

# SAFE4ALL Report on inventorying Tools, Services and Policy context for co-creation case studies: Needs Assessment and Gap Analysis for Adaptation to Climate Change

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**Authors & Reviewers**

<b>Authors</b>	<b>Reviewer</b>
Nick van de Giesen (TUD), Guus Wiersma (TUD), Frank Annor (TAHMO), John Wesongsa (JKUAT), James Natia (VIS), Emanuela Chiang (VIS), Prince Kuipa (ZFU), Gordana Kranjac-Berisavljevic (UDS), Fitsum Gelaye (RCN), Sophie Van Der Horst (CAS), Monica Estébanez Camerena (WI), Tambu Pasi (MSD), James Ngoma (MSD) and Willard Shamu (TAHMO)	Spyros Paparrizos (WU)

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## Executive Summary

The report provides an inventory of tools and services for climate adaptation focusing more on the agriculture (food) sector to identify existing gaps and how the SAFE4ALL project could fill in some of these gaps with the tools being developed within the project. The tools highlighted in this report focus on Ghana, Kenya, and Zimbabwe from the *Space for Food Security Geodata for Agriculture and water (G4AW)* report by the Netherlands Space Office and complimented with the tools being developed as part of the SAFE4ALL project. Recognizing that agriculture is crucial for the livelihoods of over 2.5 billion people, the report highlights the urgent need for effective climate adaptation tools and services to increase the resilience of vulnerable communities and the importance of sustaining the use and maintenance of such tools and services beyond projects.

Despite the existence of some climate services and tools in the case study countries, significant gaps persist in accessibility and relevance, particularly for smallholder farmers and rural communities who often lack the necessary information to navigate climate risks. Current services are typically fragmented and primarily target large commercial farmers, operating on a national scale and leaving many local needs unmet.

The report identifies critical areas for improvement, including the establishment of collaboration platforms to co-create climate information services and tools tailored to local contexts and needs. It assesses adaptation challenges and aligns them with broader policy goals to enhance food security and resilience. Additionally, it emphasizes the development of integrated tools that leverage digital innovations and existing data to address various climate-related concerns, ranging from agriculture to disaster management. Ensuring that climate services are tailored to local policy needs is also crucial for improving uptake and sustainability.

The SAFE4ALL initiative aims to address these gaps by focusing on three vulnerable regions - Ghana, Kenya, and Zimbabwe. Through collaborative case studies, the project will test bundled services using various tools designed by the project partners to enhance community resilience, improve food security, and mitigate the impacts of climate change-induced migration.

By conducting this inventory and analysis, the SAFE4ALL report lays the groundwork for actionable strategies that foster climate adaptation across Africa, ultimately contributing to the Sustainable Development Goals and enhancing the continent's capacity to thrive in an era of climate change.

## 1. Objectives and Goal

The objectives of the SAFE4ALL project with respect to climate tools and services are to:

- 1. Provide an Inventory of Tools and Services:** To compile an inventory of existing tools and services from the *Space for Food Security Geodata for Agriculture and water (G4AW)* report by the Netherlands Space Office, complimented by tools being co-developed as part of the SAFE4ALL project, available to farmers in Kenya, Ghana, and Zimbabwe that facilitate climate adaptation and resilience. Other available tools developed by others outside the project are considered in the Market Analysis Report D4.1, accompanied by country reports for Ghana, Kenya and Zimbabwe. These reports are to be published in month 24 of the project, which is December 2025.
- 2. Analyze Policy Context:** To examine the current policy frameworks governing climate adaptation in the agricultural sectors of the three countries, identifying how these policies support or hinder effective adaptation strategies.
- 3. Conduct Needs Assessment:** To assess the specific needs of lead farmers in the targeted regions regarding climate information, tools, and services, ensuring that their perspectives are integral to the co-creation process.
- 4. Perform Gap Analysis:** To identify usability gaps in the current offerings of tools and services, highlighting areas where additional resources or support are necessary to enhance farmers' capacity to adapt to climate change.
- 5. Demographic Insights:** To analyze demographic data, including gender, age distribution, educational backgrounds, and literacy levels among farmers, in order to tailor interventions that address the unique challenges faced by different segments of the agricultural community.
- 6. Inform Stakeholders:** To provide actionable recommendations for policymakers, practitioners, and researchers aimed at bridging identified gaps and facilitating collaborative efforts that empower farmers and other societal actors to adapt to climate change effectively.

## 2. Background

Agriculture is vital for the livelihoods of people globally, and in Africa, rural households are increasingly oriented towards urban markets. However, rising weather and climate risks demand that farmers access reliable information on climate variability, soil management, and financial services. Current climate services often operate in silos, primarily benefiting large commercial farmers, while smaller rural communities face unmet needs for localized, affordable and scalable solutions.

With growing demand for food due to population growth and climate extremes, ensuring food security in Africa is critical, especially as the continent is poised to become a major food basket for the world's population in the coming decades. Climate change has intensified natural disasters, adversely affected agricultural production and led to food shortages and increased migration. This is also true for natural disasters (drought and floods) from climate extremes exacerbating the already unmet food and water needs.

The 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-centered 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).

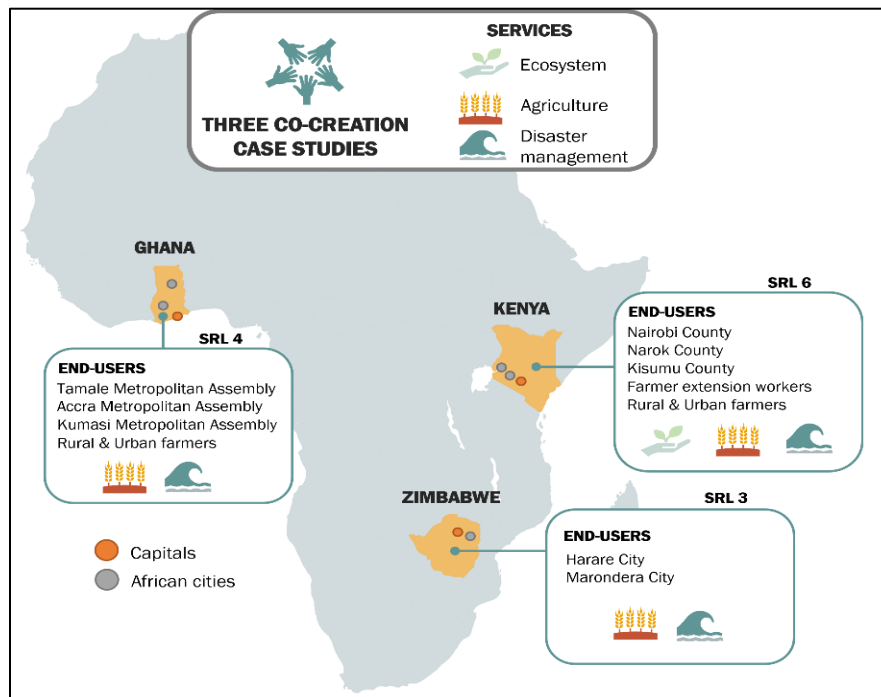


Figure 1: Map of the three Co-creation cases

Through collaborative efforts, innovative tools, and tailored services, SAFE4ALL will support the development of climate adaptation plans, promote sustainable agricultural practices, and build resilience in vulnerable communities, ensuring that Africa can meet its food security challenges effectively.

### 3. Methodology

The methodology for the study was designed to ensure a better understanding of the tools, services, and policy contexts relevant to climate adaptation among farmers and citizens in general, in Kenya, Ghana, and Zimbabwe. This will help to understand the relevance of the tools being developed within SAFE4ALL and to link appropriate stakeholders for the co-development process. The approach consisted of several key components, each contributing to a holistic assessment of the current landscape and the needs of agricultural communities with respect to climate tools and services.

#### 3.1 Literature Review

A thorough review of existing literature was conducted to gather background information on climate adaptation strategies, tools, and services currently in use. This review encompassed academic articles, government reports, and publications from non-governmental organizations (NGOs) focused on agricultural practices and climate

resilience. The literature review aimed to identify best practices, successful case studies, and the theoretical frameworks that underpin effective climate adaptation strategies. Key themes explored included:

- Historical context and evolution of climate adaptation initiatives in the agricultural sector.
- Identification of successful tools and services that have been implemented in similar contexts, as showcased in the *Space for Food Security Geodata for Agriculture and water (G4AW)* report by the Netherlands Space Office.
- Analysis of existing policy frameworks that support or hinder climate adaptation efforts.

### 3.2 Data Collection

Data collection was executed through structured questionnaires distributed to lead farmers in the selected regions. The questionnaire was designed to capture a wide range of information and was divided into several key sections:

- **Demographic Information:** Participants were asked to provide data on their age, gender, educational background, and literacy levels while ensuring conformity to General Data Protection Regulation (GDPR) and national data protection guidelines. This information is crucial for understanding the socio-economic context of the respondents and how it influences their access to resources.
- **Access to Tools and Services:** Questions assessed farmers' awareness and utilization of existing tools and services aimed at climate adaptation. This included inquiries about specific technologies, practices, and information sources that farmers currently use or have used in the past. The farmers are purposely not asked for specific tools they are using but general tools and applications.
- **Perceived Needs:** Farmers were invited to express their specific needs regarding climate information, support services, and training opportunities. Open-ended questions allowed farmers to describe their experiences and challenges in their own words, providing qualitative insights into their needs.

### 3.3 Sampling Strategy

A purposive sampling strategy was employed to select lead farmers who are actively engaged in agricultural practices and have experience with climate adaptation efforts. This method ensured that the data collected would reflect the insights and experiences of those most affected by climate change. The sampling process involved several steps:

- **Identification of Target Regions:** Specific communities within Kenya, Ghana, and Zimbabwe were selected based on their vulnerability to climate change and existing adaptation initiatives.
- **Recruitment of Participants:** Local agricultural extension officers and community leaders assisted in identifying lead farmers who met the criteria for participation. Efforts were made to ensure diversity in the sample, considering factors such as age, gender, and types of crops grown.

### 3.4 Data Analysis

Quantitative data from the questionnaires were analyzed using statistical software to identify trends and patterns in demographics, access to tools, and perceived needs. The data analysis process included:

- **Descriptive Statistics:** This provided an overview of participant profiles, including distributions of age, gender, and educational backgrounds.
- **Inferential Statistics:** Correlations between educational backgrounds and the use of adaptation tools were explored. This analysis helped identify whether higher education levels were associated with increased access to and use of climate adaptation resources.
- **Qualitative Analysis:** Responses from open-ended questions were coded and thematically analyzed to extract common themes and insights regarding farmers' needs and challenges.

### 3.5 Gap Analysis

The gap analysis involved comparing the identified needs of farmers with the existing tools and services documented in the inventory. This process aimed to highlight areas where resources are lacking or inadequate. Key steps in the gap analysis included:

- **Mapping Needs to Resources:** Identifying specific needs articulated by farmers and evaluating the extent to which current tools and services address those needs.
- **Identifying Critical Gaps:** Highlighting areas where no existing tools or services are available or where current offerings do not meet the requirements of farmers.
- **Prioritization of Gaps:** Classifying gaps based on their urgency and potential impact on farmers' ability to adapt to climate change.

### 3.6 Stakeholder Engagement

Engagement with local stakeholders was integral to the methodology. This included:

- **Workshops:** Organized workshops brought together farmers, policymakers, and local organizations to discuss preliminary findings and validate the data collected. These workshops encouraged dialogue and collaboration among stakeholders.
- **Focus Group Discussions:** Focus groups were conducted to delve deeper into specific issues identified during the data collection process. These discussions provided a platform for farmers to share their experiences and suggestions for improvement.
- **Feedback Mechanisms:** Stakeholders were invited to provide feedback on the findings and recommendations, ensuring that the report reflects a consensus view of the challenges and opportunities for climate adaptation.

## 4 Results and Discussion

This section presents an inventory of tools and climate services currently designed to support adaptation among farmers in Ghana, Kenya, and Zimbabwe. It includes details on each tool's owner, implementation period, current and target Technology Readiness Levels (TRL), device type, data temporal and spatial resolution, and geographical applicability. Additionally, it identifies gaps in the current offerings that need to be addressed to enhance climate resilience in these regions. An inventory of tools and climate services, policies and governance, and capacity needs will lead to an understanding of the current situation, as well as give insights in the gaps to bridge in the development of tools and climate services to meet the needs of users in the case-studies.

### 4.1 Inventory of Tools and Climate Services for Adaptation and Gaps

A total of thirteen (13) tools and climate services relevant for adaptation in our context and gaps have been identified, which can be seen in Table 1. Of these, nine tools and services are developed by partners of the SAFE4ALL project. The remaining four (4) Geodata for Agriculture and Water (G4AW<sup>1</sup>) tools and services have been developed and implemented, but are all not active anymore, whereas the tools and services within the SAFE4ALL project are all in the early stages of implementation or still in the development phase, only to be implemented in the coming years. The main reason attributed to the four inactive G4AW tools and services is the lack of a proper business model. Even though business models had been properly thought of and developed, setbacks occurred that led to an end of use for all of these four tools and services.

The vast majority of the tools and services provide local data and most of them require a mobile phone to access the data. Data (or information) can be provided to the users in a range of forms - from daily, even nowcasting, to decades ahead, depending on the tool or service. Some of the tools and services only use technology, measurements and models. Other tools and services combine technology with local knowledge.

#### 4.1.1 Overview of Tools and Climate Services

The tools and climate services listed below aim to empower farmers by providing critical information and resources necessary for adapting to changing climatic conditions. These tools range from mobile applications to sophisticated data platforms, each tailored to meet specific needs within the agriculture and water sectors.

*Table 1: Inventory of Tools and Climate Services from the Space for Food Security Geodata for Agriculture and water (G4AW) report by the Netherlands Space Office, complimented by the SAFE4ALL tools*

Tool name	Tool owner	Period implemented	TRL now	TRL goal	Device	Data temporal	Data spatial	Applied in Ghana (G), Kenya (K), Zimbabwe (Z)
DROP app	Wageningen University	2019	5	8	Mobile	Days to weeks	Local	G, K
Chatbot	Weather Impact Esoko	2004	4	7	Mobile	Weeks to months	Local	G, Z
Sat4Business	-	2019-2022	-	-	Radio, mobile	n.a.	Local	G
FarmGrow	-	2018-2021	-	-	Extension officers	n.a.	Local	G
Climate Atlas	CAS		3	5		Decades	Regional	K
CROPMON	-	2015-2019			SMS	Days	Local	K
GEODATIC		2015-2018						K

<sup>1</sup> <https://q4aw.spaceoffice.nl/en/>

LPJmL	Wageningen University	-	2	6	High-Performance computer Server with GPU	Weeks to decades	Regional	-
High impact thunderstorm nowcasting eWaterCycle	MMIS	2025	2	5	Laptop	Now	Local	Planned in: G, K, Z
TWIGA platform	TU Delft	2015	7	9	Laptop, mobile	Days to decades	Local to regional	G, K, Z
Hyperlocal Weather Intelligence Engine	TAHMO/WPC	2008	9	9	Desktop, laptop, tablet	Days to decades	Local to regional	G, K
Multi-agent Reinforcement learning Framework	Neuralio	2022	7	9	Desktop, laptop, tablet	Days to months	Local	G, K, Z
	Neuralio	2022	4	6	Desktop, laptop, tablet	Real-time to decades	Local to regional	G, K, Z

#### 4.1.2 Analysis of Tools and Services

According to the survey, it was noted that mobile applications play a crucial role in enhancing climate adaptation for farmers. Apps like the **DROP App**, developed by Wageningen University, harnesses the local weather forecast knowledge of smallholder farmers and provides them with timely information, significantly improving their decision-making capabilities; it currently holds a TRL of 5, with a goal of achieving TRL 8, indicating its substantial potential for scalability. Similarly, the **Chatbot** created by Weather Impact delivers weather forecasts and agricultural advice directly to farmers' mobile devices, currently at TRL 4 with aspirations to reach TRL 7, highlighting further technological enhancement possibilities. In terms of data platforms, the **Climate Atlas** serves as a regional tool that provides long-term climate data, enabling farmers to understand climate trends; it has a TRL of 3 and aims for TRL 5, suggesting room for further development. The **eWaterCycle**, on the other hand, acts as a comprehensive resource for water cycle data, currently at TRL 7 and targeting TRL 9, integrating local and regional data to support sustainable water management practices. Lastly, among forecasting and monitoring tools, the **High Impact Thunderstorm Nowcasting** focuses on providing real-time weather updates for farmers, holding a TRL of 2 and aiming for TRL 5, which indicates plans for future improvements. In contrast, the **Hyperlocal Weather Intelligence Engine** aims to deliver precise weather information at a local level, currently at TRL 7 and targeting TRL 9, demonstrating its advanced development stage.

#### 4.1.3 Gaps in Tools and Services

Despite the diverse range of tools and climate services available, several critical gaps have been identified that hinder effective adaptation strategies for farmers. One significant issue is the limited geographic coverage, as many tools are not uniformly available across the three countries. For instance, while the DROP App has been implemented in Ghana and Kenya, local knowledge of weather forecasting is highly context-specific and region-dependent, requiring significant effort to identify, document, and integrate effectively. On the other hand, the eWaterCycle is a tool that operates on a global scale and requires some adaptation to be used in Ghana, Kenya and Zimbabwe at local scale. These issues have been limiting farmers' and other users access to vital climate information and resources that could enhance their resilience.

Moreover, insufficient training and support for farmers complicate the situation. Even when tools are available, many farmers lack the technical skills or knowledge necessary to effectively utilize these resources, which highlights the need for targeted training programs that not only introduce farmers to the tools but also educate them on how to integrate these tools and services into their daily practices.

Integration and interoperability issues are another challenge, as there is a lack of integrated platforms that combine multiple services (bundling of services). This fragmentation makes it difficult for farmers to access a comprehensive suite of climate information. Additionally, data accessibility and quality can be barriers; while some tools provide valuable data, this information may not be easily accessible to farmers, particularly in remote areas with limited internet connectivity. Furthermore, concerns about data quality and accuracy can undermine trust in the use of these tools.

Another gap lies in the lack of tailored solutions, as current tools often employ a one-size-fits-all approach that may not adequately address the unique challenges faced by different communities or specific crops in Africa. There is a pressing need for the development of solutions that consider local contexts, including cultural practices, crop varieties, and specific climate challenges. Engaging farmers in the co-creation of these tools can ensure they are relevant and effective.

Lastly, funding and resource constraints hinder the ongoing development and maintenance of these tools. Many are developed and maintained by academic institutions or NGOs, which may not have sustainable funding sources beyond project duration. Limited financial resources can restrict the scaling of these tools. Securing investment and partnerships with private sector stakeholders could enhance the sustainability and reach of these services, ensuring they remain accessible to farmers and other societal actors over the long term – way beyond project lifetimes. Addressing these gaps will empower agricultural communities to adapt more effectively to the challenges posed by climate change.

## **4.2 Inventory of Policies and Governance in the Case Study Countries for Adaptation and Gaps**

### ***Ghana***

Ghana has a well-defined policy framework to address climate change adaptation, spearheaded by the National Climate Change Policy (NCCP). The policy identifies five key pillars: climate-resilient agriculture and food security, sustainable forest management, disaster risk reduction, resilience for vulnerable populations, and energy efficiency. The Nationally Determined Contributions (NDCs) focus on sustainable land management, afforestation, and renewable energy integration. Additionally, the Ghana Strategic Investment Framework for Sustainable Land Management and Ghana Plan of Action for Disaster Risk Reduction and Climate Change Adaptation enhance institutional coordination. Despite these frameworks, there are significant gaps. Limited financial resources, inadequate local-level capacity for policy implementation, and a lack of integration between national and local governance hinder effective adaptation. Moreover, the inclusion of community-based knowledge systems and gender-sensitive approaches in adaptation efforts remains weak.

### ***Kenya***

Kenya is recognized for its progressive climate change adaptation governance, with the Climate Change Act, 2016 as a cornerstone policy. The act establishes a framework for mainstreaming climate resilience into national development plans, guided by the National Climate Change Action Plan (NCCAP). Key areas of focus include water resource management, climate-smart agriculture, and disaster preparedness. Institutions such as the Climate Change Directorate oversee implementation, while the Kenya National Adaptation Plan (NAP) 2015-2030 provides specific adaptation actions at the national and

county levels. However, Kenya faces gaps in financing, technical expertise, and cross-sectoral coordination. The decentralization of governance to counties presents opportunities but also challenges in aligning local actions with national objectives. Additionally, marginalized groups, particularly pastoralists, often lack adequate representation in adaptation initiatives.

### Zimbabwe

Zimbabwe's adaptation policies are anchored in the National Climate Policy (2017) and the National Adaptation Plan (NAP) under development. These policies aim to enhance resilience in key sectors, including agriculture, water, and health. The Climate Change Management Department coordinates efforts at the national level, with support from international donors and development partners. Initiatives like the National Contingency Plan for Droughts and the Renewable Energy Policy are also integral to adaptation. Key gaps include a lack of consistent funding, weak institutional capacity, and insufficient integration of climate considerations into sectoral policies. Zimbabwe's socio-economic challenges, compounded by political instability, exacerbate the implementation of adaptation measures. Furthermore, rural communities often lack the resources to participate effectively in adaptation processes.

## 4.3 Capacity Needs for Climate Adaptation in the Case Study Countries

*The interviews amongst farmers in Ghana (319), Kenya (961) and Zimbabwe (299) show that local knowledge, weather calendar and personal experience are the most dominant sources of information for farming in all three countries. Internet and mobile, what most of the tools for agriculture use, are only used by a small percentage of the farmers, as can be seen in*

Figure 2.

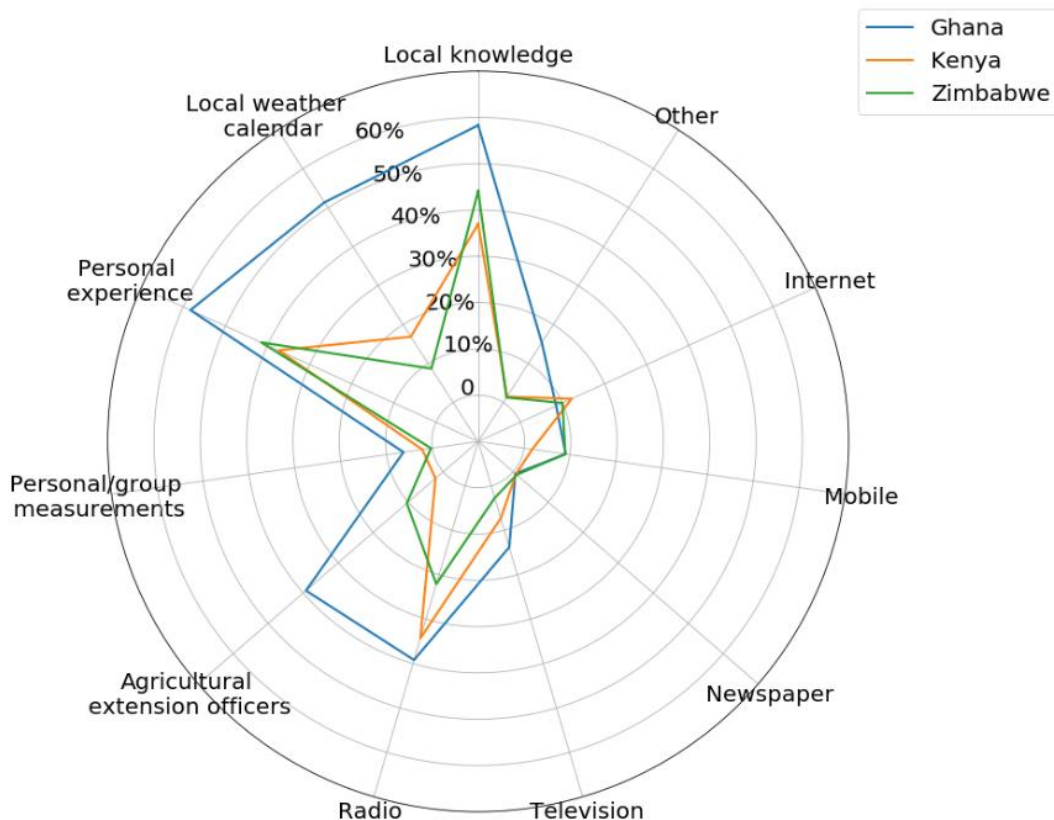


Figure 2: Sources of data currently used for farming

The interviewed farmers in Ghana also stated local knowledge, weather calendar and personal experience as the most preferred source of data for farming. Farmers in Kenya and Zimbabwe however prefer internet, mobile and radio, farmers in Zimbabwe also mentioned agricultural extension officers as preferred source of data for farming, as can be seen in Figure 3. In general, the most preferred sources of data for farming are also the most trusted sources, as can be seen in Figure 4.

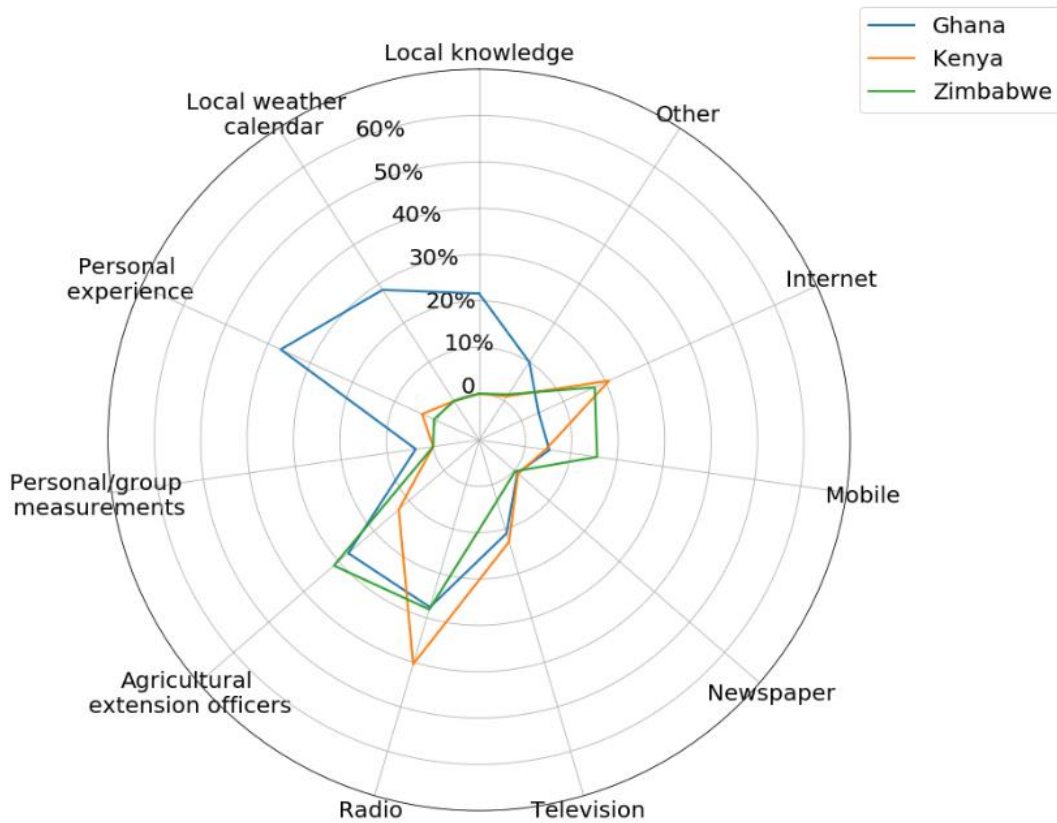


Figure 3: Preferred sources of data for farming

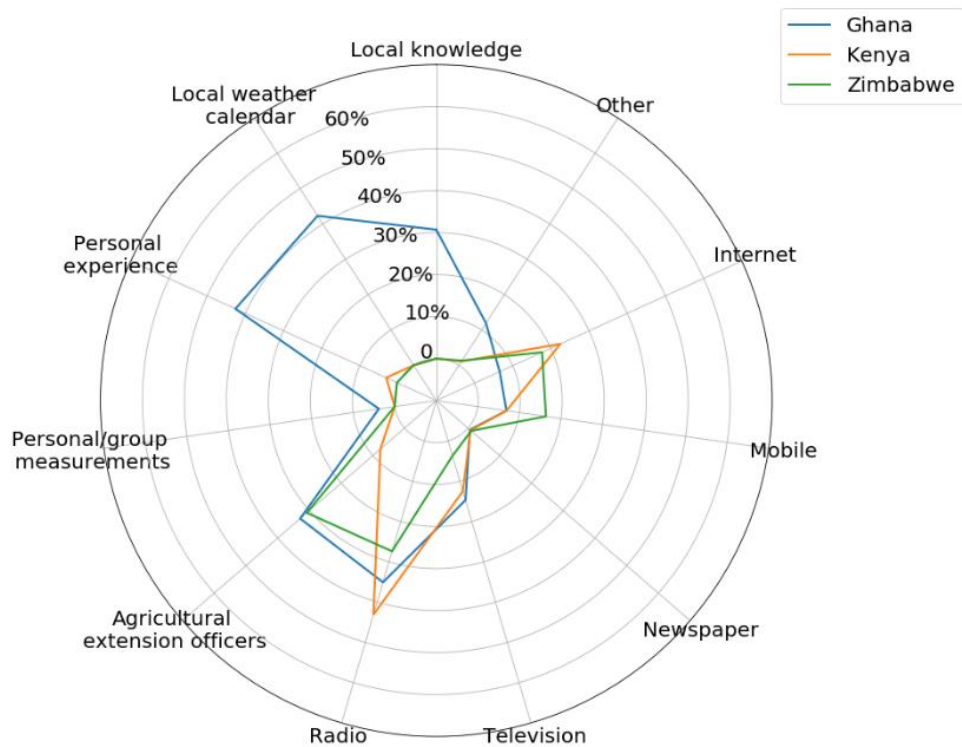


Figure 4: Most trusted sources of data for farming

Additionally, the farmers in Ghana got asked whether they prefer local knowledge or technology as a source of data for farming. 5.3% of the farmers answered local knowledge, whereas 20.7% said technology and 70.5% prefer a mix of local knowledge and technology. The weather information farmers would need most for farm management, that they currently do not have access to is when it is going to rain (66.5%), how much it is going to rain (77.1%), temperature (17.9%) and humidity (8.5%).

## 5 Conclusions

Whereas section 4.1 shows that the majority of tools and climate services are developed to be used on mobile phones, farmers do not see mobiles as a preferred or highly trusted source of data for farming. This presents a trust gap to be bridged concerning the use of mobile phones for climate services despite its high penetration levels. Looking at the responses from the interviews in Ghana, tool and climate service owners are strongly advised to not only consider technology, but also local knowledge in the development when considering farmers.

The most important lesson learnt from the review, especially the G4AW tools and services that are not active anymore, is to ensure an effective and sustainable business model is set up. Even with a business model developed, setbacks can occur requiring more attention to continuously revising the business models. For SAFE4ALL there is a danger that other tools might face the same issues so there is the need to start implementing some of the business models on time, so they can be modified if the desired results are not attained quickly. Taking (climate) policy and governance into consideration in the development of tools and services will enhance support, thus success of the tools and services.

## 6 Recommendations for Project Implementation and Services Delivery

Within the SAFE4ALL project, tools and services are developed to meet the needs of societal actors, considering already existing tools and services, policies and governance, and needs of different users, as well as lessons learnt from previous tools and services. These tools and services are tested and further developed within the LivingLabs in the case-studies of the project.

It is strongly recommended to continue expanding the inventory of tools and services and to document lessons learnt for the development of the tools and services within the project. This will increase the chances of success of the tools and services, as well as their business models. It is also recommended to ensure that changes in policy and governance do not go unnoticed, especially when having possible impact on the tools and services.

The needs of farmers in Ghana, Kenya and Zimbabwe are assessed in this report. Farmers are the main users of the majority of the tools and services, however there are also other organizations and people that could give valuable input to the developers. It is therefore strongly recommended to have stakeholder meetings on a regular basis throughout the project and throughout the development of the tools and services, to ensure taking all input into account and not just that of farmers.

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### Ghana

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