Empowering Farmers with Digital El Niño Advisories: Insights from Malawi and Zambia

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Contents

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Abstract

Climate extremes, including droughts, floods, and cyclones, are becoming increasingly frequent, severe, and geographically extensive in Southern Africa, with devastating effects on populations heavily reliant on rain-fed agriculture and broader economies. Farmers urgently need guidance and support to build resilience against climate-related disasters. However, the national extension systems in the region lack adequate funding and the capacity to respond promptly and effectively during emergencies. This report analyzes a digital advisory campaign aimed at disseminating awareness and advisory messages to farmers during an El Niño event across Malawi and Zambia, leveraging Interactive Voice Response (IVR) technology accessible via basic, non-smart mobile phones. The campaign was rolled out in December 2023, prior to the start of the 2023/24 season.

Our report builds on farmer feedback, particularly on how useful they found the campaign, their livelihood outcomes in the aftermath of the El Niño, and other notable trends in the data. The campaign reached over 1 million farmers in the two countries, with more than 90% of respondents finding the messages useful for awareness and preparedness. Both in Malawi and Zambia, radio emerged as the most popular channel for receiving extension messages. Moreover, results also confirmed that meteorological forecasts played a critical role in influencing farmers' choices of crop and planting dates. For instance, dry spells of more than 21 days led to maize yield losses of 70-90%.

Results further indicate that conservation agriculture and the adoption of drought-tolerant crops were the most popular mitigation measures employed by farmers. The findings suggest that Governments need access to appropriate information about the circumstances of their population to make informed decisions about how to efficiently extend support. Digital advisories provide an opportunity to gather real-time data on farm conditions and can be used to deploy support. Additionally, post-event analysis provides valuable evidence that can be used to enhance the design of future response interventions and reduce donor dependence.

Introduction

The El Niño Southern Oscillation (ENSO) is a natural, irregular climate phenomenon with profound impacts on global weather patterns. It is often associated with extreme variations in precipitation, ranging from above-average rainfall to severe droughts, particularly in parts of Southern Africa. Over the last 40 years, 11 El Niño events have severely affected countries such as Malawi, Zambia, and others in the Southern Africa region, resulting in extreme drought conditions (1, 2). These El Niño-induced droughts have had a devastating impact on a large proportion of the populations in Southern Africa, who rely heavily on agriculture for their livelihoods. The situation has been exacerbated by structural challenges in cropping systems, including small farm sizes, low soil fertility, and poor market access (1, 3). For instance, during seven of the last 11 El Niño events, which include those from 1982/84, 1991/92, 2004/05, 2015/16, and 2018/19, maize production in Malawi decreased by an average of 22.5% (2).

In the 2023/ 2024 agriculture season, the El Niño event triggered a severe drought in Southern Africa, prompting several governments to declare a state of disaster and appeal for international support. This reliance on donor aid to supplement deficits in drought years is a recurring issue in the region (4). Key sectors with high sensitivity to El Niño-related droughts include water, food, and energy, with agriculture being the most severely impacted (4, 5). The economic damage in the countries, often amounting to billions of dollars, is particularly significant for these small economies, underscoring the urgent need for governments to take action (5). Given the low adaptive capacity of smallholder farmers, it is critical to capacitate them with early warning systems and advisories on mitigation strategies to prepare for climate-related disasters effectively.

Smallholder agrarian communities, typically lacking formal agricultural training and risk mitigation mechanisms such as weather insurance, are acutely vulnerable to climate shocks. Any deviation from ideal conditions risk propelling them into a crisis. National governments often rely on and deploy agriculture extension services to build farmers' capacities in agriculture. However, due to a plethora of challenges that include poor funding and a lack of consistent upskilling, extension services have been rendered ineffective, necessitating alternative extension pathways (6). In addition to traditional one-on-one coaching, emerging approaches include participatory co-design, private agro-dealer extension, and e-extension platforms such as mobile phone-based messaging systems (7). Digital agronomy advisory services are on the rise, seeking to fill the gaps in the traditional extension and advisory systems, offering various forms tailored to the specific needs and the mode of information required, and therefore achieving different levels of success in scaling (8). The rapid growth of the digital knowledge economy in Africa forms the backdrop of these digital innovations. Mobile telephone subscriptions rose from 350 million in 2010 to 1.2 billion by 2020 (9). This expansion has alleviated several economic bottlenecks that were perpetuated by the poor infrastructure in Africa. Some of these improvements persisted during the COVID-19 pandemic, including money transfer and banking, and access to development messages, particularly in health and agriculture (9, 10). However, low literacy levels among smallholder farmers in Africa remain a significant barrier, limiting the effective use of many mobile applications (Zua, 2021).

Voice messages in local languages obviate the need for a farmer to read messages, and therefore effectively overcome the literacy barrier (11). Interactive Voice Response (IVR) approaches are particularly effective due to their low cost and high accessibility; as they require only the capabilities of a simple feature phone (12). Digital approaches offer significant scalability, enabling each farmer to receive the information directly, and, in the case of IVR, they can replay it as often as necessary. Furthermore, IVR enables the gauging of farmer interest in products and services with real-time engagement monitoring. Furthermore, digital capacities can also be extended to collect feedback from farmers, which can be systematically analyzed and used to inform continuous improvements.

To address these challenges, we implemented an IVR-based approach to raise awareness of El Niño impacts and deliver mitigation advisory messages to farmers in Malawi and Zambia (11, 13) just prior to the start of the 2023/24 season. This approach aimed to provide timely action, assess its usefulness, and gauge farmer engagement. In addition, the IVR platform was used to gather feedback from farmers, using survey questionnaires. This activity emerged from a collaboration between two projects, namely, CGIAR's initiative on Excellence in Agronomy (EiA) and CIMMYT's United States Agency for International Development (USAID)-funded Southern Africa Accelerated innovation delivery initiative (AID-I) Rapid Delivery Hub. While EiA's Chinyanja Triangle Use Case operates in three countries (Malawi, Mozambique, and Zambia), AID-I extends its activities to the Democratic Republic of Congo (DRC) and Tanzania in addition to Malawi and Zambia. The two programs intersect in Malawi and Zambia, where the effects of the El Niño were anticipated to be particularly severe.

This study explores the functionality and effectiveness of the IVR platform in addressing climate-related challenges and emergencies and provides evidence to support the integration of digital advisory services into national agricultural strategies.

Materials and methods

Description of location of activity

The activity was carried out in Malawi and Zambia, both located in Southern Africa and characterized by maize-mixed cropping systems. Agriculture in these countries is predominantly rain-fed, with smallholder farmers relying heavily on seasonal rainfall for their livelihoods. Further, most farmers grow maize for subsistence and sell any surplus. Farmers also cultivate a variety of additional crops and sell surplus produce as a supplemental income source.

Interactive voice response

The approach utilized Viamo, a digital platform that offers on-demand information and nearby services (press 1 for topic x, press 2 for topic y) and uses an interactive voice response system to broadcast messages to farmers on widely used mobile telephone networks in Malawi and Zambia – namely Airtel in Malawi and MTN in Zambia. With IVR, farmers only needed a basic feature phone, as opposed to a smartphone, to navigate the platform by dialing in and responding to voice prompts. The system allows listeners to listen to the whole message, stop midway, or reply to the same message as needed. Additionally, message listening statistics show the level of engagement of content with the farmers.

Additionally, for survey components, the IVR approach was also used to collect farmer responses. To encourage full participation, farmers received an incentive of USD 0.50 upon completing the survey. Only complete survey responses were considered for this report.

Standardization of El Niño campaign messages and deployment

The Excellence in Agronomy (EiA) initiative led the collaborative development of the GROWSMART campaign (G.R.O.W. S.M.A.R.T.: The Farmer's Essential Guide to Thriving in the Face of El Niño and Other Climate Challenges - CGIAR), whose name is an acronym for a list of crucial choices for farmers in responding to El Niño. In a collaborative co-development workshop, EiA GROWSMART and AID-I prioritized eight key messages with partners from the national departments of agriculture research, agriculture extension, and meteorological services.

The first message defined the El Niño phenomenon to improve farmer knowledge and alerted farmers that the current year was an El Niño event year. The subsequent seven messages focused on El Niño coping strategies, including: advice on the selection of drought-tolerant crops and a variety of options, conservation agriculture, managing soil moisture and soil fertility using organic and inorganic options, diversification to reduce risk, and timely planting and good agricultural practices to reduce disease incidence.

Messages were tailored to local contexts and translated into Chichewa in Malawi and into eight vernacular languages in Zambia, namely Chichewa, Bemba, Tonga, Lozi, Nyanja, Kaonde, Lunda and Luvale. To ensure clarity and cultural appropriateness, messages were recorded and deployed after pre-testing in both countries.

Questionnaire survey on the usefulness of the campaign

Following the El Niño survey, a 15-question digital survey was implemented via the IVR platform to evaluate the effectiveness of the messages for awareness. The survey questions were divided into three main categories.

The first category of questions aimed to understand farmers' knowledge and perspectives. Then other questions were meant to understand farmer adaptation strategies under the El Niño conditions. Finally, the objective of the third category of questions was to understand the socioeconomic implications of the interaction between the El Niño event and the farmers' responses.

In the first category, questions were about farmers' preferences for platforms for receiving advisory information, whether meteorological forecasts affect crop choice and planting dates, and the status of knowledge of weather-indexed insurance. The second category aimed to assess the longest dry spell farmers experienced, their coping strategies, their worst and least affected crops, any hindrances to implementing coping strategies, and how El Niño had affected the food self-sufficiency of their households. Finally, the third category of questions asked farmers about their outcomes with regard to crop yield and food and nutrition security.

Data analysis

Data was retrieved from the Viamo database and analyzed to draw conclusions on farmers' knowledge, coping strategies, and the impact of the drought. The R software, designed for statistical computing and data visualization, was used to perform summary statistics, create visual representations, and conduct contextual analysis. Trends in farmer outcomes, based on their situations and adaptation strategies, were examined through variable correlations. Descriptive statistics were employed to detail the experiences of farmers in the two countries.

Results

a. Descriptive statistics: Reach and interest in the messages

Message Reach

The El Niño awareness campaign achieved impressive milestones, with messages reaching over one million unique listeners across Malawi (957,200) and Zambia (107,900), significantly surpassing the target of 180,000 listeners. On average, each listener in Malawi listened to three messages in full, while those in Zambia listened to five messages in full (Figure 1). The audience comprised 61% of males and 39% of females. About 25% of age-registered listeners in Zambia and 58% in Malawi were under the age of 18. The majority of listeners tuned in using the Chichewa language and were predominantly located in the Central region of Malawi and Central Province in Zambia.
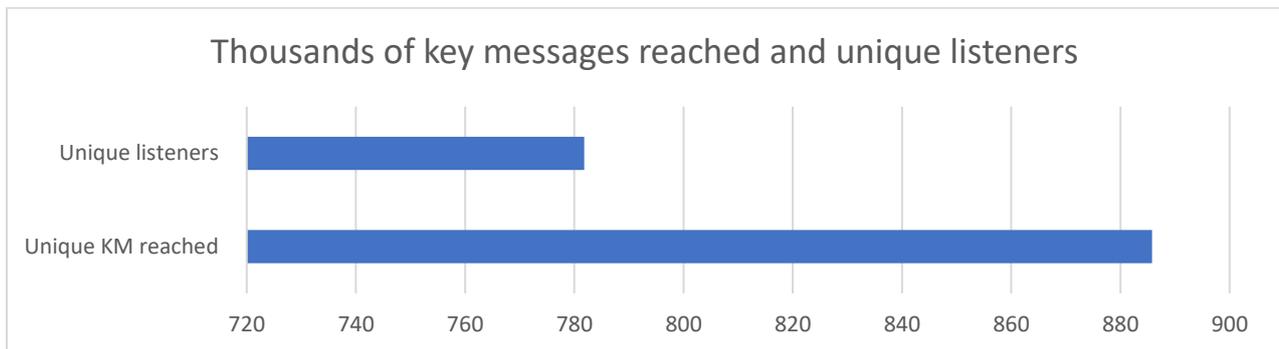

Figure 1. Thousands of unique listeners and unique key messages reached in the El Niño interactive voice response campaign in Malawi and Zambia.

b. Farmer feedback survey

Demographics, knowledge, and perceptions

A total of 4,000 follow-up feedback surveys were collected, with 2,000 respondents per country. Most respondents were male, accounting for more than 60% of the surveyed audience.

In Zambia, the largest proportion of respondents (45.3%) found the messages useful for both awareness and preparedness, followed by awareness only (27.6%) and then preparedness (20.2%). In Malawi, a large proportion of respondents found the messages useful for awareness (44.1%), followed by a combination of both awareness and preparedness (19.2%), then preparedness (32.7%). In both countries, a small proportion of listeners – 4.01% in Malawi and 6.9% in Zambia – answered that the messages were not useful for either purpose (Figure 2).
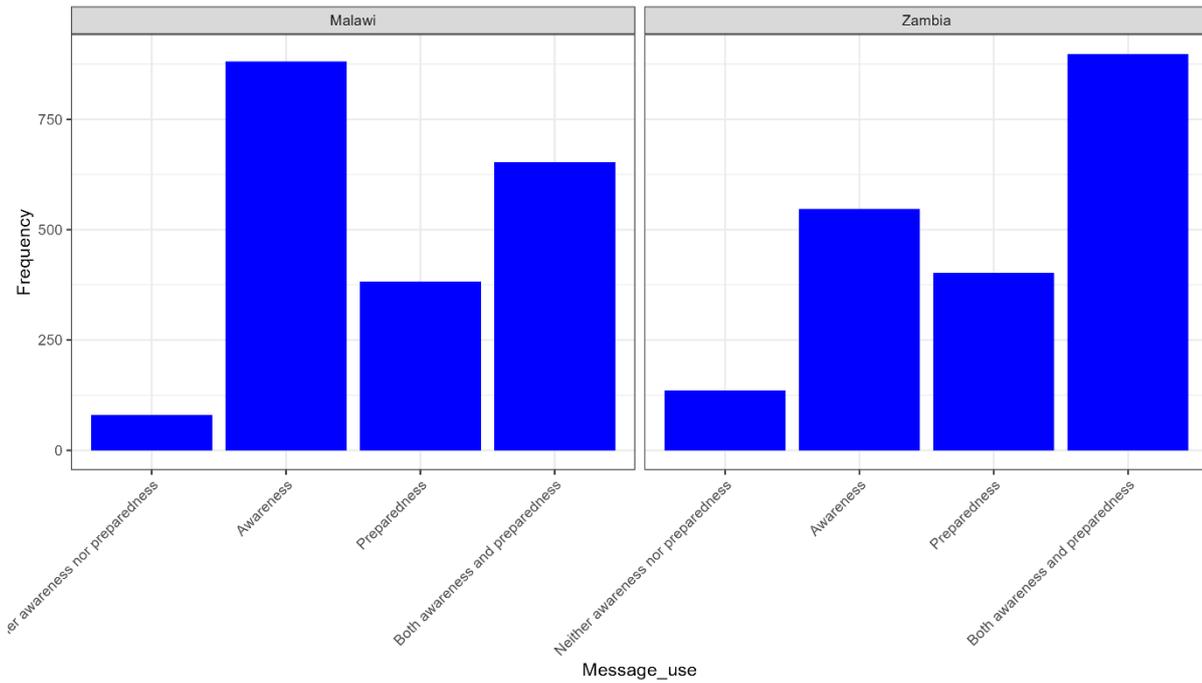
Figure 2. Distribution of purpose for which listeners found the messages.

With regard to preference for the mode of receiving extension messages, the findings were consistent across the two countries, with individuals rating the radio as the most preferred mode of communication, while TV was the least preferred. The second most preferred means of information was participatory community platforms, followed by extension officers, and then WhatsApp (Figure 3). An overwhelming majority of farmers reported that meteorological forecasts influenced their choice of crops to grow and planting dates (Figure 4 and Figure 5).
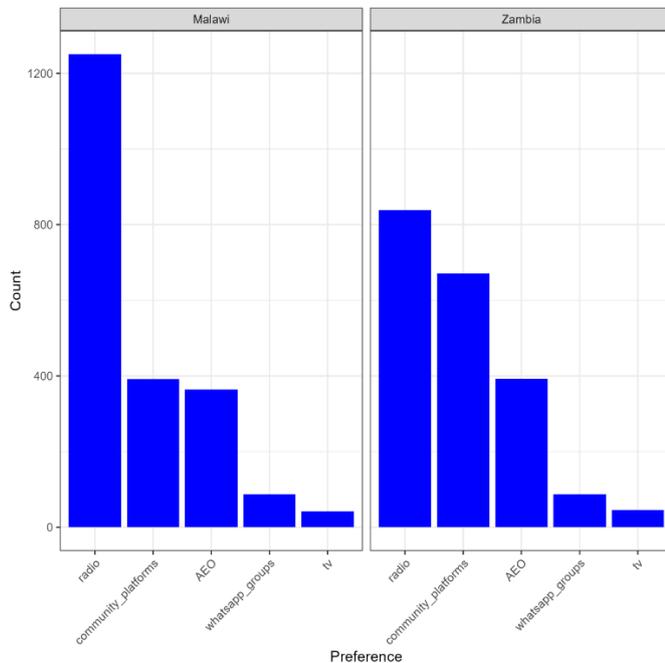

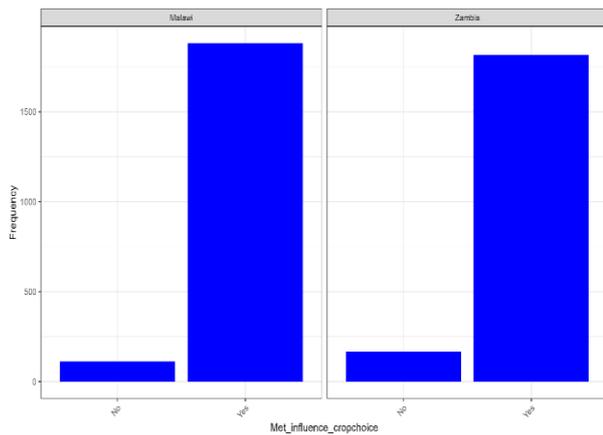Figure 3. Preferred mode of receiving extension messages.

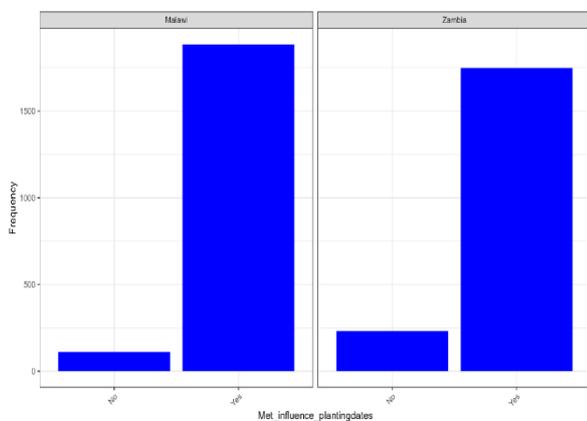Figure 4. Meteorological information influence on crop choice.

Figure 5. Meteorological information influence on planting dates.

El Niño effects

Approximately 40% of respondents in Malawi, the majority of which are from the Northern and Central Regions of the country, and about 14% of respondents in Zambia reported no negative effects due to the El Niño. In Malawi, more than 30% of respondents reported between 0% and 20% losses and slightly less than 30% had more severe effects in maize yield loss. The longest dry spell was categorized in 5-day increments, ranging from 0 to 5 days to more than 21 days. Notably, no individuals reported their longest dry spell as ranging from 0-5 days. Records were distributed across the rest of the categories, with more than 25% of respondents reporting dry spells lasting for 6 to 10 days and more than 21 days (data not shown).

Drought-tolerant crops and varieties were the most common coping strategies farmers used, followed by conservation agriculture and crop nutrition management (Figure 6). Most farmers in Zambia reported total crop failure as the main effect of El Niño, while in Malawi an increased incidence of pests was reported in a slightly bigger proportion than total crop failure (Figure 7). Maize was reported as the worst affected crop in both countries, while a range of other crops including soybean, cowpea, and groundnuts were reported as least affected, (Figure 8).

An increase in the length of the dry spell was directly associated with an increase in the maize yield losses (Figure 9). In Malawi, dry spells exceeding 21 days were associated with slightly less than 70% losses in maize yield, while the effect was stronger in Zambia, with a loss greater than 90% for the same duration of dry spell. The shortest category of dry spells (6 to 10 days) was associated with 50% to 60% yield losses in Malawi and 70% to 80% losses in Zambia. Only about 10% of respondents felt that they were self-sufficient in food after the El Niño effects, while the remaining respondents described their conditions as ranging from difficult to catastrophic (Figure 10). In addition, approximately 70% of respondents reported having no knowledge of weather index insurance (data not shown).
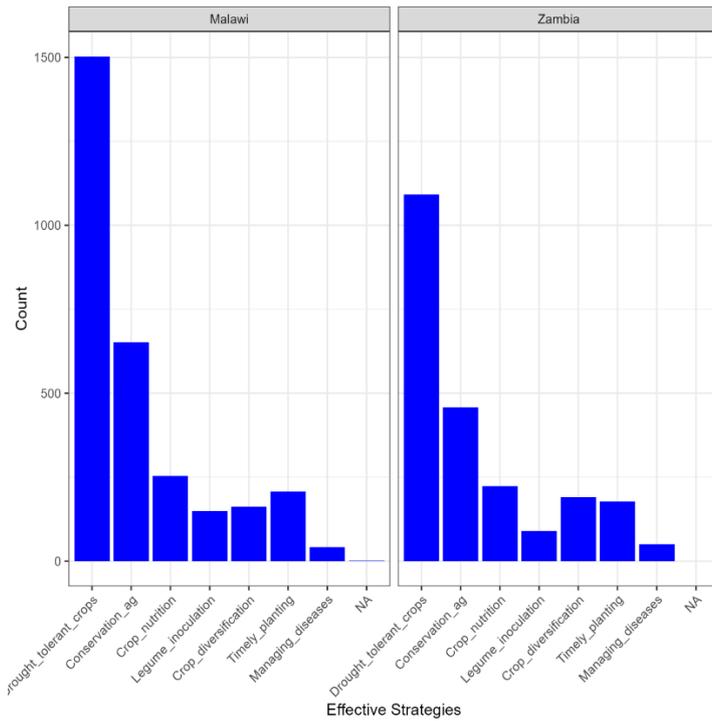
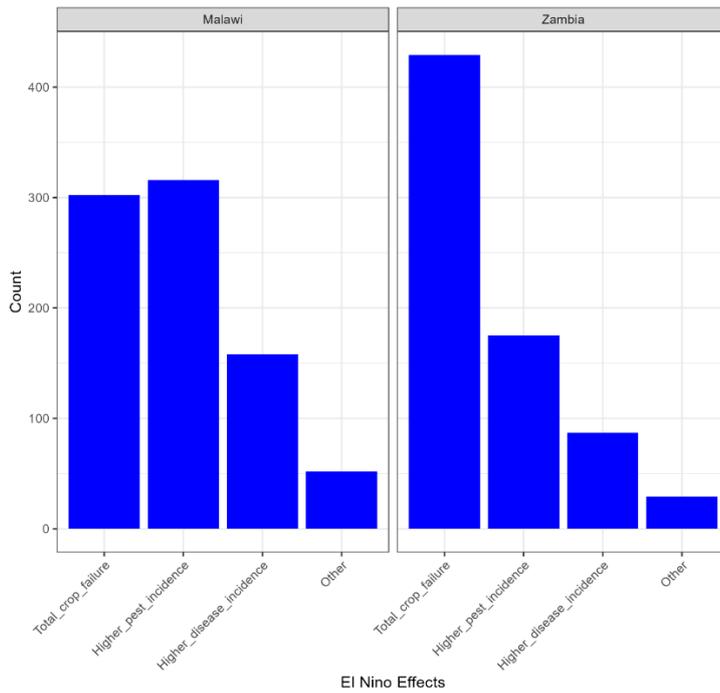Figure 6. Coping strategies used by farmers.
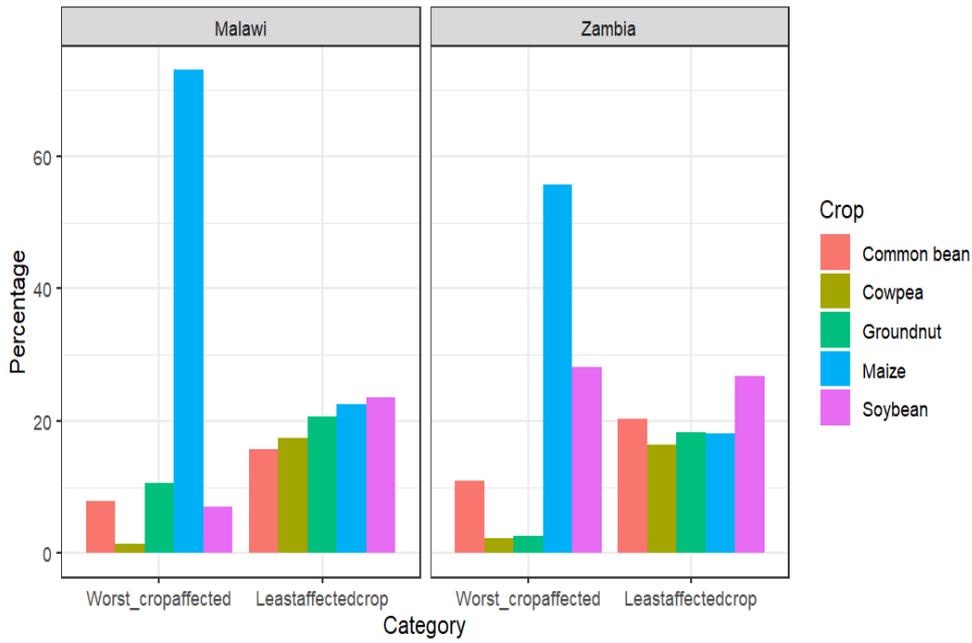

Figure 7. Effects of El Niño on crops.

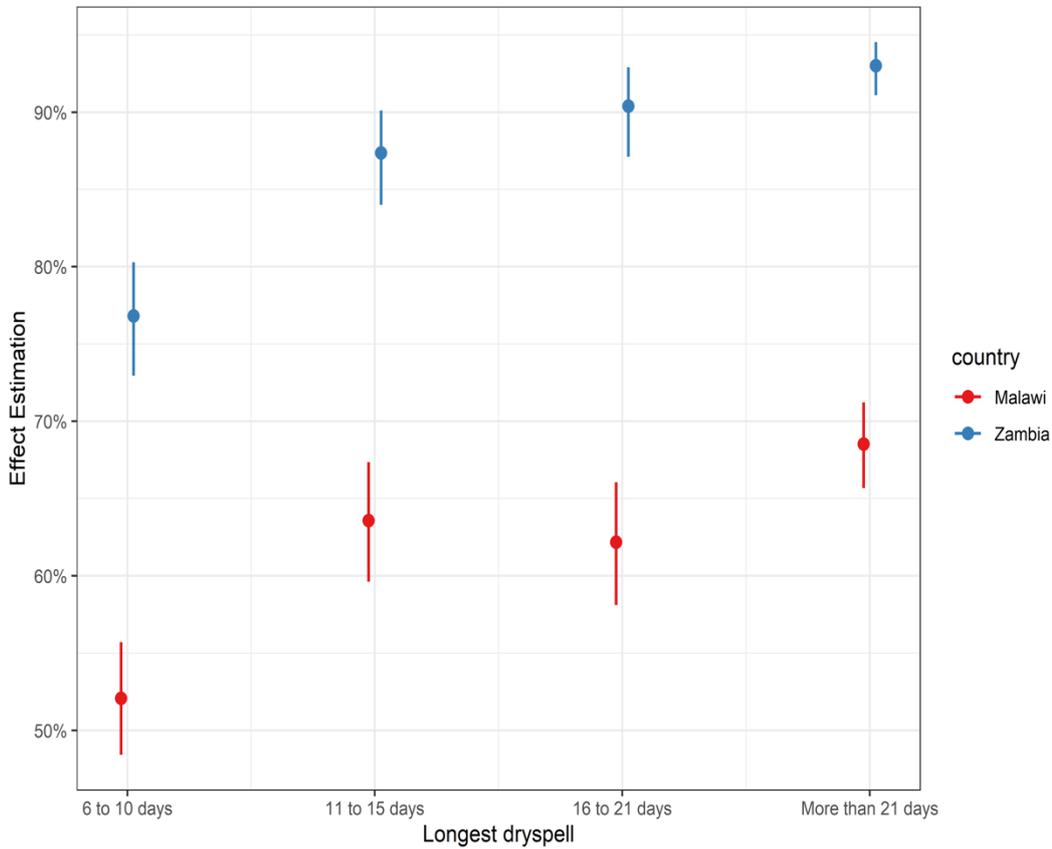Figure 8. Worst and least affected crops.

Figure 9. Relationship between duration of dry spell and estimated yield penalty in Malawi and Zambia.
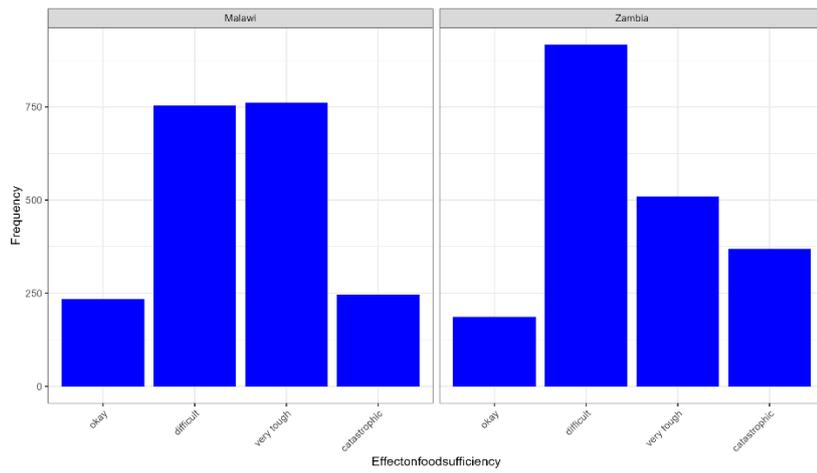
Figure 10. Food sufficiency after the El Niño.

Discussion

Knowledge, perceptions, and the opportunity of digital approaches

Smallholder farmers often lack the knowledge and coping mechanisms needed to implement resilient strategies against climate change. This report outlines efforts to raise awareness and provide advisories to enable farmers to respond to El Niño events effectively. Digital technologies, including television, social media, and phone-based approaches, have proven to be effective channels for disseminating information (14). Among these, IVR is particularly noted for its rapid and scalable information dissemination (15), though some argue that digital technologies' successes, including mobile apps, have been overstated (8).

In this study, most farmers preferred radio as a mode of receiving information, followed by community platforms, WhatsApp, and TV. These findings highlight the need for a multidisciplinary approach to addressing farmer constraints in accessing advisories (16). The findings support the use of multiple agricultural extension methods, with IVR platforms playing a valuable role.

Climatic uncertainty continues to severely impact agricultural outcomes, as farmers often fail to make appropriate decisions in a timely manner. The lack of adequate climate information prevents farmers from widely using and benefiting from improved decision-support tools. Providing agro-climatic advisories that integrate climate data with agricultural response strategies can enhance the livelihoods of smallholder farmers. This study found that most smallholder farmers use weather forecasts to select crops, varieties, and planting dates. Significant advancements in weather forecasting science can support farmers in making better-informed choices. Timely deployment of this information can help build resilience among smallholder farmers.

The extent of El Niño events, farmer responses, and outcomes

El Niño events, characterized by various types of droughts, including mid-season dry spells, lead to moisture stress and crop yield penalties. Our investigations showed that during the 2023/24 El Niño, farmers in Malawi and Zambia experienced dry spells ranging in length from 6 to 10 days to over 21 days, with Zambia experiencing longer spells. There was a clear correlation between the duration of the dry spells and maize yield losses. The results call for the development of supportive policies to mitigate the impact of prolonged droughts on smallholder farmers.

The GROWSMART campaign promoted agronomic advisories to help farmers cope with drought, emphasizing strategies such as conservation agriculture, planting with the first effective rains (17), balanced fertilization, and the adoption of drought-tolerant crops and varieties to improved outcomes. Most farmers cited drought-tolerant crops as their best coping strategy, followed by conservation agriculture. Despite these efforts, maize, which is the staple crop in Malawi and Zambia, was the worst affected, especially in the southern regions, where farmers reported catastrophic effects.

Financial constraints remain a significant barrier, hindering many farmers from implementing coping strategies. Initiatives such as Farmer Field Business Schools (FFBS) and village savings and loan schemes have been shown to help alleviate these barriers (18). Additionally, digital approaches can further improve access to credit and financial services. However, the widespread and severe effects of El Niño suggest the need for governments to proactively address climate vulnerability rather than rely on international aid at the last minute.

Gender disparities in access to digital advisories also present a critical challenge. The study revealed that men and younger farmers were more likely to access IVR messages compared to women and the elderly. Lower access to messages by women, who are crucial for agricultural productivity, is concerning and while mobile phone-assisted methods have potential, current evidence shows persistent gender disparities in ownership and usage. Addressing these inequalities is crucial to optimizing the impact of digital agricultural extension.

Discussion

The findings from this study demonstrate that the incidence and impact of the 2023/2024 El Niño event was more severe on Zambian farmers compared to their Malawian counterparts. Nonetheless, both countries remain highly vulnerable. With high engagement from smallholder farmers, where farmers interacted with 3 to 5 out of 8 available messages, this study demonstrates that digital advisories can support knowledge-based decision-making and improve farmer outcomes. However, digital advisories need to be part of a broader portfolio of methods, allowing farmers to choose their preferred option for knowledge acquisition. Integrating digital advisories into strategic agricultural advisory systems, especially for emergency services, is critical for reaching a wider audience. Furthermore, governments must establish and implement policies that enable farmers to adopt and apply effective coping mechanisms and overcome barriers to responding to El Niño. Lastly, special attention should be paid to improving access to advisory services by women, who are crucial to agricultural productivity, by addressing gender disparities in digital tool ownership and use.

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