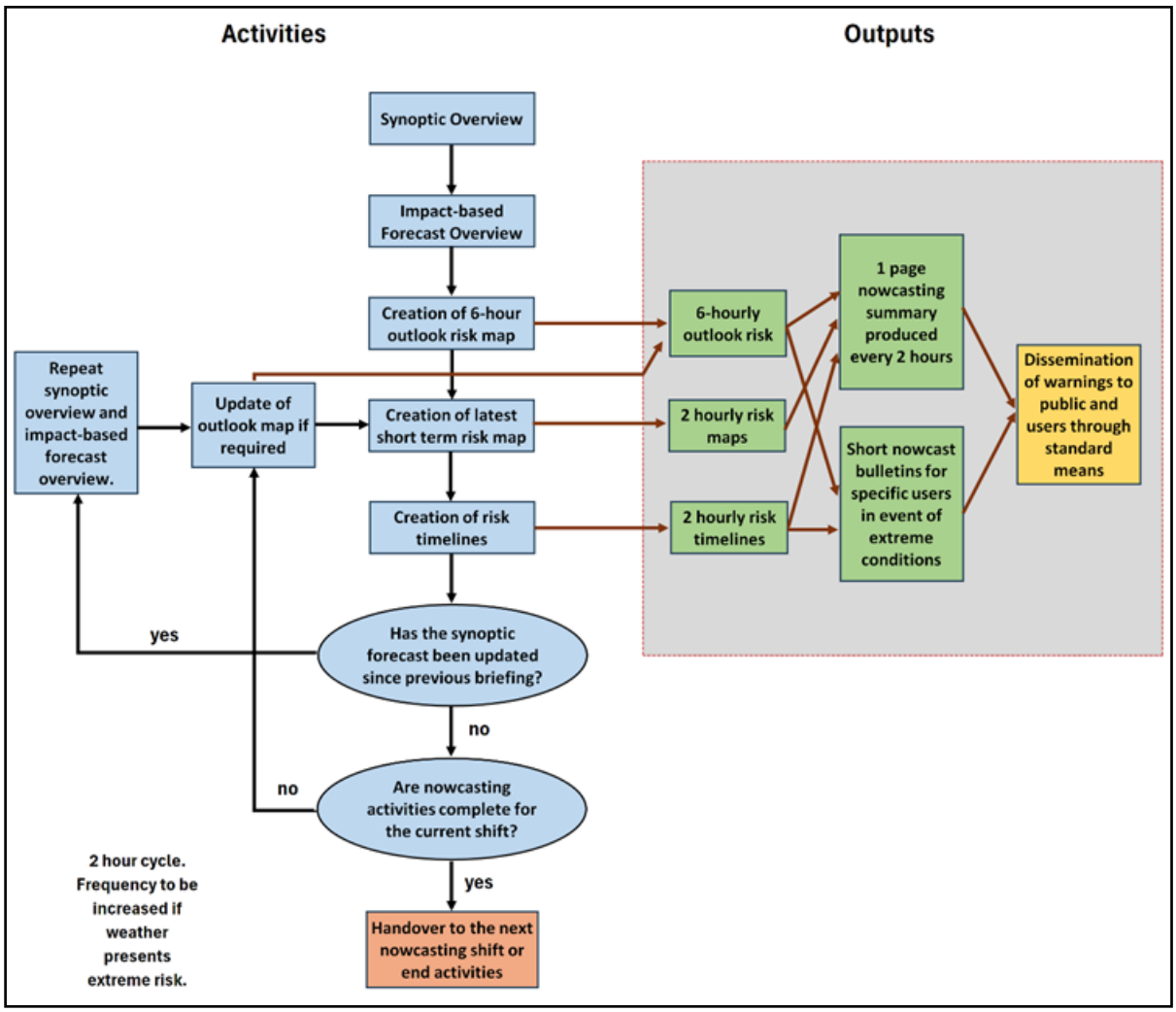


Figure 20: Flow diagram from the Nowcasting SOP detailing the activities and outputs recommended for the operation of a nowcasting shift

All these inputs were compiled into one-page **nowcasting summaries** using the WISER EWSA nowcasting template. The summaries included the 2-hour and 6-hour risk maps, risk timelines for dissemination to the community observers. SAWS developed its own nowcasting format according to their operational procedures, while ZMD and INAM used the WISER EWSA template. INAM forecasters tested modifications to the template during the first phase of implementation, such as adding icons and removing certain data fields. Following this, and based on community feedback during T2-Z, the template was further improved to include advisories, visual icons for weather risks, and it was accompanied by SMS-style short message and voice notes to increase the accessibility of the nowcast.

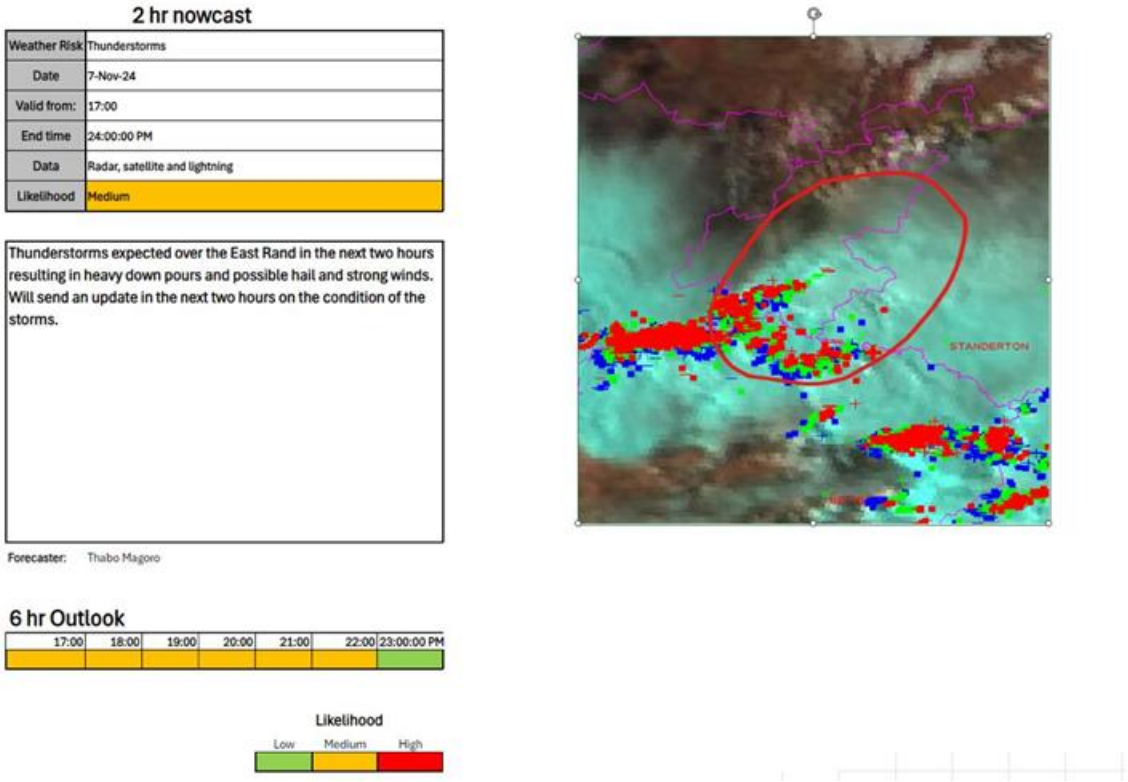


Figure 21: Example of SAWS Nowcasting Summaries during the King-Size Testbed

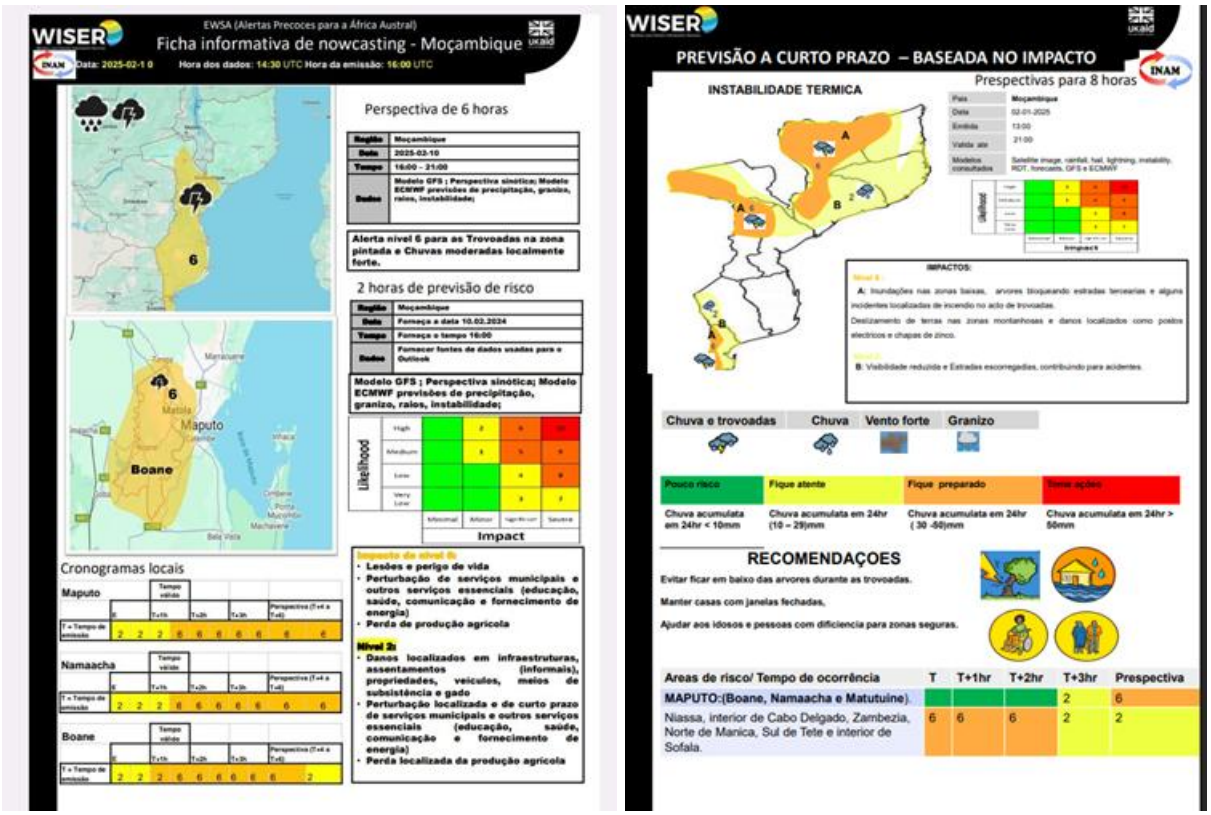


Figure 22: Example of INAM Nowcasting Summaries during the King-Size Testbed

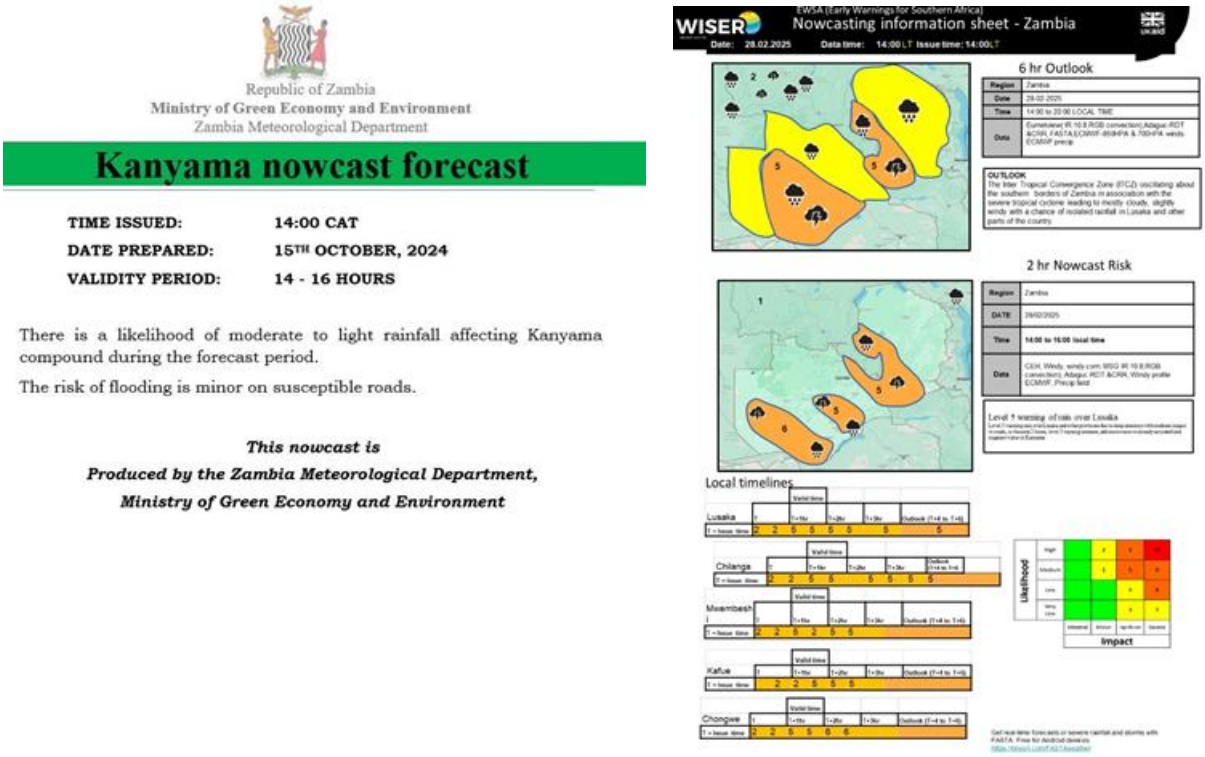


Figure 23: Example of ZMD Nowcasting Summaries during the King-Size Testbed

During the extended phases, once the initial nowcast was issued, it was followed by updates every two hours if the event continued (T+2, T+4, T+n). In the intensive testbeds, nowcasts were issued every two hours, 24 hours a day in T2-Z, and until 17:00 or 00:00 in T2-M, if necessary.

Although it was agreed during the co-production workshops that nowcasting summaries would be shared through official NMHS channels, in practice nowcasts were only produced for the partner communities. Consequently, dissemination took place mainly via the Community Observers WhatsApp groups, which by the end of the King-Size Testbed had grown to 268 members in Kanyama, 73 in Katlehong and 86 in Boane, as observers community members to boost the reach of the nowcasts. It is worth noting that INAM disseminated nowcasts through radio and television (November 2024-January 2025) when Maputo was affected by high impact weather conditions.

Figure 24: SMS Message Format and Example of SMS-Nowcast

Community mobilisers further shared the messages through their local networks using WhatsApp, SMS and in high-traffic community hubs. Social network mapping exercises led by WP1 estimated that community mobilisers reached 1,047 residents in Kanyama and over 1,563 residents in Boane. These figures exclude additional mobilisers in Boane, Matutuine

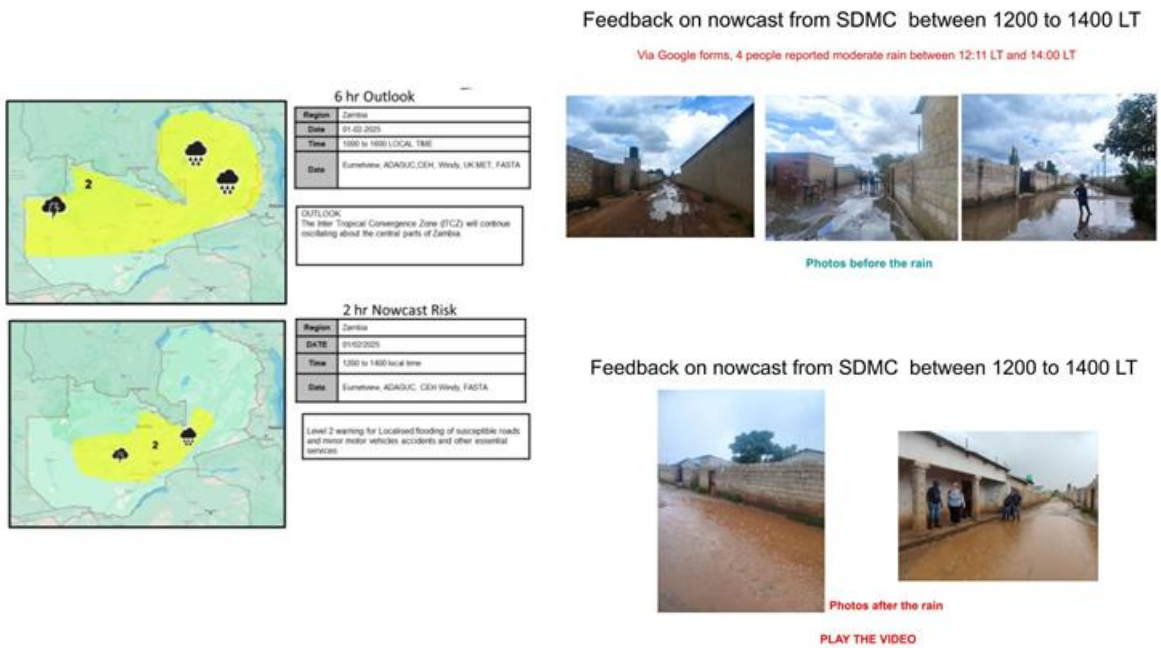
and Namaacha, as well as the mapping results for Katlehong, which were not yet available at the moment of this report.

6.2 Evaluation: Verification of nowcasts

For the initial extended phase of the King-Size testbed, the evaluation efforts were led by the coordinators, PhD researchers at the University of Leeds. During this phase, the coordinator documented the INE, including the nowcast message, and images of observations and nowcast retrieval products of the event, to compare it with images of forward projections of nowcast products, in combination with feedback from community observers gathered via the Google forms and Community WhatsApp groups. This formed part of the Weather Event Database, for later analysis for the King-Size testbed evaluation efforts.

It was for the first intensive phase, T2-Z, that the nowcast verification process leadership was transferred to the forecasters using a case study approach. This subjective verification effort was led by the forecasters in the evaluation team, to assess the accuracy and effectiveness of issued nowcasts. The teams selected one significant nowcast for Mozambique, Zambia and if issued, South Africa, issued in the previous shift, prioritising high-impact weather events. The forecasters cross-referenced the nowcasts against multiple sources, including images of observations/nowcast retrieval products (satellite imagery, rain gauge data if available, RoA, CRR retrieval, HSAF), image of forward projection nowcasting products (CRR, RDT, DWD) and direct feedback from community observers (Google forms and WhatsApp groups).

Example of Case Study Evaluation from Testbed T2-Z (02/02/2025):
Nowcast issued: 01/02/2025 Valid from 12:00-14:00 LT



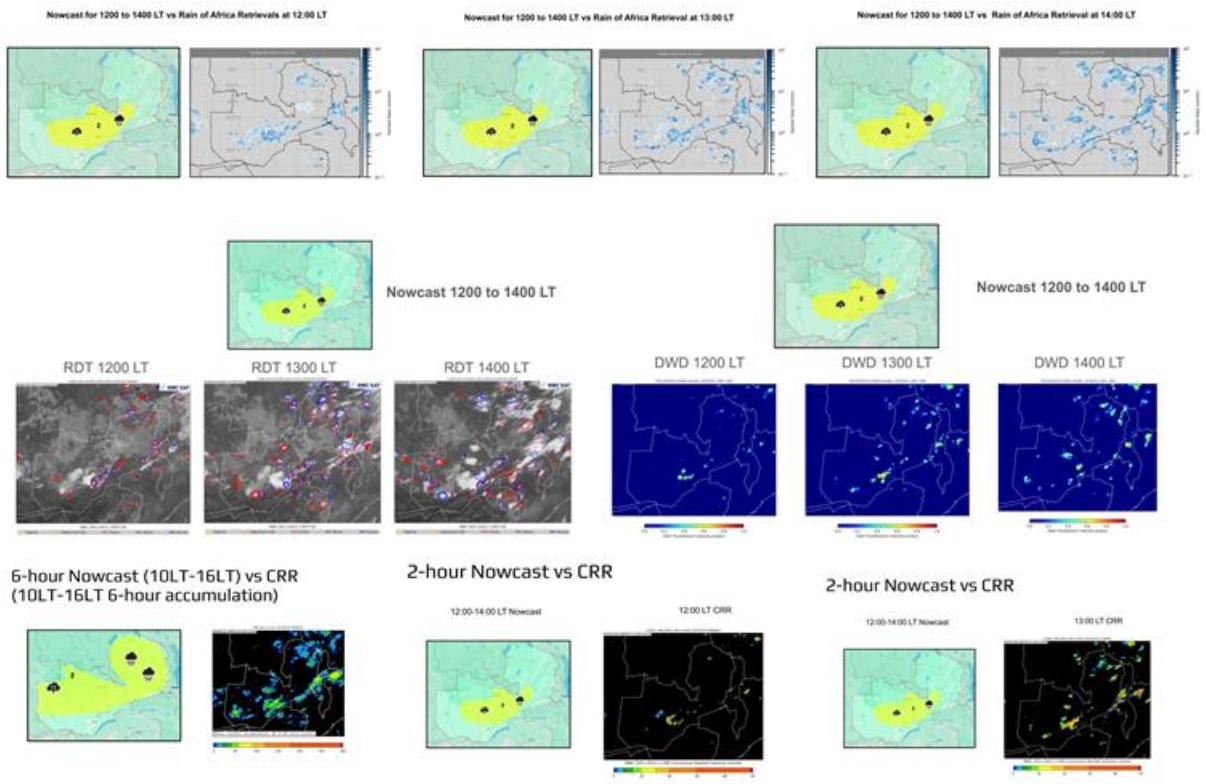
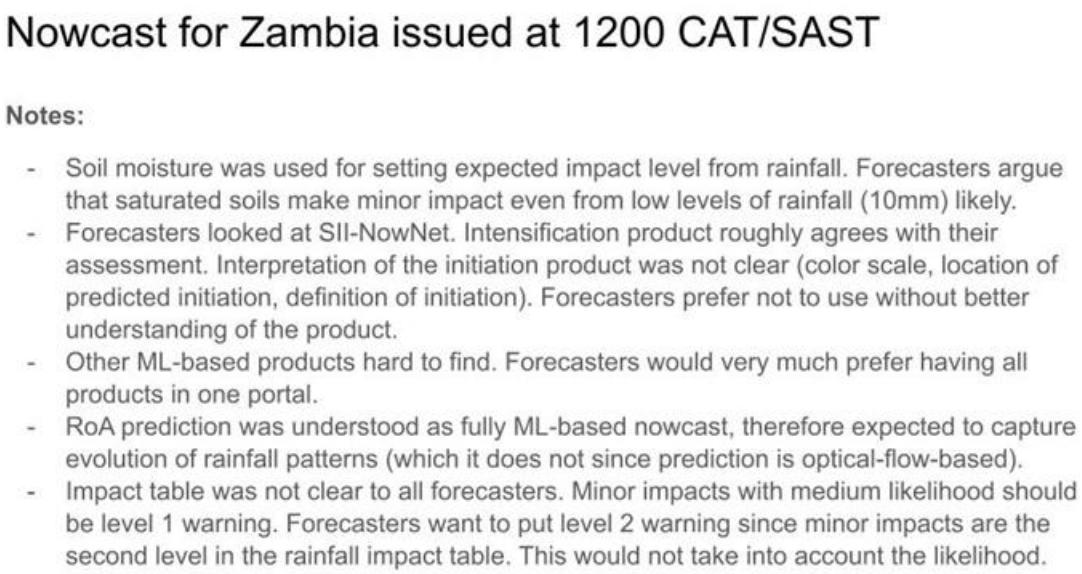


Figure 25: Example of Case Study Evaluation from Testbed T2-Z (02/02/2025)

In T2-Z the evaluation team also used the notes from the observer in the nowcasting team the previous day, in case it was necessary clarifying how the decision process was made when issuing a nowcast.



Nowcast for Zambia issued at 1200 CAT/SAST

Notes:

- Soil moisture was used for setting expected impact level from rainfall. Forecasters argue that saturated soils make minor impact even from low levels of rainfall (10mm) likely.
- Forecasters looked at SII-NowNet. Intensification product roughly agrees with their assessment. Interpretation of the initiation product was not clear (color scale, location of predicted initiation, definition of initiation). Forecasters prefer not to use without better understanding of the product.
- Other ML-based products hard to find. Forecasters would very much prefer having all products in one portal.
- RoA prediction was understood as fully ML-based nowcast, therefore expected to capture evolution of rainfall patterns (which it does not since prediction is optical-flow-based).
- Impact table was not clear to all forecasters. Minor impacts with medium likelihood should be level 1 warning. Forecasters want to put level 2 warning since minor impacts are the second level in the rainfall impact table. This would not take into account the likelihood.

Figure 26: Example of Observers notes

Using these sources, the evaluation team made a qualitative assessment and classified the results as hits, misses, false alarms, or correct rejections. The case study approach allowed identifying the best-performing products for different weather scenarios, as the team was able to identify how different products performed in each case.

After T2-Z, forecasters continued verifying the nowcasts issued during the remainder of the King-Size testbed. These verification efforts were led by the forecaster from the NMHS that issued the nowcast and were presented during the briefing meetings. As a result, the NMHS, particularly SAWS, are considering incorporating a forecaster-led, subjective verification effort process, into their regular operations.

7. Lessons Learned & Recommendations

The WISER EWSA second testbed represented a significant advancement and innovation on testbed research. The King-Size testbed was unique due to its long-term operations with daily activities and continuous engagement with end-users, marking a step forward in co-production of EWS.

Running a testbed at this scale, with sustained daily coordination, ongoing verification, and continuous community engagement, demanded substantial resources and commitment. However, this seven-month endeavour strengthened international collaboration, and enhanced forecasting capacity in INAM, SAWS and ZMD, significantly benefiting forecasters in Mozambique and Zambia, for whom nowcasting was new. The prolonged engagement enabled the three NMHS to implement nowcasting during a whole rainy season, potentially facilitating the integration of nowcasting processes into regular operations going forward.

The King-Size testbed demonstrated that when co-production transcends one-off workshops and is embedded in regular interactions, it can generate lasting impacts. Consistent user engagement in Mozambique and Zambia, fostered trust in weather information and built community capacity to interpret and use forecasts. The latter empowered community mobilisers/SMDC to take leadership of awareness raising activities in their communities, and frequently visited high-traffic venues such as churches to share weather updates. In Zambia, SDMCs were even referred to as “weather prophets”, as their growing credibility sparked interest in weather information within their communities. This outcome suggests potential long-term sustainability of the community mobilisers networks beyond the lifespan of the project.

Nevertheless, the testbed also highlighted important lessons, such as the need for availability of various platforms to access nowcasting products to prevent disruption, secure logistical resources to sustain uninterrupted operations, better aligning training with operational realities, and ensuring that evaluation processes are linked to the application of new tools and methods. This section summarises the key achievements, lessons learned and recommendations for future testbeds.

7.1 What Worked Well : Key achievements.

Nowcasting knowledge and skills development The King-Size testbed was key in building nowcasting capabilities, particularly for INAM and ZMD forecasters, for whom nowcasting was new. This required a mind-shift from focusing on 12-24 hours short/medium-range or seasonal forecasts to 0-6 hours forecasts, and the uptake of new forecasting products specifically for nowcasting.

Forecasters had access to a range of nowcasting products, including SAWS’ RSMC website. Prior to T2-Z, SAWS experienced a cyberattack that disrupted its computational and communication systems, making the RSMC website and the widely used NWP models inaccessible. This prompted forecasters to use new nowcasting products, including CRR, RDT, RoA and FASTA. During the intensive phases, researchers from SAWS, UKCEH and the University of Leeds presented AI/ML-based in development and newly developed nowcasting products, which supported nowcasting and verification efforts. This exposure increased forecasters’ interest in cutting-edge nowcasting research, and highlighted the importance of training and access to enhanced tools that improved nowcasting accuracy.

Following the intensive phases, forecasters reported increased confidence and skills with nowcasting, visible in daily briefing meetings where they increased the use of various nowcasting products and indexes to present outlook forecasts and activate INEs. Over the seven-month period, forecasters reported improved ability to monitor INE and issue more timely and responsive nowcasts and warnings.

Building verification skills: During the initial stage of the King-Size testbed, coordinators led the verification and documentation of INEs, using information from lead forecasters, observational data and community observers feedback. In the intensive phases (T2-Z and T2-M), forecasters took a more prominent role in leading evaluation activities. This marked a change from Testbed 1, where evaluation efforts were primarily led by researchers from the University of Leeds. During the intensive phases, forecasters conducted subjective verification using case studies, with the support of WISER EWSA researchers and experienced forecasters. This shift empowered forecasters to critically assess nowcasting products in relation to observational data, ground-level data and community feedback, thereby identifying product limitations and enhancing decision-making.
The intensive phases significantly increased forecasters' verification skills, who began incorporating nowcast verification into daily briefings alongside outlook forecasts. By leading the verification efforts, forecasters enhanced their understanding of the value of observational data, near real-time automatic weather station data, community feedback and information from other governmental organisations. This empowerment encouraged a continuous evaluation of nowcasting products, with the objective of issuing more accurate nowcasts that better meet end-users' needs. The three participant NMHS indicated that they aim to institutionalise similar verification processes to their standard operations to improve accuracy and build confidence in nowcasting.

Operationalisation of Nowcasting SOP: WISER EWSA researchers developed Synoptic, Nowcasting and Evaluation SOPs to guide the project testbeds and support future implementation. Prior to the launch of the King-Size testbed SAWS reviewed their current SOPs to integrate the King-Size testbed nowcasting activities to their standard operations. For INAM and ZMD these SOPs guided the nowcasting activities during the King-Size testbed. After the conclusion of the testbed, forecasters from INAM, SAWS and ZMD led an effort to customise the nowcasting SOPs to each NMHS operational context. This exercise prompted relevant discussions at SAWS to better integrate nowcasting into routine operations, such as limiting it to key areas, linking it to impact-based warning, and embedding subjective evaluation into daily meetings. ZMD committed to revising their existing SOP to integrate testbed lessons, while INAM planned to adapt the project's Nowcasting SOP to its operational capacity.

Enhanced international collaboration and teamwork: the activities conducted over the seven months of the King-Size Testbed fostered teamwork and international collaboration. The transdisciplinary and international WISER EWSA team, which included researchers, social scientists, meteorologists, forecasters, and community engagement leads, among other roles, made this possible. During the extended phase, the daily briefing meetings facilitated knowledge exchange across countries and organisations, and supported continuous peer-learning. The forecasting teams of the three countries gradually improved their performance in using new nowcasting products due to the daily interactions that the briefing meeting facilitated. Teamwork during the intensive phases further consolidated and accelerated the development of nowcasting and verification capabilities within the three NMHS. Following T2-Z, ZMD launched internal peer-learning sessions to reinforce skills and support team

development. INAM indicated that the King-Size testbed introduced them to the practice of having daily briefing meetings, which they intend to maintain post-project. SAWS expressed plans to continue using testbeds led by the three NMHS to further strengthen nowcasting capabilities and teamwork, and expand these across SADC countries.

Disability inclusion. During the king-size testbed, community mobilisers/SDMCs spent time identifying vulnerable people within their communities, and understanding their particular needs. This was useful to better comprehend people's needs and ensure that they could be personally delivered with early warning information if required. It was also useful to identify particular needs of people with disabilities for information. Needs for information in multiple languages and visual information were reflected in the design of the weather awareness raising posters, and in some of the nowcasts issued in the intensive testbeds which were in local languages and sometimes in voice notes. People with disabilities were then invited to participate in the awareness raising sessions in the community hub and thus there was very high representation. We also learned from experiences in 2024 about inclusion in the venue and the content of the sessions (although they are always limited by the availability of venues in Kanyama). Transport was arranged to ensure access to the community hub venue.

Stronger NMHS/forecaster-community links and value of co-production. The three NMHS focal points emphasised that one of key benefits of taking part in the WISER EWSA project was the capacity built around co-producing EWS and severe weather alerts. Community feedback played a central role not only in the co-production workshops where testbed operations were refined, but also throughout testbed operations. Community feedback prompted discussions in briefing meetings, whether to verify nowcasts, assess missed events, or investigate INEs that were called but did not materialise.

Based on feedback provided from the community hub about accessibility of nowcast messages, during T2-Z, ZMD started sending SMS-like nowcasts messages and voice notes in two languages (English and Nyanja) alongside the nowcasting template. The template was modified to incorporate detailed feedback gathered through exercises in the community hub. The new nowcast format, which included visual icons and advisories, was implemented by INAM during T2-M and continued to use it for the remainder of the testbed. INAM forecasters also issued voice notes in Portuguese during T2-M. However, the adoption of the new nowcast template and accompanying voice notes was inconsistent. This shows that while changes in practice can be gradual, there is clear evidence that actionable feedback from users was taken onboard.

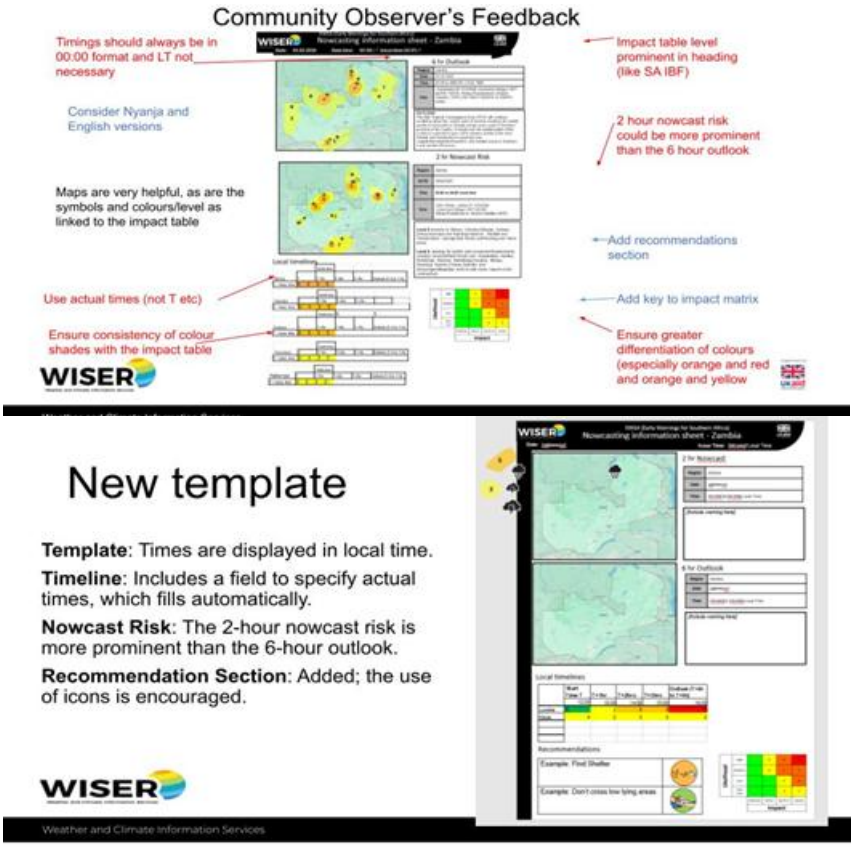


Figure 27: Integration of Community observer Feedback into the Nowcasting Template

Additionally, forecasters reported unexpected gains from working closely with community groups. These interactions fostered a deeper sense of purpose and accountability, as forecasters saw firsthand how the weather information can benefit vulnerable communities. These interactions encouraged forecasters to improve their forecasts but also fostered a greater commitment to making weather information more inclusive, accessible and relevant to end-users.

The expanded roles of the community mobilisers (done by SDMCs in Zambia) has been effective in raising awareness of, and stimulating demand for, weather information across all three sites. Interviews and focus group discussions with community mobilisers and SDMC members found that they are very well known and respected within their communities. In practice they are like "weather influencers" or "weather ambassadors" and are regularly approached for information.

In Mozambique, the network of community mobilisers and observers drew interest from various government institutions, including the Ministry of Agriculture, Environment and Fisheries, to explore the potential replication of these community networks in coastal regions. The Director of the Pequenos Libombos Dam expressed interest in utilising the existing networks in Boane for the dissemination of alerts prior to dam discharges. The National Investment Bank (BNI) seeks to engage women community mobilisers to identify women living in vulnerable areas who could benefit from its Women Credit Line programme.

7.2 Challenges & Improvements Needed

Barriers to Sustained Forecaster Engagement: Throughout the King-Size Testbed forecaster engagement was overall consistent, however initial participation was challenging and decreased following intensive phases (T2-Z and T2-M) and briefing suspensions. This was reflected in gaps in the outlook forecast table, absence of lead forecasters at briefing meetings and missed nowcasting events. Forecasters were expected to contribute to the project alongside their operational duties. Balancing regular responsibilities with testbed operations initially posed challenges, particularly when it was necessary to monitor severe weather continuously. Post intensive phases and during briefing meeting suspension periods saw a temporary drop in engagement, likely due to fatigue and the demands of sustained involvement over seven months. Some forecasters indicated that time constraints and limited guidance or follow-up after intensive phases reduced engagement. Some INAM and ZMD forecasters reported discouragement due to unmet expectations, such as delayed or unpaid allowances.

Internet & Power Instability, and Platform Access Disruption: Power outages and internet instability occasionally affected participation in the King-Size testbed. This particularly challenged ZMD and INAM forecasters working from home during weekends and night shifts, as these NMHS do not operate 24-hour services. In these instances, forecasters relied on personal resources, which at times hindered their ability to produce and issue nowcasts. The cyberattack on SAWS disrupted institutional email, internet access and the RSMC website among other systems. In the immediate aftermath, SAWS forecasters worked from home using personal resources, which restricted their participation in T2-Z. As systems were gradually restored, office-based operations resumed. During the intensive phases, actions were taken in place to ensure reliable power and internet, and forecasters received training on nowcasting products available instead of the RSMC tools. However, ongoing technical issues with the RSMC portal continued to hinder access to its nowcasting products, and forecasters indicated that reduced connectivity affected the timely issuance of nowcasts and alerts.

Limitations for Objective Verification: From T2-Z and the remainder of the King-Size testbed, forecasters led subjective verification of nowcasting efforts. While this approach was suitable for evaluating case studies, focal points and forecasters at the three NMHS expressed interest in conducting objective verification to statistically assess the accuracy and reliability of the different nowcasting products. However, this required additional preparation including providing forecasters access to platforms such as JASMIN which hosts any of the required data sets and tools, and training in programming languages such as Python or statistical software like R, and metrics like the Fractional Skill Score. While this was raised during the T2-Z, it was not possible to make the required adjustments to train forecasters in this endeavour.

Training Gaps: To better support forecasters in adopting nowcasting in real-time scenarios, the training programme could have been more closely aligned to operational practices. Initially, during the briefing meetings, expert attendees noted that some forecasters were not using nowcasting products to assess potential INEs. This underscored the need for clearer guidance and support materials. Although WP3 originally planned to deliver online training sessions throughout the King-Size testbed, these were suspended due to low attendance. Pre-testbed training, especially before the intensive phases (T2-Z and T2-M) was essential, as it allowed forecasters to apply newly gained knowledge directly within the testbed setting, with in-person support from expert meteorologists and forecasters. This not only enhanced nowcasting

capabilities significantly but also help identify remaining training gaps. By the end of the King-Size testbed, most forecasters had developed a strong knowledge of the available nowcasting products. However, because the training assessment was optional, it was difficult to fully evaluate the impact of training. Forecasters requested further guidance, particularly on nowcasting products, map-drawing tools, and statistical verification methods, and resources to better understand the products' strengths, limitations and appropriate use.

Addressing Data Gaps: Data completeness remains a challenge that affects the evaluation of a King-size testbed. Gaps in the Outlook Forecast Table—particularly missing entries or inconsistent use of colour codes, and registering INEs decisions—undermined the ability to assess how much synoptic forecasts allows identifying potential INEs. Similarly, while not every community observer provided feedback all the time on every event, rainfall events were reliably captured thanks to redundancy in the system, where at least one community mobiliser in each site submitted feedback once initial challenges with the Google Forms were overcome. At the beginning of the testbed, community observers were asked to confirm rainfall events only rather than daily reports, to respect their voluntary role and avoid placing unrealistic demands on them. After T2-Z, community observers were asked to send at least one report daily to confirm if rain took place, to ensure rainfall verification. However impact/no-impact reporting was more uneven, which limited our ability to fully evaluate nowcasts in some cases. To mitigate gaps, triangulation of information was carried out. Ensuring more consistent reporting on both the meteorological and community sides is a key priority for strengthening evaluation outcomes in future testbeds.

Uptake of Improved Nowcasting Template: Following valuable feedback from community observers during T2-Z, the nowcasting template was refined to improve clarity and accessibility, including the addition of a pictorial "recommendations" section. While the updated template was shared with ZMD forecasters, its full adoption was not achieved, as many continued to use the previous version. To improve uptake in Mozambique, the new nowcasting template was introduced and shared with INAM forecasters ahead of T2-M. This proactive approach supported more consistent use during the testbed. However, by the end of the testbed, some forecasters occasionally reverted to simpler formats, such as SMS-like messages or voice notes, particularly when monitoring time was limited, when working outside operational hours, or when relying on forecasters personal resources.

Widespread rollout of operational nowcasting: While the intensive and King-Size testbeds showed the value of nowcasting and helped introduce the approach to forecasters the number of people actually able to benefit from such warnings was very low. It is recognised that there is a need to move away from nowcasting solely for several vulnerable communities and ideally the approach should be rolled out on a national scale. Such an approach is already operational in South Africa but the timeline for this to be achieved across the region is uncertain. Barriers to implementation are numerous and the solutions required are complex, time consuming and potentially expensive. Firstly there are significant constraints in terms of staffing and resources that might prevent a rollout more broadly of the approaches that were practiced during the testbed. Specifically the need for a designated national nowcasting bench or multiple regional benches during the rainy season which are able to respond to forecasts (INEs) and current events to issue warnings when required. Secondly, the warnings issued during the testbeds were (by design) very tightly geographically focussed, it is highly likely that the approach taken for a national rollout will have to be more general and as such the methods and format of the communications might have to change significantly. Therefore there is a need to continue to revise the nowcasting standard operating procedure and update the format of information being issued to the public. During the WISER-EWSA project there has been significant effort

to make use of the Common Alerting Protocol (CAP) messaging which allows for warnings to be issued in a standard format which can then be accessed publicly and disseminated via many different channels. The continued use of CAP and the refinement in the way in which messages are issued (and used once issued) needs to be a priority and could help to broaden the reach of nowcasting activities and ensure regional consistency.

Nowcasting data processing pipeline: For the testbed activities there was a strong reliance on imagery and data being provided via UK based institutions (NCAS, University of Leeds, CEH). While this is appropriate for a limited time period for the running of testbeds, especially for products which are in development, it is unsustainable for there to be an operational reliance from NMHSs on data and imagery generated out of country by research focussed organisations. The role of SAWS as the Regional Specialized Meteorological Center (RSMC) means that they generally do provide some nowcasting imagery for the region, however the cyber attack on SAWS which saw the RSMC webpage be unavailable for multiple months has shown the vulnerability of relying on a single source of information. There are several other routes for data access/delivery which were (or could be) used for nowcasting such as EUMETSATs EUMETCAST where data is delivered via telecommunication satellites, the ADAGUC webserver and EUMETSAT online imagery, while these are still based in Europe, they are provided as operational resources so have greater reliability. The option of receiving data and processing it to produce nowcasting products internally within NMHSs is also a possibility but requires additional staffing and computational resource, it is also the case that this is likely to only be an option when using Meteosat Second Generation (MSG) which is already routinely available within NMHSs. The availability of Meteosat Third Generation (MTG) data is likely to present a significant challenge moving forward. The data available via the EUMETCAST Africa service will be a significant downgrade from the full horizontal and temporal resolution data and the implementation of the EUMETCAST Terrestrial service (full resolution data) is dependent on a very high speed internet connection due to the required bandwidth. To address this issue regionally there are already plans in place to implement an African Meteorological Satellite Application Facility (AMSAF) which will give the responsibility of receiving MTG data, processing it into usable products and disseminating to regional NMHSs to 4 regional centres (SAWs being the AMSAF hub for southern Africa). While the AMSAF hub model has the potential to help provide a significant amount of the data processing chain to make satellite nowcasting in Africa more achievable it is still in a nascent phase and is potentially years from being operational.

7.3 Recommendations for Future Testbeds

WISER EWSA assisted INAM, SAWS and ZMD to develop and enhance their capabilities and experience to spearhead the continuation of testbeds in Southern Africa. SAWS, designated as the Regional Specialised Meteorological Centre (RSMC) for SADC, participates in an EUMETSAT initiative aimed at enhancing nowcasting capabilities within the region, which includes testbeds. INAM intends to implement in-country testbeds to include coastal and cyclone-prone communities. All three NMHSs emphasised the value of co-production, and expressed commitment to sustain community engagement and feedback mechanisms, which are deemed essential for making weather information accessible, relevant, and inclusive. In Mozambique, INAM and different government institutions seek to explore scaling out community observer networks, particularly in vulnerable coastal and agricultural regions, to improve resilience and early warning systems. Building on the experience of the King-Size testbed, the following lessons and recommendations emerge to guide future testbeds.

Adopting a King-Size testbed model: Using a combination of extended (online) and intensive (in-person) phases rendered various advantages. This was beneficial for effectively managing the testbed workload over a long period, maximised opportunities for nowcasting, fostered substantial capacity-building, and facilitated testing the sustainability of nowcasting practices within each NMHS. The extended phases allowed forecasters to adapt to testbed operations and nowcasting activities, while researchers started verification of the nowcasting products. The extended phases facilitated smoother in-person phases and resulted in a reduced learning curve, as the team was already familiar with testbed operations. Moreover, in-person phases accelerated learning for all participants; for example, forecasters were able to apply new knowledge with the support of researchers and experienced forecasters.

Integration of testbed activities within NMHS operations: The Synoptic, Nowcasting and Evaluation SOPs, along with the Testbed Operations Plan, must be co-developed early with forecasters to ensure alignment between testbed activities with NMHS workflows and operational realities. These documents should acknowledge forecasters' competing responsibilities and provide clear guidance and support structures, such as dedicated shifts, tools and reasonable expectations, to facilitate effective participation. Testbed activities could include supporting customisation of SOPs for each NMHS and offer guidance for post-testbed validation, e.g. through internal testbeds or simulations.

Defining geographic scope and thresholds: During WISER-EWSA nowcasts were issued only for events impacting partner communities and when conditions met or surpassed the predefined thresholds (San Roman Pineda, et al., 2025). However, forecasters emphasised the importance of broadening the geographic scope to encompass other regions impacted by different weather events. For example, in Mozambique coastal regions often affected by tropical cyclones and storms could greatly benefit from nowcasting to enhance EWS. In future testbeds, forecasters should also reassess and improve established thresholds and consider additional metrics beyond precipitation to improve decision-making when declaring INEs.

Training linked to operational practice: Training should be followed by practical application in testbed activities to enhance learning experience. During a king-size testbed, it is essential to develop and deliver modular, on-demand training sessions and resources tailored to specific needs, such as map-drawing tools. Training on nowcasting products should focus on products' objectives and limitations, to support forecasters' uptake of these tools. Additionally, researchers should present cutting-edge research on nowcasting throughout the testbed to provide forecasters with insights into emerging technologies and methodologies, prompting critical assessment of existing products. The training plan can promote peer-to-peer learning sessions within NMHS, as seen with ZMD, to improve and expand nowcasting across the services.

Community engagement and co-production: The King-Size testbed demonstrated that sustained engagement with end-users, particularly residents of vulnerable communities, yields benefits beyond ground-level feedback and impact data. A deeper community engagement and ongoing awareness-raising activities led to unexpected gains. Community observers enhanced their ability to interpret weather information and took leadership in preparedness activities within their communities, focusing on households with people with disabilities. These efforts strengthened community trust in the NMHS and motivated forecasters to improve the relevance and communication of weather information. Maximising cost-effectiveness in scaling out community observer networks, requires collaboration with government and non-profit organisations. Leveraging existing community networks such as those created by the

Disaster Risk Management agencies, can support the expansion of weather awareness-raising activities.

Integration of end-user feedback to improve forecast accessibility: Community feedback informed the design and improvement of nowcasting templates, and led to the innovations such as incorporating icons, advisories, voice notes and local languages. Nonetheless, a recurring challenge throughout the King-Size testbed was the slow and inconsistent implementation of agreed improvements, such as updates to the nowcasting templates. While there was better evidence of integration this year compared to Testbed 1, uptake of some practices tapered off following T2-Z. Even with strong collaboration and shared commitments, operational changes often require additional capacity and sustained follow-up to ensure adoption consistently across teams. This underscores the importance of allowing sufficient lead time between planning, agreement, and execution, as well as strengthening internal communication among participating organisations. Feedback mechanisms must be enhanced. Formalising verification processes where forecasters, integrate community insights, can close the loop between forecast generation and user relevance. This would improve forecast reliability, strengthen user engagement, and ensure more inclusive and actionable early warning systems.

Product innovation and evaluation: It is highly recommended to continue forecaster-led efforts for evaluating the skill of forecasting tools, including new satellite-based and AI/ML-driven nowcasting products, indexes, and data sources (e.g., lightning observations, K-Index, RoA, and MTG data). While these products show promise, their accuracy should be quantitatively assessed. Subjective verification of nowcasts should be encouraged early, to prompt forecasters to critically evaluate the products and improve their usage. This process requires making satellite and ground observational data available, as well as community feedback. Integrating subjective and objective verification deems beneficial and future testbeds should incorporate statistical verification training. Researchers can leverage forecaster-led verification efforts to obtain feedback on nowcasting products, for their improvement and ensure products remain practical and user-friendly.

Infrastructure and technical support: Anticipating issues like power outages and limited internet connectivity is key to minimise missed events during testbeds. This entails providing offline tools and support for remote working, such as mobile data and power banks. The SAWS cyberattack underscored the importance to diversify platforms and products, therefore, providing a range of platforms for forecasting products is essential.

References

Ageet, S., Parker, D., Msemo, H.E., Colenbrander, W., de Coning, E., Gijben, M., Gonçalves, J., Groves, D., Imbwae, F., Juhanko, K.O., Kieth, G., Kroese, N., Marsham, J., Mbuli, N., Monjane, G., Monjane, M., Murambadoro, M., Perrels, A., Roberts, A., Sebego, E., Segalwe, O., Stander, J., Tawane, T., 2024. Weather and Climate Information Services Early Warning for Southern Africa (WISER-EWSA) testbed 1. Report. University of Leeds.

San Roman Pineda, I., Ageet, S., Parker, D., Msemo, H.E., Groves, D., Marsham, J., Keith, G., Kroese, N., Thole, P., Namukoko, M., Sebego, E., Gonçalves, J., Roberts, A., 2025, WISER-EWSA Testbed 2 Operational Plan V3. University of Leeds.

Acknowledgements

This work was supported by the Weather and Climate Information Services-Early Warnings for Southern Africa (WISER-EWSA) project, funded by the Met Office as part of the WISER programme on behalf of the UK Government's Foreign, Commonwealth and Development Office (FCDO).

Annexes

Annex 1. Daily reports of community hub activities T2-Z

Community hub daily activity report - 30th January 2025

Katharine Vincent

The WP1 user engagement team, communications team, forecasters from INAM in Mozambique and a Leeds project coordinator visited Chinika Secondary School in Kanyama. This followed on from a visit with geography learners during the co-production and testbed preparatory co-design workshop in August 2024. Ten boys and five girls in grades 11 and 12 (many of the same learners) participated in the meeting.

The group explained what weather is like in Kanyama, particularly highlighting the risk of heavy rainfall and flooding. They were able to raise some key questions with the WISER EWSA team, including advice on which weather apps to use, seeking clarification on why rainfall patterns can vary significantly over space and over time, and asking about the relevance of the project to climate change.

One of the weather advisory posters developed by WISER EWSA has been posted in the school. Learners were asked for their suggestions on a follow up poster targeting youth. In terms of content, the priority was on actions to reduce risk, including:

- Carrying rainwear at all times in the rainy season, knowing that weather can be unpredictable
- Being careful not to shelter under trees during lightning
- Not playing in and around water due to contamination risk
- Switching off electrical appliances in instances of lightning and heavy rain (where there is a flood risk).

In terms of presentation, the priority should be a visually appealing, bright poster that contains text in both English and vernacular language (Nyanja).

Learners were also keen to highlight their potential role in communicating weather advisory and early warning information in their communities. They noted the potential for social media, videos, theatre - recognising that they have the advantage of greater access to technology relative to the older population. They also expressed interest in developing a school club on weather and climate and receiving further training from ZMD.

All learners took up the option to leave their phone number to be added to the ZMD Kanyama WhatsApp group, in which forecasts and nowcasts are shared. A separate group was also created to share the illustrated icons that communicate advisories in the face of particular weather risks (https://drive.google.com/drive/folders/1dNBMGHn0RA7g7KQdlLJ29KtT_DuK2dxE?usp=drive_link), as learners were keen to use this when sharing forecasts and nowcasts.

Community hub daily activity report - 31st January 20205 morning

Gilda Monjane

Twenty three community members from Chinika Ward 11, together with the 4 Satellite Disaster Management Committee (SDMC) members (who play the role of community mobilisers),

participated in the community hub in Kanyama on 31st January in the morning. The group had a high proportion of women and included a variety of ages and a high proportion of persons with disabilities, including mobility, sight and hearing.

After an introduction to the project, a Zambia Meteorological Department forecaster presented an introduction to the weather and climate, how forecasts are generated and an overview of the meteorological product and services in Zambia and how to access them. Participants indicated that this was their first time to interact with a forecaster. They asked questions about the accuracy of weather information - particularly on why the seasonal forecast was not correct from October to December (in their perception), the underuse of cellphone communications channels to share information, and the lack of forecast availability in local languages. Questions were also asked about what to do to protect oneself in a thunderstorm from lightning. Only a minority of participants use weather forecasts, which they receive from the radio and television, with some stating that they simply observe the sky.

This was followed by a groupwork exercise where participants were given examples of nowcasts and impact-based forecasts issued by Zambia, Mozambique and South Africa during the kingsize testbed (since 1st October 2024) and asked to explain what they understood by them, and reflect on what is not clear and what could be improved.

Visual imagery and graphics were cited as useful, with particular interest expressed in maps that show the location of intended weather. The impact table from the impact-based forecast was not well understood, although the intuitive nature of the traffic light risk levels colouring was well appreciated and understood. However the inclusion of recommended actions and advisories in the impact-based forecast examples were liked. There were also suggestions on communicating the in local languages and sending through voice notes to better reach persons with disabilities who cannot see to read.

Figure 28: Groups discussed nowcasts issued during the King-Size testbed

Figure 29: Each group presented back a summary of their discussion (with simultaneous interpretation in English-Nyanja and sign language)

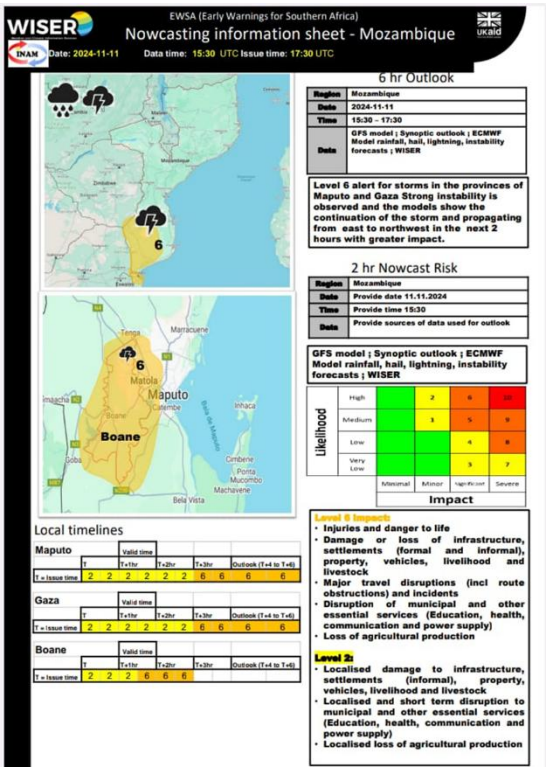


Figure 30: Example of nowcast discussed in community workshops

Figure 31: WISER EWSA team with some of the SDMCs and community members

Community hub daily activity report - 31st January 2025 afternoon

Miriam Murambadoro

Twenty four community members from Makeni Villa Ward 14, together with the 4 Satellite Disaster Management Committee (SDMC) members (who play the role of community mobilisers), participated in the community hub in Kanyama on 31st January in the afternoon. The group was majority women (20) and included a variety of ages and a high proportion of persons with disabilities, including mobility and hearing.

After a brief introduction to the project and an overview of the role of the Satellite Disaster Management Committee, a Zambia Meteorological Department forecaster presented an introduction to the weather and climate, how forecasts are generated and an overview of the meteorological product and services in Zambia and how to access them.

Republic of Zambia
Ministry of Green Economy and Environment
Zambia Meteorological Department

Kanyama nowcast

TIME ISSUED:	**10:00 CAT**
DATE PREPARED:	**21ST JANUARY, 2025**
VALIDITY PERIOD:	**14 - 16 HOURS**

There is a high likelihood of **heavy and continuous** rainfall affecting Kanyama compound during the forecast period.

There is very high risk of flooding on susceptible roads.

Be advised to **avoid crossing flooded points** and moving around in rainy weather conditions.

This nowcast is
Produced by the Zambia Meteorological Department,
Ministry of Green Economy and Environment

LEVEL 6 WARNING: HIGH LIKELIHOOD OF OCCURANCE WITH A SIGNIFICANT IMPACT

This was followed by a groupwork exercise where participants were given examples of nowcasts and impact-based forecasts issued by Zambia, Mozambique and South Africa during the kingsize testbed (since 1st October 2024) and asked to explain what they understood by them, and reflect on what is not clear and what could be improved.

The following comments were received on the specific formats.

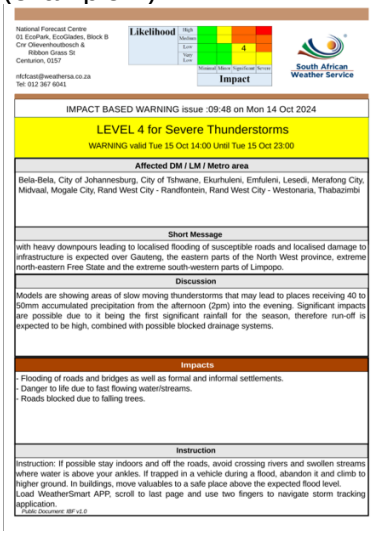
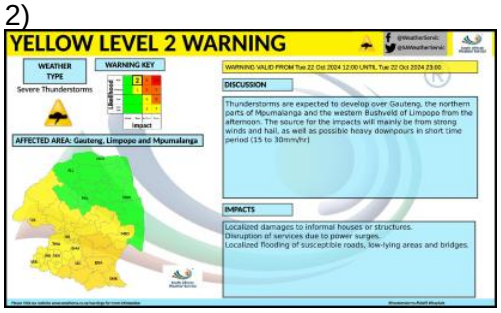
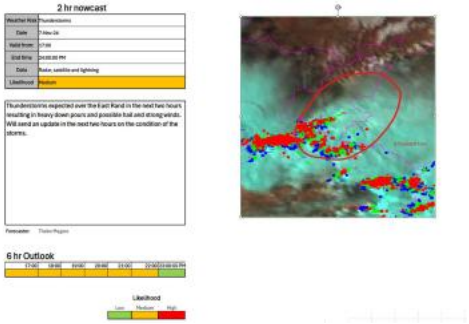
Zambia nowcast issued on 21st January 2025

The warning was clear but could be enhanced by having graphics showing the hazard type and a map showing the location of the target area. There was a suggestion to add more advisory information on what to do in response to the warning.

Mozambique nowcast issued on 21st November 2024

The warning was clear and the map and images were well appreciated. However, a section on the table with data sources was considered irrelevant for the general public as they did not understand it and could not relate to it. The warning alert level was 6 but the colour was yellow which didn't correspond with the IBF matrix or the similar alert issued by ZMD for level 6 which was orange.

South Africa impact-based forecast, warning and nowcast

Issued 14th October 2024 (example 1)	Issued 22nd October 2024 (example 2)	Issued 7th November 2024 (example 3)
		

The warning was considered clear and included the hazard type. Warning 1 was clear but did not include advisory information and did not include a map. Warning 2 was clear and included information on what to do but the warning level number is difficult to understand without explanation or a key. Example 3 (the nowcast) included a map image but without a key and scale it was difficult to interpret.

As well as maps and advisory information, other suggestions for improvement included availability in local languages and more images to assist those who cannot read. There was a request for more capacity building initiatives to improve understanding of weather and weather forecasts.

Community hub daily activity report - 1st February 2025

With inputs from Gilda Monjane, Itzel San Roman Pineda, Greg Dritschel, Joey Smith, Katharine Vincent and others

The Satellite Disaster Management Committee (SDMC) members who are playing the role of community mobilisers guided tours of our three Kanyama wards: Chinika ward 11, Kanyama ward 13 and Makeni Villa ward 14. Rain started towards the end of each visit, and highlighted how relatively light rain can rapidly lead to overflowing drainage channels and flooded roads.

Chinika ward 11

Chinika ward 11 contains houses that were built in the 1960s. Whilst walking through the neighbourhood, the team visited the water tank and an adapted drainage system that was made by the community. Water is a problem - when it is flooded around the tap there is no access to clean water. The team spoke with a young boy in a wheelchair and people who live close to the tap that floods. They also spoke with the chairperson of a group for persons living with disabilities, and invited him to attend the community hub meeting on Monday.

In general, a lot of people do not understand the importance of good weather forecasting. In the past there have been issues with reliability, and conversations suggested that education on weather forecasting would get people more interested. One of the SDMC members observed that the WISER EWSA project is having a positive effect on people's trust in forecasts. Forecasts are available on radio twice daily, but most people consider that phones and social media are the best communication channels - although recognising the need for adaptations for disability inclusion (e.g. voice notes). The chairperson of the group for persons living with disabilities said that special phones are given for transmitting messages to their members by SMS.

Figure 32: Contrasting drainage styles in Chinika ward 11

Figure 33: Team members tour Chinika ward 11 with an SDMC member

Kanyama ward 13

The team met with several community members and discussed weather information.

The mother of a boy with a hearing disability who cannot speak explained how she receives weather information from various channels and communicates it to her son. She is a member of a whatsapp group which sends written test and voice notes - but requires her to be connected to the internet, which is not always possible. When her phone is off, she observes the clouds to determine the weather. Her main livelihood is selling fritters. She also pays 50c for 20 litres of water from the local taps. Her son used to attend a special education school but stopped as he would prefer to be in a larger school, but that is further from home and more expensive to get to. Cholera affects some parts of the ward (e.g. the Mutanda Bantu market area) but not where she lives.

A middle aged widow with six children explained how her husband passed away seven years ago. Her main livelihood is piece work, e.g. washing and cleaning for people, for which she typically earns K50 per day. Water poses challenges to them. They obtain drinking water from the local tap, but the tap was stolen yesterday (and the meter has previously been stolen), and these thefts are regular occurrences. When it rains, water enters her house, and when they have to walk through flooded streets, they are at risk of developing sores on their feet and between their toes. She receives weather information when there is electricity, but otherwise observes the clouds to determine weather.

The team also observed the WISER EWSA weather awareness raising posters at the Aunty Mercy lodge and the clinic.

Figure 34:The team meet community members in Kanyama ward 13

Figure 35: The team find the poster at Aunty Mercy lodge in Kanyama ward 13

Makeni Villa ward 14

The team spoke with residents from two households, including persons with disabilities. These residents explained that they had been receiving weather information from SDMCs and community observers, which they found valuable as it helps them plan their activities better—for instance, avoiding travel or trips to the shops when rain is forecasted, as it can lead to flooding and difficult conditions for travel.

Some of the streets we visited were flooded or partially flooded. Since the roads are unpaved, they become extremely muddy and difficult to walk on. Additionally, many roads are uneven and contain sharp stones, which become hidden under floodwaters, making them particularly

hazardous for people with mobility impairments. Despite these challenges, many residents still have to cross these flooded streets.

The team also observed open sewers that are often poorly maintained and clogged with waste materials. Some small drainage ditches have recently been dug through social work programmes in an attempt to channel rainwater off the roads and properties, but these channels are often incomplete, leading to stagnant water accumulation. During heavy rainfall, they appear insufficient to prevent flooding, contributing to health and sanitation risks.

The team also visited the health post, which provides primary care to the community, including vaccinations and maternal care. It is displaying one of the WISER EWSA weather awareness raising posters, alongside information about the M pox outbreak in Africa.

Weather forecasts, nowcasts, and early warnings help community members take action to prepare for impactful weather events. However, walking through this ward made it evident that addressing flooding problems requires proper drainage systems, to effectively mitigate flood risks.

Figure 36: SDMCs show how to navigate flooded streets in Makeni Villa ward 14

Community hub daily activity report - 2nd February 2025

Today the team took the Satellite Disaster Management Committee members (SDMCs) who are performing the role of community mobilisers out of Kanyama. The purpose was to undertake interviews for the forthcoming video and also to find out more about how they have individually been undertaking their roles as community mobilisers.

Overall, the utility of weather information is widely appreciated. When commencing their roles, most were not accessing weather information at all. However there are now many examples of how they are using the forecasts and nowcasts that they receive to alter daily activity patterns, commercial activities, and agricultural practices. As part of the expanded mobiliser role in the kingsize testbed, SDMCs have also been actively spreading weather messages around their communities. Many report positive reactions and increasing demand, with neighbours and relatives approaching them to know what the weather is going to be. Furthermore they also report increasing reliability of weather information from ZMD.

Interviews will be continuing throughout the rest of the intensive testbed.

Community hub daily activity report - 3rd February 2025

Thirty three community members from Kanyama Ward 13 (20 female and 13 male), together with the 10 Satellite Disaster Management Committee (SDMC) members (who play the role of community mobilisers) participated in the community hub in Kanyama on 3rd February in the morning. The group included a variety of ages and a high proportion of persons with disabilities, including mobility, sight and hearing. The group was joined by representatives of various intermediary and end user organisations (11 female and 6 male), including Zambia Association of Persons with Disabilities, Zambia Federation of the Deaf, Youth and Disability Inclusion and the Ward Development Committees for both Kanyama ward 13 and Makeni Villa ward 14.

After an introduction to the project, a Zambia Meteorological Department forecaster presented an introduction to the weather and climate, how forecasts are generated and an overview of the meteorological product and services in Zambia and how to access them. There was a subsequent discussion on the nature of data and observations that are used to generate forecasts, and reasons why forecasts can change over time (e.g. why the seasonal forecast evolves over the season).

This was followed by a groupwork exercise where participants were given examples of nowcasts and impact-based forecasts issued by Zambia, Mozambique and South Africa during the kingsize testbed (since 1st October 2024) and asked to explain what they understood by them, and reflect on what is not clear and what could be improved.

As in similar exercises earlier in the intensive testbed, groups were not always clear on the meaning of symbols (e.g. for rain and thunderstorms) or the colour coding in the impact table. The satellite image in the example from SAWS was not clear, and neither was the language of likelihood (in contrast to the impact tables). In the Mozambique example, groups felt there was too much information. Several participants highlighted that text and images should be larger, noting also the special accessibility needs of people with disabilities.

There was a lot of commonality between the groups in the ideal presentation. This was widely believed to be a combination of text and visuals. Text would be most useful in English and local languages, and visuals are most useful when there is a legend. One group also highlighted the wish to see a clearer separation of the time and amount of rainfall.

In the afternoon session, Miriam Murambadoro presented the experience of the Katlehong community observers, and Gilda Monjane presented the experience of the Boane community mobilisers. Before the end of the testbed, the SDMCs will prepare a reciprocal presentation on their experience to be shared with their counterparts in South Africa and Mozambique.

Figure 37: Groups discussed nowcasts issued during the King-Size testbed

Figure 38: Each group presented back a summary of their discussion (with simultaneous interpretation in English-Nyanja and sign language)

Figure 39: Gilda Monjane presented the experience of the Boane community mobilisers

Community hub daily activity report - 4th February 2025

Katharine Vincent

Fifteen of the Satellite Disaster Management Committee (SDMC) members (who play the role of community mobilisers) participated in a half day session in the community hub in Kanyama on 4th February.

Over the last few days, community sessions have been held for each of the three wards in Kanyama in which we work - Chinika Ward 11, Makeni Villa Ward 14 and Kanyama Ward 13. During these community sessions, groups debated and critiqued different nowcast and impact-based forecast formulations, coming up with a common list of positive attributes (see reports for 31st January and 3rd February). In today's session, the SDMCs consolidated the recommendations and developed their own fictional nowcasts that apply the presentational features that they found useful.

The fictional nowcasts all contained the key attributes that had been preferred. This includes a combination of text and visuals (typically a map, and use of symbols to indicate weather), use of the impact-based table (with a key), use of traffic light colour to indicate risk levels, prominent headers on the level of the warning, clear recommendations/advisories and use of two languages (English and Nyanja - although it was noted that there are 7 major language

groups in Zambia and ideally information should be available in all to ensure universal accessibility).

These nowcasts will be presented in tomorrow's main hub at ZMD.

Figure 40: One of the SDMC teams presents their fictional nowcast

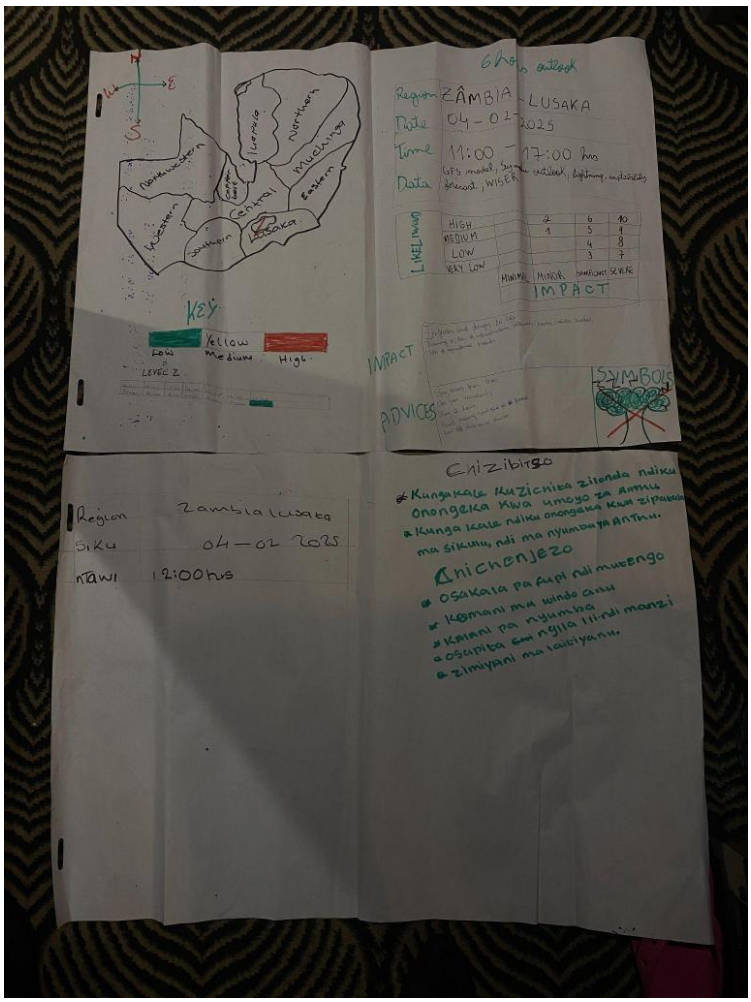


Figure 41: English and Nyanja presentations of a nowcast from one group

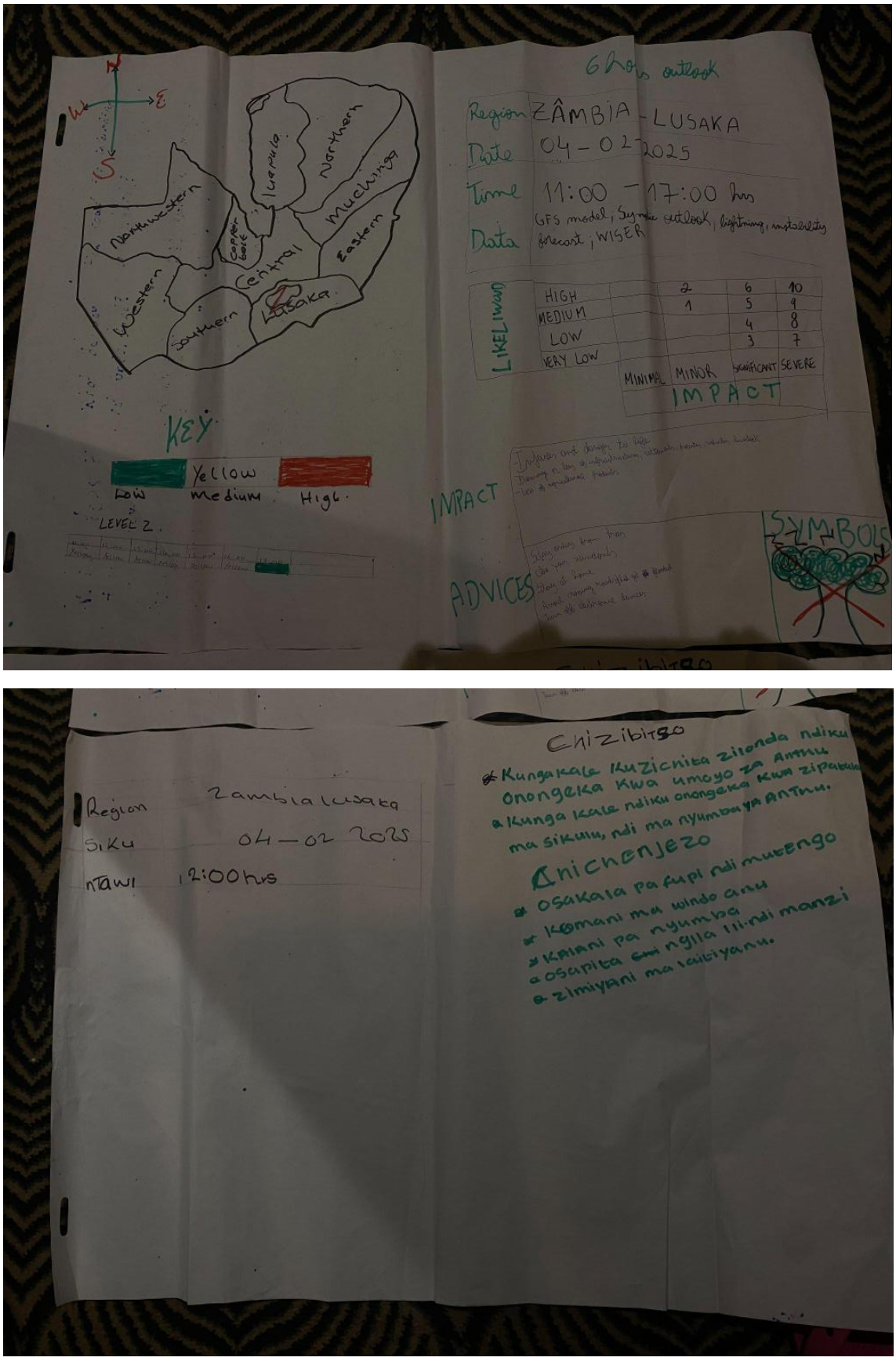
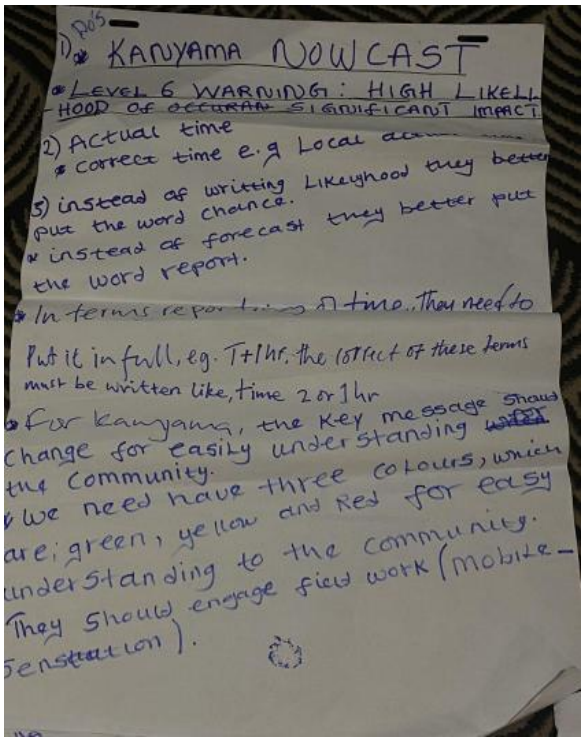


Figure 42: English and Nyanja nowcasts from another group



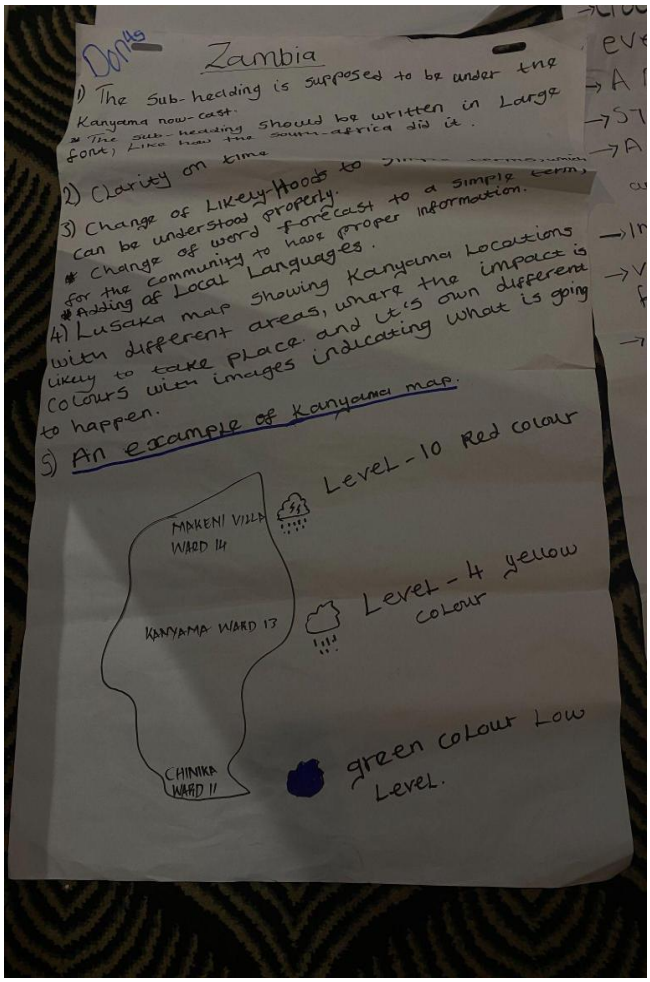


Figure 43: Recommendations on presentation from one group

Community hub daily activity report - 5th February 2025

Katharine Vincent

Sixteen of the Satellite Disaster Management Committee (SDMC) members (who play the role of community mobilisers) travelled into Lusaka to join the technical centre of the testbed on 5th February.

The morning saw the official opening ceremony of the testbed, with presentations from ZMD director Mr Edson Nkonde, Acting PS in the Ministry of Green Economy and Environment Mr Ranford Simumbwe, and WISER EWSA representatives Hellen Msemo (WMO) and John Marsham (University of Leeds). The opening was followed by tours of the nowcasting and synoptic forecasting testbed stations. This provided the SDMCs with the opportunity to gain insights into the process of analysing data to inform product development, to understand the challenges of predicting rainfall at high resolution, and to appreciate the process that is followed to generate the information that is then received on their cellphones.

In the afternoon, the SDMC members presented their example nowcasts and lists of recommendations that had been developed in the session on 4th February. This prompted a varied discussion. Comments included commendation for closing the feedback loop in the co-production process and for the level of understanding of weather and early warnings shown by the SDMCs. Questions included:

- clarification on the use of CAP messaging in Zambia (which forecasters confirmed is applied),
- the nature of a key for the impact table,
- the scope of training received by SDMCs (which includes sessions from forecasters during the intensive testbed and other sessions throughout the kingsize and intensive testbed, and training by DMMU on their roles as SDMCs),
- whether there would be scope in Kanyama for police to disseminate messages through loudspeakers on vehicles (this was refuted on the grounds that the police in Kanyama only have one vehicle which is already overstretched),
- how and to whom nowcasts are further disseminated (through word of mouth, whatsapp and meetings in churches)

The final session of the day was a refresher on safeguarding and culminated in collective agreement on principles to guide the work of SDMCs and standards for behaviour whilst in role.

Community hub daily activity report - 6th February 2025

Katharine Vincent

Sixteen of the Satellite Disaster Management Committee (SDMC) members (who play the role of community mobilisers) travelled into Lusaka to join the technical centre of the testbed on 6th February.

In the morning the group undertook a social network mapping exercise to try and track the onward reach of forecasts and nowcasts that are received by the SDMCs from ZMD. Each

SDMC forwards the messages directly to between 10 and 1408 people, taking into account face to face and electronic transmission. Primary communication occurs with family members, tenants, work colleagues, churches and their congregations, schools, persons with disability and whatsapp groups (based on politics, sport, community and friends). Efforts were also made to identify the next stage of transmission, whereby these recipients further disseminate the information among their own networks.

The group then compiled a powerpoint presentation which outlines how they conduct their work, and some of the activities that they have undertaken during the kingsize testbed. Counterparts in Boane and Katlehong had developed similar such presentations, which were facilitated by the relevant community engagement leads in each country, who then shared them during the intensive testbed. The reciprocal presentation from the Kanyama SDMCs will be shared in South Africa and Mozambique in the coming weeks as part of regional exchange and learning.

In the afternoon, after listening to presentations on different aspects of the project's work - including evaluation of intensive nowcasting events during the king size testbed using their feedback, the group commenced reflecting on the testbed (kingsize and intensive) to date, and future plans. They also participated in individual interviews to elaborate their motivations for undertaking the voluntary roles of community mobilisation and SDMCs, and to give personal examples of how they have used weather information to date.

Figure 44: SDMCs participate in the technical testbed hub in Lusaka

Community hub daily activity report - 7th February 2025

Katharine Vincent

Sixteen of the Satellite Disaster Management Committee (SDMC) members (who play the role of community mobilisers) travelled into Lusaka to join the technical centre of the testbed on 7th February.

In the morning the group undertook formal evaluations of the intensive testbed. They then had a reflection and learning session to take stock of activities in the kingsize testbed (including the intensive testbed). To date in the kingsize testbed, SDMCs have been meeting regularly

(fortnightly) and visiting individuals in their communities to identify the persons with disabilities and their particular weather information needs. Based on a suggestion from one of these meetings, they have been visiting churches in Kanyama to share weather information. They have also been verifying the occurrence of rainfall on a daily basis through a Google form. Feedback received to date is that the Kanyama community members are appreciating receiving weather information, with some people actively seeking out the SDMCs for updates, demonstrating increased demand.

For the remainder of the kingsize testbed, they will continue this approach with some minor modifications. The first step will be to try and increase the number of people who receive weather information directly from ZMD. This will be done by encouraging people with smartphones to join the ZMD WISER EWSA Kanyama SDMC Whatsapp group, on which forecasts and nowcasts are disseminated, and collecting phone numbers of those without smartphones to provide to ZMD so they can be manually added to the SMS list (which currently is only available for self subscription by people with smartphones). This will free up the time of SDMCs to share information by word of mouth with the most marginalised members of the community who cannot follow either of these options (e.g. a blind person without a smartphone - as voice notes are only available on smartphones). ZMD has committed to send text only versions of the nowcasts (as well as the forecasts) to the SMS list as well as the full version on Whatsapp.

For the remainder of the rainy season, SDMCs will endeavour to provide daily feedback on the Google form - whether or not there has been rain. This is in response to a request from nowcast evaluators to verify dry conditions as well as wet. They will also continue - and ramp up - their engagement with key community leaders (including councillors, Ward Development Committees, and chairpersons). Feedback will be sought from community members on forecasts and nowcasts, taking into account the need to do so in line with sound ethical and safeguarding practices.

Figure 45: SDMCs reflect on the kingsize testbed thus far, and plan for the remaining months

Annex 2. Weekly WP4 reports of T2-Z activities

Intensive Testbed Weekly Summary: January 27th–February 3rd, 2025

Dear colleagues,

We officially launched the **T2-Z Intensive Testbed** on **January 30th**, which will run until **February 7th, 2025**. Prior to the start, a **three-day training programme** (January 27–29) was led by WP3, with **Cynthia Nemutudi from SAWS**, where forecasters from ZMD and INAM received training on **nowcasting products, Impact Based forecasting, CAP messages and the standard operations procedures (SOPs) for nowcasting and synoptic forecasting in preparation for T2-Z.**

For T2-Z, **forecasters from ZMD, INAM, and SAWS** were assigned to teams focusing on **synoptic forecasting, nowcasting, evaluation, and community engagement In Kanyama**. The **ZMD nowcasting team operates 24 hours**, with three shifts:

- **08:00–17:00 CAT** (main shift)
- **16:00–01:00 CAT**
- **00:00–09:00 CAT**

During T2-Z, ZMD will be issuing nowcasts for **Kanyama every 2 hours**, and **community observers (SMDCs)** will provide structured feedback via **Google Forms, WhatsApp messages, photos, and videos** three times a day.

INAM will be issuing **daily weather updates** to Boane's community observers and will provide **nowcasts when an Intensive Nowcasting Event (INE) occurs** in Mozambique. When necessary, these nowcasts will be distributed nationally. Additionally, **INAM will be sending daily rain gauge data** to facilitate the evaluation and verification of nowcasts.

During the first week of T2-Z, SAWS forecasters were unable to join due to **a network disruption at their offices**. However, starting from today, **Monday, February 3rd**, forecasters from SAWS joined online and resumed issuing nowcasts for Katlehong.

Kick-off Meeting Highlights

The Testbed was officially launched with a **speech by Mr Edson Nkonde, PR Zambia Meteorological Department,** followed by opening remarks from:

- **Doug Parker** (WISER-EWSA PI, University of Leeds)
- **Hellen Msemo** (WMO representative)
- **Nico Kroese** (SAWS, WISER-EWSA representative)

During the kick-off meeting, it was emphasized that **international collaboration** is a key driver in advancing **scientific research and forecasting applications**. Additionally, the **adoption of new technologies** is essential for improving **forecasts and warnings in Southern Africa**. Finally, **community engagement through co-production** plays a crucial role in enhancing adaptation to extreme weather events, ensuring that **weather information, including nowcasts, is valuable and actionable for end-users**.

Key Achievements – Week 1 of the Intensive Testbed

- **ZMD introduced voice notes** in **English, Nyanja, and other local languages**, to disseminate nowcasts, improving the accessibility of weather information for a broader audience.
- **Nowcasting teams** are utilizing a diverse range of forecasting products, including **CRR, RDT, RoA, and Lightning data**, to enhance the accuracy of nowcasts.
- **Forecasters from ZMD and INAM** are actively engaged in the **evaluation of nowcasts**, contributing to improving forecast accuracy.
- **The evaluation team is conducting:**
    - **Cross-validation of retrieval products** against **rain gauge data** to assess accuracy.
    - **Assessment of forward prediction models** (CRR, RoA) to understand **their performance and limitations** in capturing nowcasted events.
    - **Analysis of AI-driven nowcasting models**, including **Jawairaa's CNN-based nowcast of convective cores**, to evaluate their effectiveness in predicting convective rainfall development.
- **Evaluation of the King-size Testbed** (from October 1st, 2024 to January 27th,2025) **is underway**, to assess the effectiveness of nowcasting operations during this period.

Looking Ahead

- **Continued daily nowcasting operations** and evaluation of forecast accuracy.
- **Assessing the accessibility of nowcasts** – ensuring that **maps, warnings, and advisories are clear and understandable** to all users.
- **Refining the nowcasting template** based on feedback from **community observers** in response to nowcasts issued by **SAWS, INAM, and ZMD**.
- **Addressing time constraints** – the current nowcast template is time-consuming, leading to lost opportunities for monitoring real-time weather developments.
    - Possible improvements include **simplifying the process**, incorporating **colour-coded rainfall intensity**, and ensuring long-term **sustainability of nowcasting operations**.
- **Expanding capacity-building for SDMCs** to support the dissemination of nowcasting information more effectively.
- **Integrating AI prediction models** for improved nowcasting through **intercomparison of new products** developed by the team's scientists.
- **Enhancing training opportunities** for forecasters on new nowcasting models:
    - **Facilitating collaboration** between model developers and forecasters.
    - **Sharing instructional materials** through different platforms.
    - **Inviting PhD students to provide training sessions**.
    - **Incorporating training materials into platforms like Moodle** for long-term learning.

Thank you for your collaboration in ensuring the **smooth kick-off** of the T2-Z Intensive Testbed! We look forward to making further progress during this week.

Intensive Testbed Weekly Summary: February 3rd–7th, 2025

Dear colleagues,

This week in the T2-Z Intensive Testbed was marked by significant knowledge exchange and engagement, including the participation of colleagues from Malawi and Zimbabwe, who actively contributed to the nowcasting and evaluation teams. Key events included the Open Day, Cross-Project Day, and a final session featuring PhD students and researchers from Zambia and the UK, who presented state-of-the-art research on AI-driven nowcasting.

During the week we had very productive discussions on nowcasting evaluation, verification of new products, debates impact-based forecasting and making stronger synergies between researchers, forecasters and community members. A major focus of the discussions this week was on sustainability beyond the project's completion, highlighting the need for continued leadership from national meteorological services in Southern Africa.

Open Day Highlights

The Open Day was an opportunity for government institutions in Zambia, partner agencies, and community observers to experience the testbed in action. Key moments included:

- **Welcoming remarks** by ZMD PR, the Ministry of Green Economy and Environment, WMO, and WISER-EWSA.
- **WMO's emphasis** on the global mandate for Early Warnings for All (EWSA) by 2027 and how WISER-EWSA is uniquely bridging social science with meteorology to improve early warning systems.
- **WISER-EWSA overview**, discussing the importance of nowcasting for high-impact weather events and its potential for long-term forecasting improvements in the region.
- **'Guided-Tour of the testbed'** by PhD students from Leeds led a guided tour of the testbed for community observers and intermediary organizations, offering a behind-the-scenes look at its operations and demonstrating how scientific advancements are integrated into real-world forecasting and decision-making.

Cross-project Day Highlights

During our **Cross-Project Day**, we heard important updates from various work packages, highlighting key advancements and reflections. WP4 presented preliminary results of the **evaluation of the King-Size Testbed**, assessing progress and identifying areas for refinement. WP1 provided **insights on community engagement**, sharing lessons learned from working with local stakeholders. A **socio-economic analysis** explored the broader impacts of nowcasting, emphasizing its role in reducing economic and social vulnerabilities. Finally, we had a presentation on **WISER and EW4ALL** (Nico Kroese and WMO's Daniela Cuellar), discussing ongoing efforts to strengthen early warning systems and their alignment with global resilience initiatives.

Key Developments

Nowcasting & Evaluation

- **Forecasters from ZMD and INAM** emphasized the need for **developing country-specific impact tables** to replace reliance on SAWS frameworks. These must be tailored to local hazards and user needs.

- Discussions focused on **evaluation strategies**, particularly the need for **systematic verification of nowcasting performance**, including analysis of **hits, missed events, and false alarms.**
- Community observers provided **feedback on nowcasting formats, warning communication, and operational procedures**, helping refine forecasting products.

Community Engagement & User Feedback

- **Community observers (SDMCs),** actively spreading nowcasting information and integrating disaster risk reduction practices within their communities.
- **Feedback on nowcasting templates included:**
  - Need for **greater consistency in warning levels** (color-coded rather than numbered).
  - **Clearer maps and impact symbols** to assist community mobilizers in conveying warnings.
  - **Use of local languages (Nyanja & English)** for better accessibility.
  - **Voice notes in multiple languages** for enhanced engagement.
  - **Expanded SMS-based alerts** for users without smartphones.

Research & Innovation

- PhD students and researchers presented their research on **AI-driven nowcasting.**
- WP2 gathered feedback on forecasting tools, warning communication, and operating procedures, contributing to refinements in the **King-size Testbed** and broader forecasting strategies.

Looking Ahead

- The feedback gathered during T2-Z will be instrumental in refining the **King-Size Testbed**. Insights from forecasters, community observers, and researchers will be applied to **enhance Standard Operating Procedures (SOPs), refine nowcasting templates, and improve communication guidelines**. These improvements aim to streamline processes, ensure consistency across participating meteorological services, and strengthen the overall effectiveness of nowcasting operations for the future.
- **Expansion of community engagement**, adding more participants to WhatsApp groups and ZMD's SMS list for wider dissemination of nowcasting information. **Daily reporting on the Google Form** will continue, ensuring consistent data collection from community observers.
- **ZMD will maintain regular updates in multiple languages and formats**, strengthening trust in meteorological services.
- **ZMD's forecasters will continue engaging communities**, explaining meteorological products to improve understanding of weather alerts and advisories.

We will **resume our daily briefings on Monday, February 17th**. We encourage forecasters from **ZMD, INAM, and SAWS** to continue filling in the **Outlook Forecast Table daily**, as this remains crucial for supporting the evaluation of nowcasting operations.

Thank you for your continued collaboration and contributions to the T2-Z Intensive Testbed! Your dedication has created a valuable environment for learning, knowledge exchange, and international collaboration, making this intensive testbed a meaningful success.

Annex 3. Reports of community hub activities T2-M

Report of Community Hub - intensive testbed 26th March

Marita Monjane Saraiva

On 26th March, Gilda, Marita and Adriaan did interviews at INAM with Dr Mussa and also went to the Ministry of Transports and Communications to interview Dr Lameque. The interviews are being done within the scope of the Potential benefits of EWSA for Mozambique and the value chain of weather information.

We still need to interview other sectors to have more information and get insights.

Report of Community Hub - intensive testbed 25th March

Marita Monjane Saraiva

On 25th March 2025, the community hub took place at the administration of Boane venue. The meeting started at 9AM. We had a total of 69 (F/M) community mobilisers from the 4 main communities (Boane, Namaacha and Matutuine), 8 persons for Media coverage with TV Surdo and Tv Dinamica, Social communication center and bureau of public information. The Project team members who attended are Doug, Gilda, Alex, Peggy, Puseletso, Adriaan, Marita, Gonçalves Mabui and Delcia.

First of all, we divided them into groups for the exercises that were going to be done. The main topics of the agenda were: free and prior consent for being participating, safeguard instructions, Not to take risks life during activities in the community; brief recap of king size testbed (importance of the Feedback in the communities to validate the weather information provided by INAM), the role of community mobilisers during testbed (in case of extreme weather events and even without), the importance of raising awareness of protecting the vulnerable groups (people with disabilities, old people, women and children), explain about nowcast format and clarification of the impact table matrix). We also asked the different groups, what formats of weather information they prefer and what they don't prefer.

The last presentation of the morning activities was from the INAM meteorologists, where they explained the different channels of spreading weather information, the meaning of some weather symbols, the different types of forecast (24 hours, 48 hours, one week), and the other services that INAM offers. After the last presentation they filled out the evaluation form.

The community mobilizers at the end of the session shared the benefits of receiving weather forecasts in their daily activities. Luís, who is a bricklayer/ constructor said that when knows that it is going to rain, he doesn't prepare the concrete, otherwise it might get spoiled. Mr Lino, who is a farmer, also shared that when it´s going to be a windy day, he doesn't spray the plants to avoid waste of the product.

Another community member who is a farmer shared that he doesn't leave the curtain open when it's a windy day because the chickens might suffer.

In the afternoon, the team members went to Pequenos Libombos dam and had a short meeting with the director, Mr. Jaime Timba, who is the director of the management division of Umbeluzi Water basin. Mr Jaime dam explained the functionality of the dam, the discharge mechanism, what is the dam capacity, what was the maximum level it has reached. In the end,

he asked to collaborate with the community mobilizer to spread the information of the increasing level of the discharges, because sometimes they don´t have an effective channel to communicate with the community. He also added that sometimes they increase the level of discharges in a short period of time due to weather conditions or to the quantity of water coming from South Africa. He also shared that sometimes the water level rises so fast that they don't even have time to wait for the approval of the authorities, so to prevent the dam from collapsing, they open the floodgates.

After the visit to the dam, all participants had lunch in Umpala with the community. It was a total of 110 persons (51M, 59F). We had the privilege to be with the 3 community leaders, 11 old persons and people with disabilities from the community.

We also had a cultural moment with Mr. Bata, who presented the weather song playing his guitar and sung the chorus with the community mobilizers.

Finally, the community leaders said that they were happy to receive the visit of the project members, he shared that now that they receive weather information daily, they have less impact of extreme events in terms of loss of life and loss of properties; additionally he said that they can now better plan their daily activities according to the weather.

Figure 46: Activities in the community hub during T2-M

Evaluation day of the Kingsize testbed 2M - 27th March
Marita Monjane Saraiva

On 27th March, 17 (9 M; 8F) Community mobilisers joined the evaluation day session at Kaya Kwanga venue.

The first presentation of the day was “Preliminary evaluation of the benefit potential for Mozambique of EWSA based on nowcasting and EWS and its associated resourcing options” - Adriaan.

After that, we had presentations of the case studies- Peggy, Pedro and Puseletso.

Presentation of the FASTA App, its benefits and there was an interaction with the community where they shared the benefit of receiving weather information in their daily activities.

At 12AM there was the daily briefing.

In the afternoon, we had the presentation of WP1 reflections for the king-size testbed; contributions from the community:

- We feel very happy to be part of this project, especially because it changed our approach within the community when an extreme event was approaching;
- Now we have an opportunity to speak in the community meetings, and take those opportunities to raise awareness of the importance of weather information;
- We are very happy with the forecasters who came to the field and explained to us the technical terms and other phenomena that we didn't know much about (E.g. local rains vs widespread rains)

The last presentation was the final review meeting.

The room was divided in 3 groups (A, B and C) where all the participants had the opportunity to share in what ways the King-size testbed impacted their work.

Group A shared the forecast tools they started using after the testbed and its advantages; and also shared that they feel encouraged to keep on using those tools after the testbed because they feel the compromise of having an accurate forecast to share with the community.

Group B shared that before the beginning of the project few community members knew about INAM and its services. The meteorologists shared that going to the field changed the way they produce forecasts because they had feedback that sometimes the information wasn´t understood. Being part of the project made them realize that they must also produce forecasts for disadvantaged people (voice messages, sign languages, flags, text messages). The meteorologists also reinforced their willingness to do more community engagement in the future, in order to fill the gap between met services and final users; communicating weather information in local languages to ensure clear understanding of the weather information.

Group C presented the nowcasting products that they are currently using and what they want from the researchers in future.

The last presentation of the day was from INAM Director (Dr. Adérito), where he showed gratitude for the projects because it increased the capacity building of the forecasters, and

consequently the INAM´s products and services also improved. He hopes that all the exchanged experience and training between Mozambique, Zambia and South Africa keeps improving the weather information to the final users.

Figure 47: Closing day in Maputo's TOC

Annex 4. Weekly WP4 reports of T2-M activities

T2-M Intensive Testbed Summary: 22–27 March 2025

Dear colleagues,

Apologies for the delay in sharing this summary of activities held in Maputo during T2-M, which took place from the 22nd to 27th of March. This was the final in-person testbed of the WISER-EWSA project, bringing together 25 participants from Mozambique (INAM), South Africa (SAWS), Zambia (ZMD), the UK, and Finland for six days of intensive nowcasting operations and community engagement. We resumed King-Size Testbed activities this past Monday, March 31st, and I will share a summary of the first week of resumed operations on Monday April 7th.

T2-M was preceded by a training led by Cynthia Nemutudi (SAWS), which covered nowcasting products, Impact-Based Forecasting (using Tropical Cyclone Jude as a case example), CAP messages, Standard Operating Procedures (SOPs), new products and the UKCEH portal's map-drawing tool. INAM engaged five forecasters new to the WISER-EWSA project in the training, who gained practical experience throughout the testbed—expanding INAM's internal nowcasting capacity.

During the testbed, forecasters were organised into synoptic, nowcasting, and evaluation teams, each of 2–3 people. Experienced forecasters from SAWS and ZMD in Maputo

supported these teams. Unlike T2-Z, operations in T2-M focused on a single shift (08:00–17:00 CAT), with a second shift (Nowcasting II: 16:00–00:00 CAT) activated only in the case of an identified Intensive Nowcasting Event (INE).

Ahead of T2-M, WP1 trained new community observers in Matutuine and Namaacha, expanding the project's focal communities beyond Boane. During the testbed, INAM forecasters issued nowcasts every two hours from 09:00 onwards relevant to the three locations. Community observers provided structured feedback three times a day via Google Forms and WhatsApp messages.

Daily all-testbed and review meetings were held, where forecasters from SAWS and ZMD joined INAM forecasters remotely. These sessions included presentations from synoptic teams (who provided the forecast for the next two days), nowcasting teams (who shared the most recent nowcasts), and evaluation teams (who reviewed and analysed the nowcasts previously issued). During the review meetings, the **synoptic team made decisions about activating the Nowcasting II team based on forecast conditions.** This occurred once, on Tuesday, March 25th, when a cold front approaching southern Mozambique raised the potential for strong winds and heavy rainfall.

Key Events:

- **March 22:** Kick-off meeting in Maputo with an introduction to WISER-EWSA by Nico Kroese and a testbed briefing by Alex Roberts.
- **March 24:** World Meteorological Day celebration hosted by INAM. The leadership team in Maputo presented WISER-EWSA to the media and stakeholders.
- **March 25:** Community engagement day. Gilda, Puseletso, Adriaan, Alex, Doug, and INAM forecasters Delcia and Goncalves visited Boane. The event gathered 69 community mobilisers from Boane, Namaacha, and Matutuine, along with eight people from the media. In this visit, the team gave an overview of the WISER-EWSA project and the role of community observers in disseminating weather information. INAM forecasters presented their different products, the meaning of weather icons and the communication channels used to disseminate this information. Community members gave feedback on preferences for information formats, accessibility, and understanding of nowcasts and impact warnings.

  The team also visited Pequenos Libombos Dam to meet the director, Mr. Jaime Timba, who shared concerns about communicating dam discharge information quickly and efficiently with nearby communities.

  Afterwards, the team had lunch in Umpala with 110 community members, including community leaders and people with disabilities. In this lunch, community leaders expressed that having access to daily weather information has improved preparedness and reduced the impact of extreme weather in their communities.

  Correction: Attendees to community engagement day included: Gilda and Marita Monjane, Peggy Thole, Puseletso, Adriaan, Alex Roberts, Doug Parker, and INAM forecasters Delcia and Goncalves.

  The team also visited Pequenos Libombos Dam to meet the director, Mr. Jaime Timba, who shared concerns about communicating dam discharge information quickly and efficiently with nearby communities. Mr Timba expressed interest in collaborating with the WISER-EWSA project to engage community mobilisers who could help disseminate timely warnings to at-risk communities—particularly on days when emergency discharges are required.

- **March 27:** Reflection Day. On this day, community observers joined the T2-M hub to take part in the technical activities. In this day we had the following presentations:
    - Adriaan Perrels presented a cost-benefit analysis for Mozambique showing that nowcasting benefits outweigh costs.
    - Three forecaster teams presented their selected case studies, which will be further developed and submitted for review in April. Notably, some teams include forecasters from different countries—such as South Africa and Mozambique—working together, with mentorship provided by UK-based researchers, highlighting the strong spirit of international collaboration fostered through the project.
    - WP1 community engagement leads and community mobilisers, gave a presentation highlighting how receiving weather information has improved preparedness amid high-impact weather events and that they have gained confidence in relaying weather information. Community observers indicated that they have increased their knowledge and understanding of forecast language and symbols, and really appreciate the direct engagement with INAM forecasters when they visit their communities.
    - The final review meeting included breakout discussions reflecting on the testbed's impact, highlighting continued use of new tools, a renewed commitment to inclusive forecasting, and requests for clearer guidance from researchers on nowcasting products.

Next Steps:

- Case Studies: Forecasters must complete and evaluate their assigned case studies by 30 April. Mentors are encouraged to schedule support sessions.
- Analysis of achievements, challenges and lessons learned to implement during the remainder of the King-Size testbed and include in reporting and papers in progress.

Thank you to all partners, forecasters, and community mobilisers and observers who contributed to the success of T2-M. T2-M demonstrated the power of collaboration - bringing together meteorologists, researchers, and communities to co-create warnings that can save lives and livelihoods. As we move forward, these shared experiences and lessons will continue strengthening climate resilience across Southern Africa.

Best regards,
Itzel San Roman Pineda
FASTA Development Manager
National Centre for Atmospheric Science, University of Leeds

Annex 5. Blogs:

Intensive weather forecast testbed kicks off in Zambia, South Africa and Mozambique: https://ml-env-for.leeds.ac.uk/news/wiserewsa-testbed2/

Improving early warnings of thunderstorms: https://www.leeds.ac.uk/main-index/news/article/5732/improving-early-warnings-of-thunderstorms

Thoughts shared by the Permanent Secretary: https://ml-env-for.leeds.ac.uk/news/thoughts-shared-by-the-permanent-secretary/

WISER-EWSA Extended Testbed: https://ml-env-for.leeds.ac.uk/wiser-ewsa-extended-testbed/

Annex 4. List of acronyms

AI	Artificial Intelligence
CAT	Central Africa Time
DRR	Disaster Risk Reduction
EWS	Early Warning System
EWSA	Early Warnings for Southern Africa
FASTA	Forecasting African Storms Application
INAM	Instituto Nacional de Meteorologia, Mozambique
INE	Intensive Nowcasting Event
NCAS	UK National Centre for Atmospheric Science
NMHS	National Meteorological and Hydrological Service
NWCSAF	Nowcasting Satellite Application Facility
NWP	Numerical Weather Prediction
RSMC	Regional Specialised Meteorological Centre
SAWS	South African Weather Service
SDMC	Satellite Disaster Management Committee
SOP	Standard Operating Procedure
T2-M	Testbed Mozambique
T2-Z	Testbed Zambia and Zuid-Afrika
TOC	Testbed Operational Centre
WISER	Weather and Climate Information Services programme
WMO	World Meteorological Organisation
ZAF	Zambia Air Force
ZMD	Zambia Meteorological Department