Report on the technical kick-off week

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Authors & Reviewers	
Author	Mónica Estébanez Camarena (WI), Theano Mamouka (Neuralio), Lukas Ivica (MMIS), Ignacio Saldivia Gonzatti (WU), Sophie Van Der Host (CAS), Guus Wiersma (TUD),

	Sylvester Ayambila (UDS), Frank Annor (TAHMO)
Reviewer(s)	Spyros Paparrizos (WU)

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Executive summary

Climate change threatens food and economic safety in sub-Saharan Africa region that depends heavily on (rainfed) agriculture. Facing this threat, the Safeguarding African Foodsheds and Ecosystems for All Actors Across Local, Regional, and International Levels to Manage Migration (SAFE4ALL) project is working to enhance climate resilience and improve decision-making support for local and regional actors. SAFE4ALL is a collaborative effort among multiple African and European partners. SAFE4ALL is working in three African countries as study cases, representative of different African regions – Ghana, in West Africa, Kenya, in East Africa, and Zimbabwe, in Southern Africa. A key component of this initiative is capacity building for local ownership and sustainability of the nine climate services and tools being developed under the project. These tools aim to support data-informed decision-making from farm to policy level, strengthening responses to climate-induced food insecurity and migration pressures.

To kick-start these efforts, two technical days were held in Accra, Ghana, following the project's Year 2 General Assembly in March 2025. These two days of interactive theoretical and practical sessions served as the foundation for the SAFE4ALL learning program. The agenda combined joint plenary sessions—such as tool stock-taking, end-user needs assessments or co-creation of roadmaps for the three study cases—with more focused, technical workshops in breakout rooms. Topics ranged from AI-based weather nowcasting and data assimilation to user-centered service design and indigenous knowledge integration.

The event was a successful launch of the learning and co-creation journey, bringing together national meteorological agencies, agricultural extension officers, researchers and the private sector. It fostered meaningful discussions, identified concrete next steps, and marked the beginning of SAFE4ALL’s efforts to ensure long-term relevance, sustainability, and local embedding of its climate services. These days laid the groundwork for ongoing capacity building and the gradual transfer of tools and knowledge to stakeholders in Ghana, Kenya, and Zimbabwe.

1. Introduction

Africa's food systems are increasingly exposed to complex pressure from climate change, environmental degradation and migration dynamics. These interacting drivers are reshaping agricultural livelihoods, food security, and rural-urban socio-economic transitions across the continent. Although Africa is projected to play a pivotal role in global food production over the coming decades, food systems remain highly vulnerable to shocks, underscoring the need for resilient and adaptive policy frameworks (SAFE4ALL Grant Agreement, 2024).

The Safeguarding African Foodsheds and Ecosystems for All Actors Across Local, Regional, and International Levels to Manage Migration (SAFE4ALL) initiative aims to address these interconnected issues by fostering climate resilience and improving decision-making support for local and regional actors. By co-creating user-centred climate tools and services, and prioritizing local needs, SAFE4ALL seeks to enable better adaptation strategies, mitigate migration pressures, and ultimately enhance food security across selected regions in Ghana, Kenya, and Zimbabwe (Figure 1).

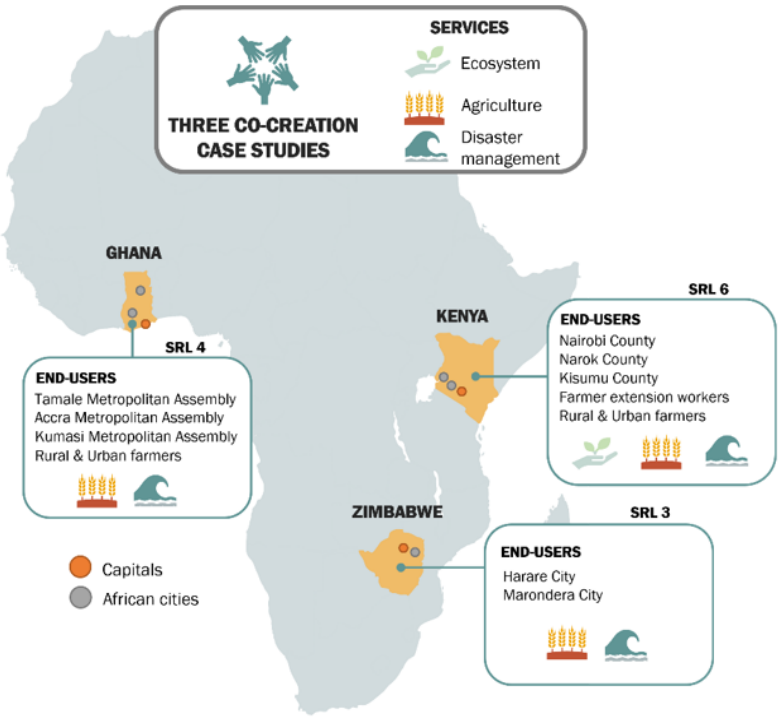

Figure 1: Map of the three SAFE4ALL co-creation study cases.

The project is divided in seven thematic work packages (WP), with capacity building and local sustainability of the SAFE4ALL climate tools being central. Particularly, WP5 is titled "**Local embedding, community building, upscaling and cross-country learning, twinning**". It is led by Climate Adaptation Services (CAS) and has the objective to *ensure that the SAFEALL outcomes are used and integrated into their future work*. Within this WP, task 5.1 is to *develop and implement an open learning program for practitioners in the co-creation cases.* At the same time, WP4 is on "**Business and implementation models"**, with the objective to *develop institutional and financially sustainable business models with local ownership of climate information services.* Task 4.4 tackles *institutional arrangements, practical implementation and local ownership*.

Bridging tasks 5.1 and 4.4, a technical kick-off week was planned to start the SAFE4ALL learning program. Although the initial plan was to have a technical week, it was decided to shorten its length to two days, for maximum attendance following the GA. This was made possible by holding parallel sessions with different audiences, e.g. agricultural extension officers and national meteorological agencies. The SAFE4ALL Technical Days were held following the project's Year 2 General Assembly (GA) in Accra, Ghana.

The aim of this report is to document the SAFE4ALL technical days that took place in Accra, Ghana, in March 2025. It starts by setting the goal of the technical days, in Section 2. Section 3 constitutes the core of the report and describes the program and all the sessions and workshops that were delivered during these days. Finally, Section 4 concludes the report and presents the outlook, compiled from the next steps agreed upon during the technical days.

2. Goal of the technical days

The goal of the technical days was to **establish a collaborative platform for co-creation and engagement, focused on identifying priorities and co-developing needs-based climate information services (CIS)** to tackle issues related to migration, food security and climate resilience within the rural-urban continuum in sub-Saharan Africa.

3. The technical days

3.1 Program of the technical days

Table 1 contains the program of the technical days, that took place on the 27th and 28th of March 2025.

Table 1: Program of the technical days

<table>
<tr><th colspan="4">DAY 1</th></tr>
<tr><th>Start</th><th>End</th><th colspan="2">Activity</th></tr>
<tr><td>09:00</td><td>09:30</td><td colspan="2">Arrival and registration</td></tr>
<tr><td>09:30</td><td>10:00</td><td colspan="2">Introduction</td></tr>
<tr><td>10:00</td><td>10:30</td><td colspan="2">Objectives of the workshop</td></tr>
<tr><td>10:30</td><td>11:30</td><td colspan="2">Stock taking</td></tr>
<tr><td>11:30</td><td>12:00</td><td colspan="2">Needs Assessment – Ghana case</td></tr>
<tr><td>12:00</td><td>12:30</td><td colspan="2">Gaps</td></tr>
<tr><td>12:30</td><td>14:00</td><td colspan="2">Lunch break</td></tr>
<tr><td>14:00</td><td>14:30</td><td>Theory: user stories</td><td rowspan="2">Workshop 1:
AI basics and implication to satellite nowcasting</td></tr>
<tr><td>14:30</td><td>15:30</td><td>Developing user stories by participants</td></tr>
<tr><td>15:30</td><td>16:00</td><td>Feedback on user stories</td><td rowspan="3">Workshop 2:
Hands-on using Jupiter notebooks</td></tr>
<tr><td>16:00</td><td>17:00</td><td>Refining user stories by participants</td></tr>
<tr><td>17:00</td><td>17:30</td><td colspan="2">Summary & Close of day</td></tr>
</table>

<table>
<tr><th colspan="5">DAY 2</th></tr>
<tr><th>Start</th><th>End</th><th colspan="3">Activity</th></tr>
<tr><td>9:00</td><td>9:30</td><td colspan="3">Arrival and registration</td></tr>
<tr><td>9:30</td><td>10:00</td><td colspan="3">Recap of Day 1</td></tr>
<tr><td>10:00</td><td>10:30</td><td colspan="3">Theory: enablers</td></tr>
<tr><td>10:30</td><td>11:30</td><td>Market of inspiration</td><td rowspan="2">Workshop 3:
Data assimilation and benchmarking</td><td rowspan="2">Workshop 4:
Foodsheds</td></tr>
<tr><td>11:30</td><td>12:30</td><td>Market of inspiration matchmaking</td></tr>
<tr><td>12:30</td><td>13:30</td><td colspan="3">Lunch break</td></tr>
<tr><td>13:30</td><td>14:30</td><td>Groups (Outputs & Visualisation)</td><td rowspan="3">Workshop 5:
Chatbot</td><td rowspan="3">Workshop 6:
Drop App</td></tr>
<tr><td>14:30</td><td>15:30</td><td>Presentation</td></tr>
<tr><td>15:30</td><td>16:00</td><td>2-Way communication for validation of products & services</td></tr>
<tr><td>16:00</td><td>17:00</td><td colspan="3">Living Lab Concept & Operationalisation</td></tr>
<tr><td>17:00</td><td>18:00</td><td colspan="3">Closing</td></tr>
<tr><td>18:00</td><td></td><td colspan="3">Drinks and snacks</td></tr>
</table>

3.2 Plenary sessions

3.2.1 SAFE4ALL climate services: Tool stock taking and market of inspiration

Central to the SAFE4ALL projects, nine climate services and tools are being developed to enhance climate resilience in sub-Saharan Africa. These services and tools provide vital information for decision-making across all levels, from smallholder farmers to policy levels. These tools are:

- **Climate Atlas and critical threshold explorer (CAS):** The Climate Atlas provides interactive maps and tools for exploring climate impacts and critical thresholds, supporting climate adaptation planning. It includes regional portals with stories, demonstrators, and learning resources.

- **Hyperlocal Weather Intelligence Engine (Neuralio):** This tool employs Generative Adversarial Networks (GANs) for statistical downscaling of climate predictions, providing high-resolution sub-seasonal forecasts. It uses climate data and digital elevation models to enhance accuracy.

- **Multi-agent Reinforcement Learning Framework (Neuralio):** A virtual simulation tool that models interactions among various entities (agents), predicting environmental outcomes based on climate information, earth observation, and socioeconomic data. It supports strategic planning through a Reinforcement Learning module resulting in a clustering of suitable criteria that maximizes crop yield.

- **DROP App by (Wageningen University and Research, WU):** The DROP App offers location-specific climate services, integrating scientific weather forecasts with local knowledge. It provides tailored hydro-climate information for better agricultural decision-making.

- **Agro-weather and -Season Decision Support Chatbot (Weather Impact,**

WI): The Uliza-WI Chatbot delivers real-time weather and farming advice, accessible 24/7. It supports farmers with climate and agronomic resources, helping them make informed decisions to enhance crop yield.

- **e-WaterCycle – Platform for open and FAIR hydrological modeling (Delft University of Technology, TUD):** The e-WaterCycle platform offers open and FAIR (Findable, Accessible, Interoperable, Reusable) hydrological modeling, integrating various data sources and models for accurate hydrological predictions.

- **High Impact Thunderstorm Nowcast (MicroStep-MIS, MMIS):** The tool provides precise thunderstorm nowcasts with a lead time of 30 minutes to 1 hour by using EUMETSAT satellite data and AI algorithms. It enables issuing of severe weather warnings, to safeguard people and property from harm.

- **Hydro-climatic impacts on crops and hydrology (LPJmL; WU):** This tool models the impacts of hydro-climatic variables on crops and hydrology using the LPJmL framework, helping to predict agricultural outcomes and water resource management. It feeds to the development of the SAFE4ALL's Foodshed Information Service (FIS), which is a service under development and delivery by month 36.

- **TWIGA Platform (TAHMO):** The TWIGA platform integrates ground-based observations with satellite data to enhance weather and climate services, supporting better decision-making in agriculture and water management.

Figure 2: Hasse Goosen and Sophie Van Der Horst (CAS) stand at the Climate Atlas stand during the market of inspiration. Accra, Ghana, March 2025.

During a first a *stock taking*, the tool owners of all SAFE4ALL climate services and tools presented briefly their respective products. Each tool was then showcased at individual

stands during an *inspiration market*, allowing for in-depth interaction with stakeholders. This format created a valuable space for discussion on the usability, sustainability, and future ownership of the tools. External stakeholders—including agricultural extension officers, farmers, researchers, and technical staff from national meteorological agencies—had the opportunity to explore the tools, provide feedback, and consider how their application can support climate change adaptation at different levels. Lastly, participants were invited to stay engaged for further training and updates on new features and other developments in the tools.

3.2.2 Understanding the end-users: Needs assessment and gaps

In this session, representatives from the three SAFE4ALL countries – Ghana, Kenya and Zimbabwe – presented the preliminary results of a needs assessment survey carried out during the first year of the SAFE4ALL project. This assessment was performed in completion of SAFE4ALL deliverable *D1.3 - Report on needs assessment for adaptation to climate change in the cocreation case studies*, led by TUD. The presentations shared the analyzed outcomes of a questionnaire administered in 2024 to smallholder farmers in the three countries, with the intention to understand their needs and preferences related to weather and climate information services.

The goal of this session was to share information with stakeholders, in order to better understand the end-users of the climate services we are developing, and their needs and preferences. In this way, the consortium has the needed understanding to develop relevant and effective climate services.

Figure 3: Sylvester Ayambila (UDS) presents the results of the needs assessment in Ghana. Accra, Ghana, March 2025.

3.2.3 User-centered service design: User stories and enablers

During the firs technical days, Frank Annor (TAHMO) led a "**User Stories**" session, focused on **designing user-centred climate services by considering the needs of end users from their perspective**. User stories are short, simple descriptions of a desire of the end-user in the form: "*As a {role}, I want to {goal}, so that {benefit}*", accompanied by acceptance criteria or conditions of satisfaction. In this way, we can ensure that services are relevant, practical, and valuable. To put the concept into practice, participants worked in a group exercise in which they had to formulate user stories from the point of view of different stakeholders, such as agricultural extension officers, media or general public. Results were collected in an online Miro. The following figure shows some of the collected stories.

On the second technical day, Frank hosted a session on "**Enablers**", that are the steps needed to **turn a user story into reality**. They break down the user's wishes into clear, actionable and reachable steps, with a clear role division (*who needs to do what*). They should contain specific actions and requirements for the action to be completed.

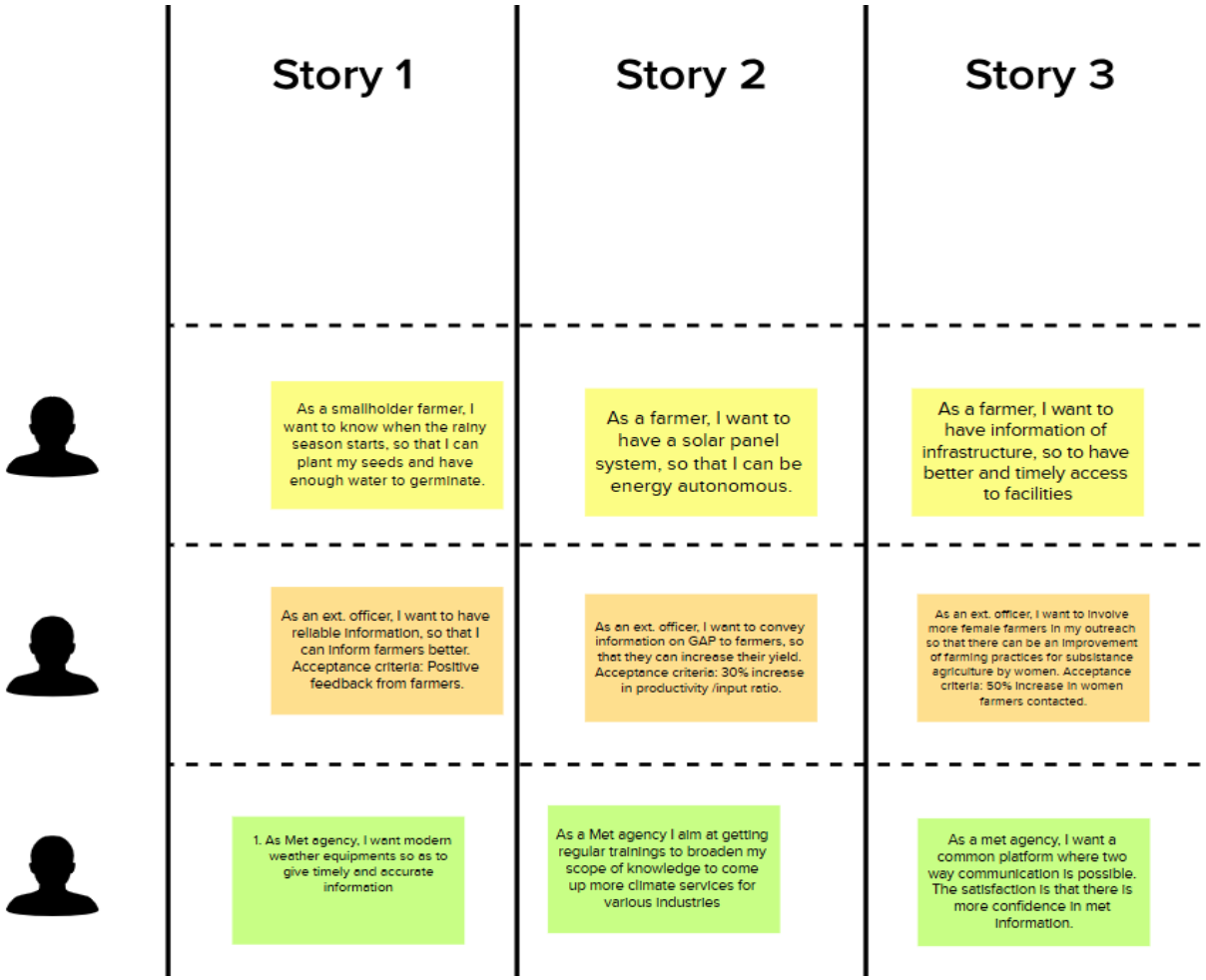

Figure 4: Some of the User Stories results on Miro.

Figure 5: Frank Annor (TAHMO) presenting during the "User Stories" session. Accra, Ghana, March 2025.

3.2.4 Towards the future: Onboarding learning sessions and living labs

The plenary session closed the second and last technical day presenting and devising some of **the future common plans of the project**: the SAFE4ALL onboarding learning sessions and the roadmaps of future steps in the living labs of the three SAFE4ALL countries.

The **onboarding learning session** aimed to introduce participants to the SAFE4ALL learning program, encouraging future engagement. It was hosted by Fitsum Gelaye (R-Cities). It provided an overview of the onboarding modules, explaining their contents and how they can contribute to enhanced understanding of climate adaptation. The session also invited participants to register for the first learning session, on the topic "T*he Fundamentals of Climate Change – History and Science"* and scheduled on the 16th of April, and remain involved through upcoming sessions and collaboration opportunities.

The **Living Labs session** focused on co-developing draft roadmaps for the three case-study countries: Ghana, Kenya, and Zimbabwe. Each country team collaboratively identified key milestones—such as workshops and deliverables—linked to project goals. Participants from different roles contributed across tables, fostering cross-partner input. The session concluded with a commitment to follow-up meetings with in-country partners to refine and expand each roadmap, reinforcing a shared understanding of project direction and responsibilities. Guus Wiersma (TUD) hosted this session.

Figure 6: Fitsum Gelaye (R-Cities), assisted by Guus Wiersma (TUD), presents the SAFE4ALL Onboarding Learning Program. Accra, Ghana, 2025.

Figure 7: Gordana Kranjac-Berisavljevic presents the roadmap for the Ghana Living Lab. Accra, Ghana, March 2025.

3.3 Workshops

3.3.1 Workshop 1: AI Basics and Implication to Satellite Nowcasting

The first workshop of the technical days was held by MMIS and was on the topic AI Basics and Implication to Satellite Nowcasting. It had the main goal to **introduce participants to the fundamentals of Artificial Intelligence (AI) and its practical application in meteorology, specifically for satellite-based nowcasting of thunderstorms**. The workshop aimed to present both theoretical foundations and real-world examples of AI-supported nowcasting tools being developed within SAFE4ALL.

The workshop was divided into several parts: First, an **Introduction to AI and Data Science** explained basic AI concepts, data types and common challenges in data quality. Second, a section on **AI methods in nowcasting** consisted of a detailed discussion on the use of computer vision and deep learning (e.g. U-NET architecture) for image-based precipitation forecasting. Third, a **Proof of Concept (PoC)** model trained on 10 years of EUMETSAT data was presented, including data preparation, model training, hyperparameter tuning with Optuna, and statistical verification. A fourth part gave an overview of the **application for SAFE4ALL countries – Ghana, Kenya and Zimbabwe -**, including adaptations, resolution setups and grid parameters. Lastly, the workshop presented **Explainable AI (XAI)**, providing a brief insight into how model decisions can be interpreted.

Figure 8: Workshop 1 - AI Basics and Implication to Satellite Nowcasting. Olga Valentinova and Jozef Omelka (both from MMIS) sit on the front. The participants included technical staff from GMet, KMD and MSD, as well as researchers. Accra, Ghana, March 2025.

The target audience comprised **meteorological professionals, technical staff from national meteorological and hydrological services (NMHSs), researchers, and decision-makers involved in early warning systems**. It was attended by representatives from partner NMHSs and interested stakeholders from Ghana, Kenya, and Zimbabwe.

The learning objectives of the workshop were to **build a basic understanding of AI and its potential in operational meteorology, as well as to stress the necessity to demonstrate the applicability of AI models in data-sparse regions using satellite data**. This contributes to SAFE4ALL's overall objective by **promoting innovative, scalable forecasting solutions for African NMHSs**, where radar coverage is often limited. Lastly, **local weather characteristics collected from national experts** through a questionnaire conducted at the end of the workshop, can contribute to further enhancing and tailoring the nowcasting models in the future, contributing to the overall project.

Finally, **next steps** discussed during the workshop were (1) to continue technical development and model training for African regions using localized data and specifications; (2) to adapt the AI nowcasting tool to local conditions with information gathered from local experts who provided domain knowledge on regional storm characteristics and (3) to engage further with national experts for model validation using available ground observation data.

3.3.2 Workshop 2: Hands-on using Jupyter notebooks - Accessing Weather and Yield Data in Africa

The second technical workshop was hosted by Austin Kaburia (TAHMO) and was **a hands-on session aimed at building the capacity of national meteorological agencies to access, explore, and apply high-resolution climate datasets.**

Figure 9: Austin Kaburia (TAHMO) presenting during the Hands-on using Jupyter notebooks - Accessing Weather and Yield Data in Africa workshop.

The workshop included a **series of theoretical explanations and hands-on exercises**, including practical demonstrations of how to: (1) extract and compare data from multiple sources (e.g., ERA5, TAMSAT, CHIRPS); (2) identify and assess trends in extreme weather events in Accra and Nairobi; and (3) explore links between climate data and agricultural yield using FAOSTAT and GDHY datasets. The session covered accessing data for Ghana, Kenya, and Zimbabwe and analyzing it using Jupyter Notebooks. The session emphasized the importance of data preparation (e.g., station metadata, time series formatting) and concluded with comparisons of datasets for both temperature and precipitation, offering insights into climate trends over the past 40 years.

It was targeted to the **national meteorological agencies of the SAFE4ALL countries – GMet (Ghana), KMD (Kenya) and MSD (Zimbabwe).**

The main goal was to **learn to access, analyse and apply climate data**. The with the focus was on analyzing severe weather events—such as extreme rainfall, high winds, and temperature anomalies—and comparing these with crop yield data from FAOSTAT.

Participants were introduced to a range of key datasets and tools, including TAHMO, ERA5, CHIRPS, TAMSAT, CBAM, and GHCNd. This contributed to the overall SAFE4ALL learning program in that it **improved the weather and climate modelling capabilities of the national meteorological agencies.**

The workshop was received with great interest and it is envisioned that **similar trainings will continue to occur** during the remaining of the SAFE4ALL project, in order to keep building the capacity of the national meteorological agencies.

3.3.3 Workshop 3: Data Assimilation and Benchmarking

Workshop 3, on data assimilation of benchmarking, was a joint effort by Neuralio and TAHMO, with a guest presentation from Rhiza Research, as collaborator of TAHMO.

The primary goal of this workshop was to **introduce project partners and other participants to the principles, importance, and operational aspects of data assimilation in numerical weather prediction**. Additionally, it aimed to touch upon **how benchmarking can be used to evaluate and improve model performance**, which is crucial for delivering reliable climate services through SAFE4ALL.

Theano Mamouka (Neuralio) contributed with a **theoretical presentation and a practical showcase of Neuralio's systems**. Particularly, they gave an introduction to data assimilation and its theoretical underpinnings (covering both 3D-Var and 4D-Var concepts); presented an overview of the WRFDA (Weather Research and Forecasting model Data Assimilation) system; discussed the types of observational data that can be assimilated and the expected outputs; and carried out a showcase of Neuralio AI's operational workflow for 3D-Var atmospheric data assimilation, including the integration with the WRF model and post-processing with the Unified Post Processor (UPP). The presentation of Rihza Research deepened the understanding about **benchmarking of weather forecasts**. The workshop was further supported by Austin Kaburia (TAHMO).

Figure 10: Data Assimilation and Benchmarking workshop. Theano Mamouka (Neuralio) and Austin Kaburia (TAHMO) – converse on the front. On the screen, Genevieve Flaspohler (Rhiza Research) is delivering a remote presentation on benchmarking. Participants included GMet, KMD and MSD, among others.

The workshop was targeted to **project partners, researchers, and technical staff from meteorological agencies and other institutions** involved in or benefiting from improved weather forecasting and climate information services within the SAFE4ALL project. Participants included representatives of GMet, KMD, ZMD and TAHMO, among others.

It aimed to foster a better understanding of data assimilation techniques and encourage partners to consider their application. Concrete learning objectives were: (1) to ensure participants understand the fundamental concepts of data assimilation and its significance in enhancing weather forecast accuracy; (2) to familiarize attendees with common methodologies (3D-Var, 4D-Var) and tools (e.g., WRFDA); (3) to demonstrate a practical workflow of data assimilation; and (4) to highlight the importance of benchmarking in evaluating and improving model outputs.

As per the overall SAFE4ALL learning program, the contribution provided by this workshop was to **build capacity in advanced weather modelling techniques, and generate discussions towards improved forecasting capabilities**. Improved understanding and potential adoption of data assimilation by partners can lead to more accurate and reliable local weather forecasts and climate information. This is fundamental for the local integration of SAFE4ALL, as enhanced forecasts directly support better decision-making in agriculture, water resource management, and disaster risk reduction – key objectives of the project for the benefit of end-users in Ghana, Kenya, and Zimbabwe. More accurate initial conditions for models, achieved through data assimilation, are crucial for the quality

of all downstream products and services developed within SAFE4ALL.

Concerning **next steps**, there was interest from the participants for follow-up training. It was understood that partners could explore the integration of data assimilation in their local modelling efforts with support from the project, and that this topic would be part of ongoing capacity building efforts within SAFE4ALL.

Figure 11: Theano Mamouka (Neuralio) introducing the Data Assimilation and Benchmarking workshop.

3.3.4 Workshop 4: Foodsheds Information Service (WU)

On the second technical day, the WU held a workshop on the Foodsheds Information Service. The goal of the workshop was to **inform stakeholders about the concept of foodsheds, facilitate the exchange of ideas, and encourage collaboration**. Specifically, the session aimed at collecting stakeholder feedback to refine the Foodshed Information Service and ensure it effectively meets local decision-making needs related to food availability and security.

The workshop included a **presentation from Ignacio Saldivia Gonzatti (WU) on the foodsheds information service and interactive group activities** structured into two main parts. Initially, stakeholders mapped their organizations onto a foodshed diagram, facilitating an understanding of their roles and interactions within the local food system. Participants then discussed risks to food availability, proposing actionable indicators relevant for decision-making. Following this, a prioritization exercise highlighted the most critical risks. In a subsequent exercise, stakeholders organized themselves according to their agricultural expertise in specific agroecological zones to create detailed cropping calendars. This involved refining planting and harvesting dates, confirming the presence

and characteristics of local crops, and identifying critical moments when crops are most vulnerable to climate-related stresses. These practical insights ensured the outputs were aligned with local agricultural practices and seasonal realities.

Figure 12: Ignacio Saldivia Gonzatti (WU) discusses the interactive exercises with workshop participants during the Foodsheds Information Service workshop.

The workshop originally targeted stakeholders from ministries of agriculture, trade, municipalities, agricultural extension officers, and farmers. However, the majority of actual participants were **extension officers and farmers**. This shift proved beneficial, particularly for exercises focusing on cropping calendars, as these participants provided detailed, practical insights reflecting their experiences.

The workshop aimed for stakeholders to **understand foodshed-related risks, identify practical indicators, and pinpoint critical moments in agricultural production linked to climate variability**. These objectives contribute directly to SAFE4ALL's overarching goal of enhancing stakeholder capacity through the open learning program. The session aligned with Task 5.1, which involves identifying learning needs, facilitating stakeholder engagement, and integrating climate services into local decision-making. By highlighting real-world connections between food security, climate risks, and practical interventions, this workshop advanced the **integration of tailored decision-making tools, such as the Foodshed Information Service, into local practices, supporting ongoing capacity building activities within the SAFE4ALL project**.

As **next steps**, the successful engagement and valuable feedback received during the workshop prompted plans to replicate similar sessions later this year in Zimbabwe and

Kenya. Continued stakeholder participation and feedback from these future sessions will further refine the Foodshed Information Service, ensuring it remains actionable, relevant, and beneficial to the needs of local communities across the project regions.

Figure 13: Workshop participants discuss during an interactive exercise of the Foodsheds Information Service workshop. Accra, Ghana, 2025.

3.3.5 Workshop 5: Uliza-WI chatbot

Also on the second technical day, WI held a workshop on their agro-weather advisory chatbot, Uliza-WI. This workshop gave looked into the chatbot functionality, architecture and inner working (backend), including the software and tools behind it. It had the goal to **set a practical basis to discuss integration and/or transfer of the chatbot with the meteorological agencies of the three SAFE4ALL countries**.

The workshop combined **theoretical presentations and lively discussions**. It started with a round of introductions and a discussion on the methods that the meteorological agencies employ to reach smallholder farmers. Then, it introduced the chatbot, including its features and some early test results and feedback. Afterwards a more in-depth technical lecture followed. This included a description of the software architecture and a typical data stream, from the creation to the delivery of the weather forecast. Finally, the participants discussed integration of national data into the chatbot as well as transferability and local ownership.

The target audience of this workshop were the **national meteorological agencies of the SAFE4ALL countries**. Unfortunately, it had less attendance than initially envisioned. Although the heads of the three meteorological agencies attended the workshop, the representation of the technical staff was limited.

Figure 14: Lorenzo Occelli (WI) introduces the Uliza-WI chatbot to representatives of GMet, KMD and MSD. Accra, Ghana, 2025.

This workshop had the main learning goal to **understand the technical requirements needed to operationalize and maintain the Uliza-WI chatbot**. This gives a practical base to current and future conversations about transferability and sustainability of the service, in relation with SAFE4ALL WP4. Furthermore, this contributes to the overall SAFE4ALL learning program by **kick-starting the learning journey for the chatbot to be potentially transferred and maintained by the national meteorological agencies.**

Based on the discussions from this workshop, **next steps** will mainly include further conversations about tool transfer with the three countries, including discussions about available technical resources and possible training plans. An immediate next step is the integration of national meteorological data into the chatbot.

3.3.6 Workshop 6: DROP App (WU)

On the same day, the WU held a second workshop to introduce and demonstrate the DROP App—a hydro-climatic, two-way information and communication service co-designed to support climate-informed agricultural decision-making.

The primary goal of the workshop was to **present the main functionalities of the DROP App to participants, explain its relevance to local agricultural practices,**

and initiate a dialogue about how the app can be co-developed further based on user feedback and local knowledge systems of southern Ghana.

The workshop began with a **live demonstration of the DROP App, followed by an interactive discussion with participants**. Agricultural extension officers were guided through the installation of the app on their phones and received printed user manuals with explanation of the various app functionalities and future reference. **Key features** presented included: (1) the graphical user interface (GUI) and structure of the app, (2) interpretation of scientific weather forecasts; (3) functionality for farmers to input indigenous weather forecasts based on local ecological indicators; (4) comparative use of scientific and indigenous forecasts, including concepts like forecast probability and predictability; and (5) understanding rainfall categories (low, medium, high, very high) in their local context.

During the session, the WU highlighted the practical application of forecasts and the importance of combining different sources of knowledge to support adaptive decision-making in agriculture.

The intended audience comprised **agricultural extension officers** from the **Greater Accra Region**, as they serve as critical intermediaries between technical agricultural information services and smallholder farmers. These officers have the potential to scale out the use of the DROP App by sharing knowledge and practices with the broader farming community.

Participants were equipped with both the **practical skills to use the DROP App and the conceptual understanding needed to interpret and communicate forecasts to farmers**. The session contributed to the **SAFE4ALL learning program** and agenda by: (1) building capacity in climate information services at the intermediary level; (2) supporting the integration of scientific and indigenous knowledge systems and (3) facilitating engagement for information co-creation and user-centered improvements of climate services specifically linked to short-term weather forecasting.

Several **action points and follow-ups** emerged from the workshop session:

- New locations to provide weather forecasting were proposed by participants and were added to the app, enabling access to more localized and relevant weather forecasts.

- Participants were invited to share local ecological indicators used in indigenous forecasting, allowing researchers to assess their predictive skill and explore ways to integrate them in hybrid weather forecasting systems.

- A dedicated WhatsApp group that was established during the SAFE4ALL General Assembly Year 2 is also meant to be used to maintain ongoing feedback loops, where users can report on app functionality and the usability and accuracy of forecasts.

- These activities support a continuous improvement cycle for the DROP App within the duration of the SAFE4ALL project, ensuring that it is responsive to smallholder farmers' contextual needs and rooted in both scientific and local knowledge systems.

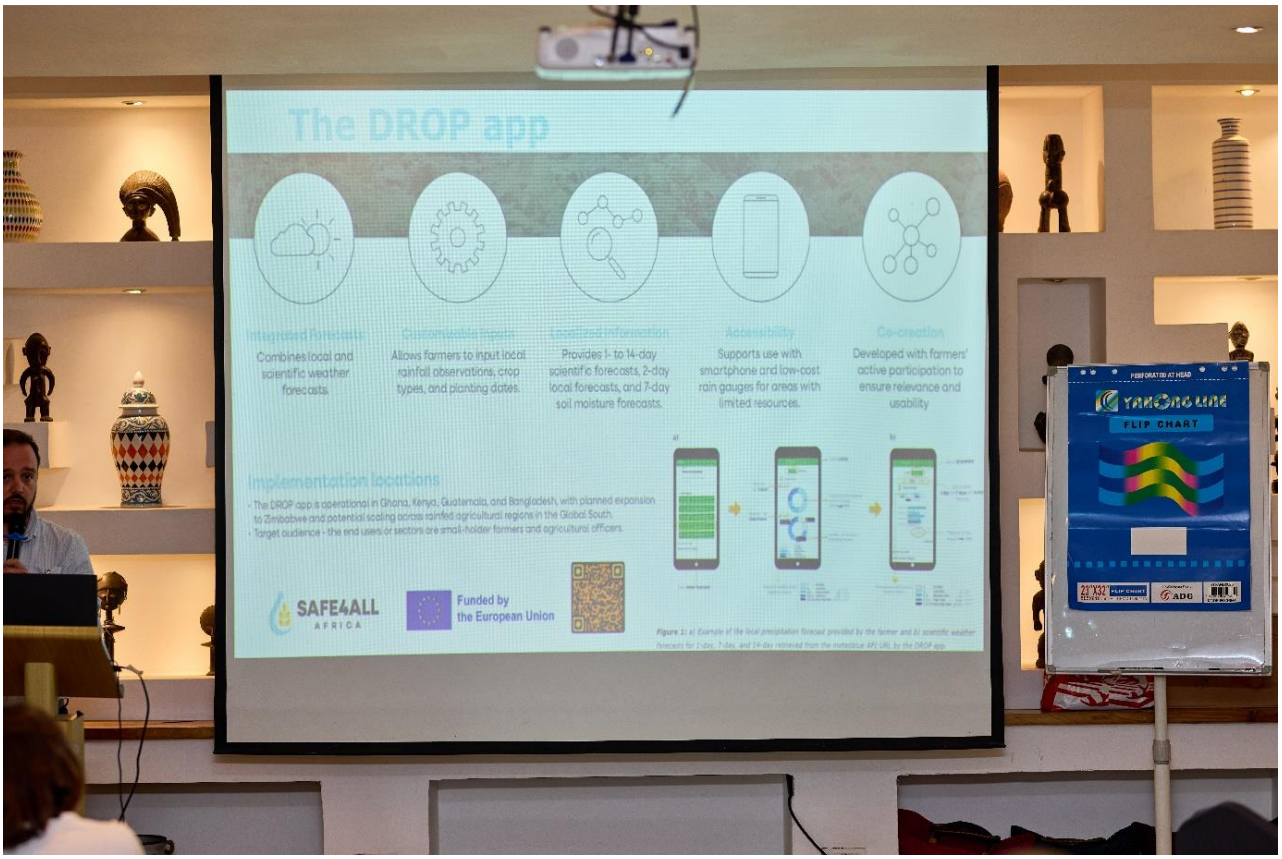

Figure 15: Spyros Paparrizos (WUR) introduces the DROP App to the workshop participants, Accra, Ghana, March 2025.

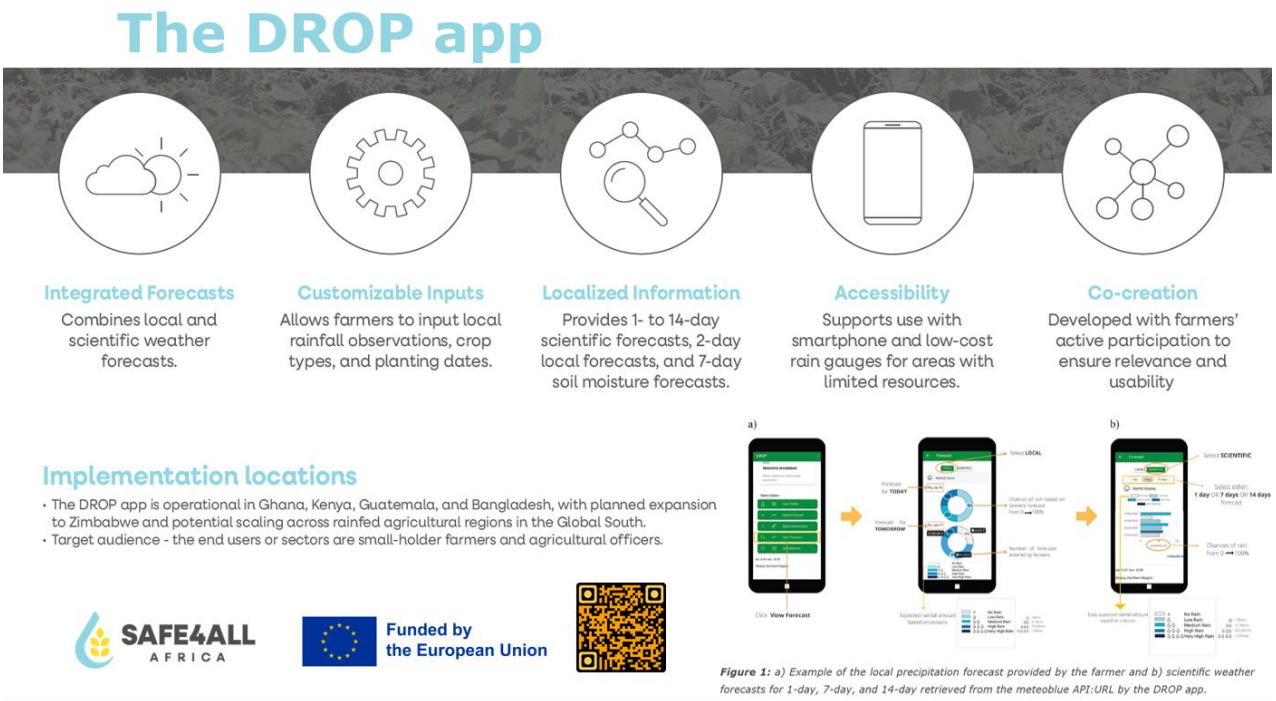

Figure 16: DROP App in a nutshell: Presentation to the workshop participants, Accra, Ghana March 2025.

4. Conclusion and outlook

The SAFE4ALL technical days marked a crucial starting point for the project's capacity building and local ownership strategy. Participants responded with enthusiasm and demonstrated strong interest in further engagement. While the sessions provided valuable exposure to the project's tools and approaches, they also highlighted the need for deeper, sustained training and technical support to enable full adoption and integration at the national level.

Moving forward, the SAFE4ALL learning program will build on this momentum, with additional training sessions, country-specific roadmap development, and continued collaboration among stakeholders. Although questions remain about how many tools can be fully transferred to local institutions, the technical days established a solid foundation for collective learning, tool refinement, and long-term sustainability—key steps towards addressing the intertwined challenges of climate change, food security, and migration in sub-Saharan Africa.

Figure 17: Group photo of all the SAFE4ALL technical days attendees. Accra, Ghana, 2025.

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