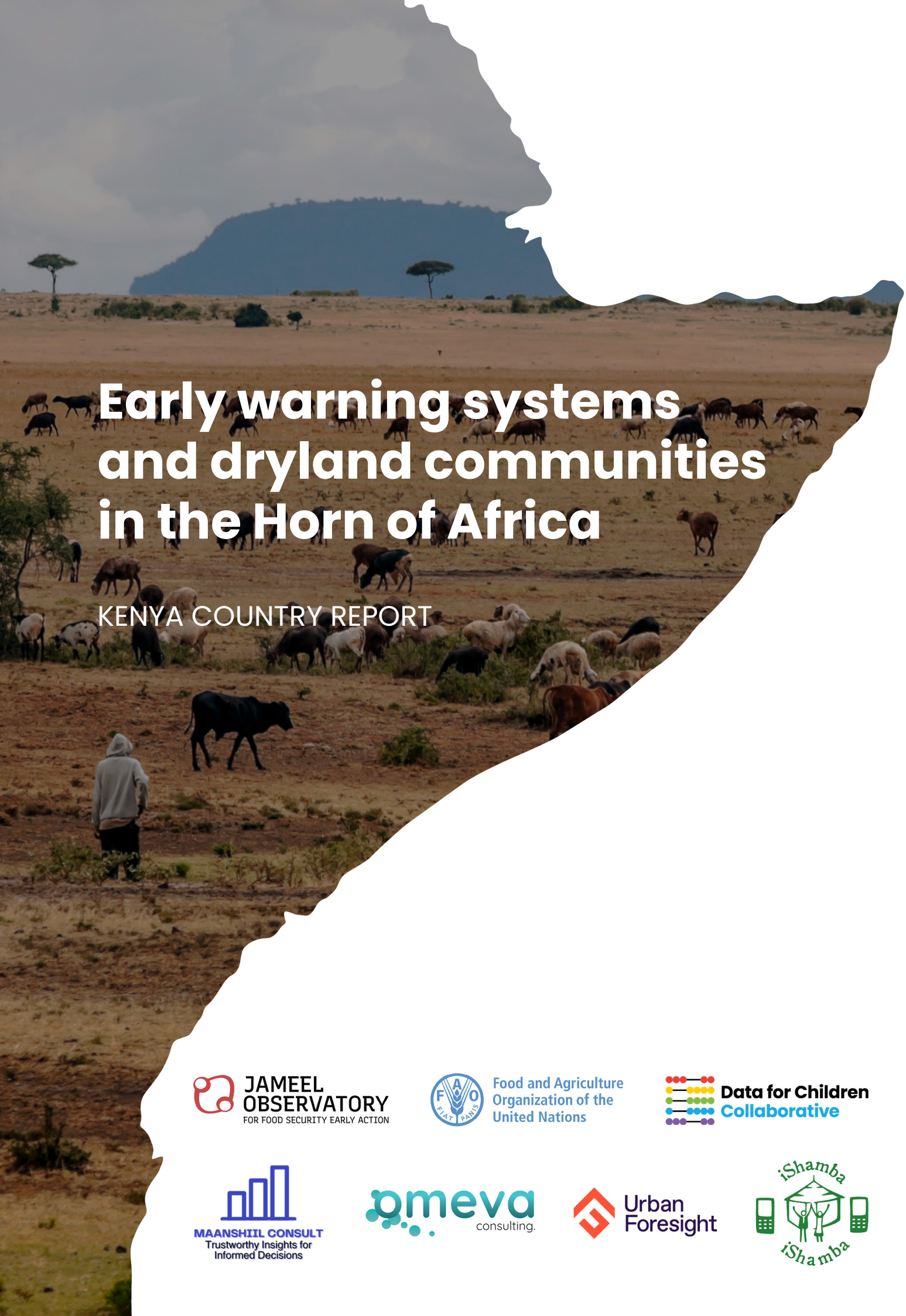

Early warning systems and dryland communities in the Horn of Africa

KENYA COUNTRY REPORT

JAMEEL OBSERVATORY
FOR FOOD SECURITY EARLY ACTION

Food and Agriculture Organization of the United Nations

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Kenya country report

Alvin Muhandale, Lilian Kirwa, Aurelie Walker, Julia Allard, Fraser Brown, Abdulfatah Adam, Naima Mohammed, Maria de la Puerta Fernandez, Nathaniel Jensen, Brenda Lazarus, and Kim Kristensen

January 2026

Acknowledgements

Staff from iShamba Limited (Kenya), Maanshil consult (Ethiopia), Omeva Consulting, and Urban Foresight are thanked for their contribution to this report. We also thank the Jameel Observatory for Food Security Early Action for financing this study, the Data for Children Collaborative for posing the challenge question, and the Food and Agriculture Organization of the United Nations who acted as sponsor for the question.

Sincere thanks are extended to all of those who supported with the coordination of the fieldwork in Kenya, the key informants who were interviewed, and the communities who participated in the research.

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Suggested citation

Muhandale, A., Kirwa, L., Walker, A., Allard, J., Brown, F., Adam, A., Mohammed, N., De la Puerta Fernandz, M., Jensen, N., Lazarus, B., and Kristensen, K. 2026. *Early warning systems and dryland communities in the Horn of Africa: Kenya country report.* Edinburgh, Urban Foresight for the Jameel Observatory for Food Security Early Action and the Food and Agriculture Organization of the United Nations.

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Contents

List of acronyms

AA	Anticipatory Actions
AI	Artificial Intelligence
ASAL	Arid and Semi-Arid Lands
CBDRR	Community-Based Disaster Risk Reduction
CCCF	County Climate Change Funds
CIDP	County Integrated Development Plans
CSDRM	Climate Smart Disaster Risk Management
DEWS	Drought Early Warning System
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
EWS	Early Warning Systems
FAO	Food and Agriculture Organization of the United Nations
FEWS NET	Famine Early Warning Systems Network
FGD	Focus group discussions
GDP	Gross Domestic Product
GHACOF	Greater Horn of Africa Climate Outlook Forum
GIS	Geographic Information System
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
HERC	Human Ethical Review Committee
HoA	Horn of Africa
ICPAC	IGAD Climate Prediction and Applications Centre
ICRC	International Committee of the Red Cross
ICT	Information and communication technologies
IDDRSI	IGAD Drought Disaster Resilience and Sustainability Initiative
IGAD	Intergovernmental Authority on Development
IK	Indigenous Knowledge
ILRI	International Livestock Research Institute
IREC	Institutional Research Ethics Committee (of ILRI)
KII	Key Informant Interviews
KMD	Kenya Meteorological Department
KRCS	Kenya Red Cross Society
MIDP	Merti Integrated Development Programme
MIMS	Multilayer Management System
NACOSTI	National Commission for Science, Technology and Innovation
NCCAP	National Climate Change Action Plan

NCOFs	National Climate Outlook Forums
NDCF	National Drought Contingency Fund
NDMA	National Drought Management Authority
NDOC	National Disaster Operations Centre
NGO	Non-Government Organisation
OCHA	Office for the Coordination of Humanitarian Affairs
OSS	Sahara and Sahel Observatory
PSP	Participatory Scenario Planning
SMS	Short Message Service
SPI	Standardized Precipitation Index
UN	United Nations
UNDRR	United Nations Office for Disaster Risk Reduction
UNICEF	United Nations Children's Fund
VCI	Vegetation Condition Index
WFP	World Food Programme
WISER	Weather and Climate Information Services for Africa

Foreword: Understanding early warning systems and dryland communities in the in Horn of Africa

Pastoral and agro-pastoral communities in the Horn of Africa face severe challenges from climate shocks and natural disasters. Frequent droughts, erratic rainfall, and extreme weather events leave millions food insecure, exacerbated by a reliance on rain-fed agriculture and pastoralism. Despite advancements in scientific weather forecasting, many communities struggle to access reliable and actionable information, while poor infrastructure further delays response efforts.

In 2023, the Jameel Observatory for Food Security Early Action commissioned and financed an 'impact collaboration' process aimed at reducing the impacts of shocks on pastoral and agro-pastoral communities in East Africa by studying if and how early warning systems could better support those communities. This process was 'sponsored' by the Food and Agriculture Organization of the United Nations acting as 'customer' for the outputs and emerged from a co-development process with stakeholders from the region facilitated by the Data for Children Collaborative. The impact collaboration process and team were established to address the following challenge question.

Challenge question

"How can we bridge the disconnects between food security, climate, and natural hazards early warning systems and the anticipatory actions that pastoral and agro-pastoral communities in the Horn of Africa can take to overcome recurring shocks and threats to their lives and livelihoods?"

This challenge question prompted a year-long study on early warning systems and anticipatory actions in the Horn of Africa, resulting in a desk review and country reports for Ethiopia and Kenya. This Kenya Country Report is part of that series.

1. Introduction

Kenya straddles the equator and features diverse climates ranging from tropical coasts to arid interiors. The country's population exceeds 55 million and is made up of over 40 ethnic groups, each with distinct languages and traditions (World Bank, 2023). While this diversity enriches Kenya's culture, it also poses challenges for social cohesion. Swahili and English are the official languages, but there are over 80 languages spoken there.

Kenya has a mixed economy driven by agriculture, manufacturing, and services, with agriculture as the main employer and exporter of tea, coffee, and horticultural products. The country's GDP grew by 5.6% in 2023, led by strong performance in agriculture, forestry, and fishing (World Bank, 2024). Infrastructure development and education remain key priorities, though rural inequalities persist (Kochore, 2016).

Across Kenya's drylands, the seasons are increasingly unpredictable: droughts last longer, sudden floods destroy roads and pasture, and rain-reliant households must make high-stakes decisions with imperfect information.

Building resilience in this context depends on communities' ability to anticipate and prepare for climate shocks: to act early, not just react. Early warning systems play a crucial role in enabling such anticipatory action (AA), but their effectiveness relies on timely communication, trusted intermediaries, and alignment with local realities. Alongside scientific forecasting, Indigenous knowledge remains a vital resource, offering locally attuned insights that can complement and strengthen formal systems when integrated appropriately.

This report describes qualitative research conducted with agro-pastoral and pastoral communities in Kenya. The study aimed to identify early warning communication methods and their limitations, document existing Indigenous knowledge, and co-design recommendations to improve early warning systems with these communities. More specifically, the research was guided by the following objectives:

- Identify current early warning communications methods both available and most used, formal and informal, modern and Indigenous, as identified by communities.

- Carry out community engagement to understand barriers to current communications channels and communities' preferred channels of communications; and to understand how local actors in agro-pastoral and pastoral communities interpret and act on the content that they receive.
- Co-design recommendations with the communities concerned on the preferred content and means of communication for an effective early warning system so they can effectively respond based on this messaging.
- Document the community practices and Indigenous knowledge used to anticipate and mitigate climate shocks and disasters. Assess the effectiveness of the practices and the potential to scale the response to the national or regional level. Explore opportunities to integrate community practices and Indigenous knowledge into scientific early warning systems to improve their effectiveness and acceptance levels.

This report presents the findings from fieldwork undertaken in two communities in Kenya. It begins with an overview of the current EWS institutions and policies in Kenya, before outlining the methodology used in the fieldwork. The findings from the focus group discussions (FGD) and key informant interviews (KII) are then presented thematically to address the key aims of the research.

2. Background

2.1 Overview of early warning systems and key policy frameworks in Kenya

Kenya's early warning systems (EWS) have evolved considerably since their establishment in the 1980s, shifting from basic meteorological alerts to complex multi-hazard climate risks systems. The Kenya Meteorological Department (KMD) began laying the groundwork in the early 1980s, after recurring episodes of severe food insecurity devastated the country, by providing simple weather forecasts and drought notices. In the 1990s, community-based monitoring was introduced through projects such as the Arid Lands Resource Management Project (1996), marking the first efforts to localize drought EWS.

Between 2000 and 2010, three key institutional developments took place. The National Policy for Disaster Management (Government of Kenya, 2009) formalized a multi-hazard approach; the National Climate Change Response Strategy (Government of Kenya, 2010) officially endorsed EWS as an adaptation measure; and, most notably, the parliamentary enactment in 2011 established the National Drought Management Authority (NDMA). The NDMA transformed drought monitoring in Kenya by systematically integrating satellite data with ground observations through its Drought Early Warning System (DEWS).

Since 2015, technological advancements and decentralization have further shaped the development of Kenya's EWS. The NDMA began issuing routine drought bulletins and collaborative agreements with the technology company IBM were established to improve forecasting accuracy. The National Climate Change Action Plan (Government of Kenya, 2023) formalized systems at the county level through the establishment of Climate Change Funds.

The NDMA has, over the years, integrated specific trigger thresholds into its monthly drought bulletins to guide timely response actions. These bulletins categorize drought severity into five phases (Normal, Alert, Alarm, Emergency, and Recovery) using indicators such as rainfall patterns, the Vegetation Condition Index (VCI), and the Standardized Precipitation Index (SPI).

A notable development occurred in the early 2020s when NDMA collaborated with broader government agencies to develop specific actions in response to each drought phase. Notably, reaching the "Alarm" phase now prompts the automatic

disbursement of funds from the National Drought Contingency Fund (NDCF) for early interventions. While it initially focused on emergency responses, NDMA has recently begun aligning its system with forecast-based action approaches, reflecting a broader move towards more anticipatory and proactive drought risk management, especially in Kenya's Arid and Semi-Arid Lands (ASAL) regions. This progress reflects the strategic transition that Kenya has made from reactive response to proactive, integrated risk management, an evolution evident in the expanded mandates of key institutions such as the KMD and NDMA.

Kenya has developed a multi-layered EWS policy framework to address climate-related disasters, including droughts, floods, and food insecurity. The framework integrates national policies, county-level implementation, and international commitments; however, gaps remain in coordination, funding, and community engagement. The National Climate Change Action Plan (NCCAP) 2023–2027 identifies EWS as a key adaptation priority within the country's Climate Smart Disaster Risk Management (CSDRM) approach. It emphasizes the development of multi-hazard systems that address droughts, floods, and pests, designating the Kenya Meteorological Department as the lead agency responsible for forecasting and coordination (Government of Kenya, 2023). Complementing this, the National Disaster Risk Management Policy establishes the National Disaster Operations Centre (NDOC) to coordinate alerts and responses. It promotes a hybrid approach that integrates Indigenous knowledge with scientific methods, aiming to strengthen preparedness, risk reduction, and resilience across all levels of society.

The Kenya Meteorological Policy (Government of Kenya, 2020) further enhances the provision of weather, climate, and hydrological information in support of national development, climate change adaptation, and disaster risk reduction. It positions the KMD as the sole authority mandated to produce and disseminate official forecasts and early warning information, emphasizing that these forecasts must be timely, accurate, and locally relevant. The policy advocates for accessible communication through SMS, radio, and community networks, as well as participatory scenario planning with farmers, pastoralists, and county governments to ensure information is meaningful and actionable at the local level.

At the subnational scale, County Integrated Development Plans (CIDPs) and County Climate Change Funds (CCCFs) provide vital resources for community-based EWS, particularly in ASAL counties. Examples include drought monitoring through livestock body condition assessments and flood alerts using river gauges and local scouts (ACTED, 2022). Isiolo's CIDP (2023–2027), for instance, supports mobile alert systems

for pastoralists, while Tharaka Nithi's CIDP focuses on agro-pastoralist advisories delivered through farmer networks (County Government of Isiolo, 2023).

2.1.1 Kenya Anticipatory Action Roadmap (2024-2029)

Despite decades of early warning work, until recently, most efforts have focused on informing emergency response, rather than taking an AA approach. This has started to change, however, with Kenya taking steps towards institutionalizing AA. Kenya's Anticipatory Action Roadmap (2024–2029), launched in August 2024, marks a major shift towards proactive climate risk management. Developed collaboratively by government institutions and non-state actors, including UN agencies, the Red Cross, and NGO partners, the roadmap aims to respond to the growing frequency and severity of climate-related disasters affecting communities, particularly in the ASAL regions. Moving beyond reactive disaster response, it recommends a structured and forward-looking approach that enables action ahead of forecasted hazards to minimize their impact.

The roadmap presents an integrated framework, built around seven thematic pillars: Early Warning; Early Action; Coordination and Governance; Research, Innovation and Learning; Policy and Advocacy; Financing; and Monitoring and Evaluation. These pillars are designed to ensure that anticipatory measures in Kenya are informed, timely, and embedded within existing systems. The strategy is aligned with global and regional frameworks, including the Sendai Framework for Disaster Risk Reduction, Africa Agenda 2063, IGAD's Drought Disaster Resilience and Sustainability Initiative (IDDRSI), and the IGAD Regional Roadmap for Anticipatory Action.

Implementation began with the formation of technical working groups, inclusive stakeholder consultations, and the development of a national roadmap implementation workplan. A strong emphasis is placed on local, community-based systems as the foundation for effective AA. As the roadmap moves forward, the focus is on embedding AA into national and county-level disaster risk management structures, ensuring Kenya is better equipped to safeguard lives and livelihoods from future climate-related disasters.

Building on the foundational overview of EWS and the Kenya Anticipatory Action Roadmap (2024–2029), Kenya has made notable progress in institutionalizing AA mechanisms to mitigate climate and disaster-related risks. The roadmap emphasizes strengthening predictive capacities, community responsiveness, and cross-sectoral coordination, areas that directly interact with the performance of Kenya's current EWS.

2.2 International and non-governmental organizations

Several intergovernmental and international stakeholders also play important roles in EWS and AA in Kenya. For example, the Kenya Red Cross Society (KRCS) has supported the development of Flood Early Warning Communication Strategies for Kilifi, Garissa, and Tana River Counties in Kenya, in collaboration with local governments. GIZ, in cooperation with local ministries, also supports the establishment and implementation of EWS in Kenya. Additional organisations involved in early warning systems and anticipatory action in Kenya include ICPAC, FEWS NET, Mercy Corps, Save the Children, WISER, the ICRC, WFP, UNICEF, UNDRR, the World Bank, OCHA, FAO, ILRI, and CGIAR. Further details are available in the related desk review by De la Puerta Fernandez et al., (2025).

2.3 Technology providers

Modern telecommunications and digital innovation are playing an increasingly central role in strengthening Kenya's early warning systems. Mobile network operators such as Airtel and Safaricom have integrated early warning and climate information services into their broader communication and agricultural platforms.

Airtel Kenya, for instance, disseminates early warning information to subscribers through SMS alerts, voice calls, and mobile or social media applications. These alerts provide critical information on impending disasters, safety measures, and evacuation procedures. Through the Kenya Red Cross-supported Trilogy Emergency Relief Application platform, Airtel has sent targeted SMS warnings that include actionable advice, such as relocation guidance, alongside hazard notifications (IFRC, 2016). However, Airtel continues to face significant challenges in reaching all users effectively due to poor network coverage in some areas (Abuya, 2025).

Safaricom Kenya has collaborated with the Kenya Red Cross to send SMS early warning messages to over 11 million people living in flood prone areas (Safaricom, 2023). These messages, disseminated via the M-Salama/SMS warning tool, have provided information on natural disasters and guided many families to move to higher ground or take protective decisions ahead of floods (African Leadership Magazine, 2018). Safaricom Kenya has also developed several digital platforms that contribute indirectly to early warning and anticipatory action. Its flagship product, DigiFarm, offers farmers access to affordable inputs, credit, insurance, and market

opportunities, while also providing agricultural training and extension services through digital channels and local advisors (Digifarmkenya.com, n.d.).

Similarly, iShamba, launched in 2015, delivers timely agricultural and weather information directly to farmers' phones, supported by a call centre staffed with agricultural experts. Drawing weather forecasts from Plant Village, iShamba ensures that farmers can make informed decisions based on accurate and localized information. Its web-based tool, Budget Mkononi, further supports young or inexperienced farmers by helping them plan and budget for their farming enterprises (ishamba.com, n.d.).

At the regional level, Kenya also benefits from the HUSIKA Multilayered Information Management System (MIMS), developed by the IGAD Climate Prediction and Applications Centre (ICPAC) in partnership with the Sahara and Sahel Observatory (OSS) and funded by the Adaptation Fund. HUSIKA serves as an interactive platform for sharing and receiving early warning information through web, mobile, and SMS interfaces. It aims to enhance communication, knowledge exchange, and awareness across the Greater Horn of Africa, providing an innovative ICT-based solution to improve disaster resilience and the reach of early warning systems (Global Water Partnership, 2022).

While ICT-enabled access to EWS is promising, there is an opportunity for disaster messaging to include more specific actions tailored to the needs of pastoralists.

2.4 Successes and lessons learned from Kenya's early warning systems

Kenya has built a strong policy foundation for early warning and disaster preparedness. Frameworks such as the National Climate Change Action Plan (NCCAP 2023–2027) and the National Disaster Risk Management Policy (2021) position EWS as a central pillar of climate adaptation and disaster preparedness. These policies clearly define institutional mandates, such as the Kenya Meteorological Department for forecasting and the National Drought Management Authority for drought monitoring, helping to institutionalize practices like weekly drought bulletins and contingency planning. Complementary instruments, including the Kenya Meteorological Policy, reinforce participatory scenario planning and ensure that forecasts are better aligned with the needs of pastoralist and agro-pastoralist communities. Although national frameworks clearly outline institutional mandates, coordination between agencies such as KMD, NDMA, and county governments often breaks down during implementation. Overlapping roles and unclear responsibilities

delay decision-making and reduce the efficiency of response mechanisms (Kenya Law, 2021).

While Kenya's EWS are underpinned by strong policy frameworks, financing remains a significant constraint. Disaster risk reduction (DRR) and EWS activities receive less than 2% of the national and county budgets (Owino, 2019), limiting the scale and sustainability of SMS alerts, radio broadcasts, community training, and essential infrastructure such as flood gauges and monitoring systems.

Kenya's current EWS now adopts a multi-hazard climate risk perspective, expanding beyond its earlier focus on drought to encompass floods, pests, and other hazards. This shift acknowledges the compounding nature of overlapping shocks, from flash floods in Tharaka Nithi to prolonged droughts in Isiolo and enables more comprehensive risk communication and preparedness planning.

Kenya's partnership with IGAD's Climate Prediction and Applications Centre (ICPAC) has also strengthened cross-border early warning capabilities, particularly for pastoralist communities such as the Borana, who move across administrative and national boundaries. Key regional initiatives such as the East Africa Hazards Watch and the East Africa Drought Watch provide harmonized, multi-hazard alerts. ICPAC's Forage Monitoring and Prediction Model has become an important tool for pastoralist planning, while forums such as the National Climate Outlook Forums (NCOFs) foster collaboration and localization of regional forecasts.

Aligning national systems with regional climate centres has enhanced the accuracy, timeliness, and credibility of alerts, while ICPAC's ongoing capacity-building efforts contribute to sustainable and effective use of these systems across Kenya. Such regional collaboration not only strengthens Kenya's access to ICPAC's modelling and early warning tools but also improves the accuracy and coverage of forecasts. Despite this, many communities report that warnings are either too general, too late, or not actionable. Forecasts such as "heavy rainfall expected" or "risk of drought" lack the specific timelines, locations, and recommended actions needed for meaningful preparation.

The increased use of diverse communication tools, including SMS, local radio, and digital platforms such as IBM Weather Insights, has improved the timeliness and accessibility of alerts. SMS dissemination has been especially valuable in remote areas with low internet penetration, while local FM radio has helped reach women, elders, and other groups often excluded from formal information channels.

Moreover, counties such as Isiolo have begun testing approaches for integrating IK systems, such as interpreting wind patterns, observing budding trees, and listening to birdsong, into formal EWS processes. Elders discuss and interpret forecasts at chief barazas before disseminating information to communities, providing cultural legitimacy and increasing trust in official messages. While not yet formalized, this hybrid approach between scientific and traditional knowledge offers a valuable model for strengthening local relevance and uptake of warnings. However, EWS remain largely top-down in design and delivery, leading many communities to view them as government-driven rather than participatory. This perception reduces trust and limits response rates, particularly when messages are not easily understood or locally contextualized. Women and young people, in particular, report limited involvement in early warning design, dissemination, or interpretation (Baudoin et al., 2016).

3. Study methodology

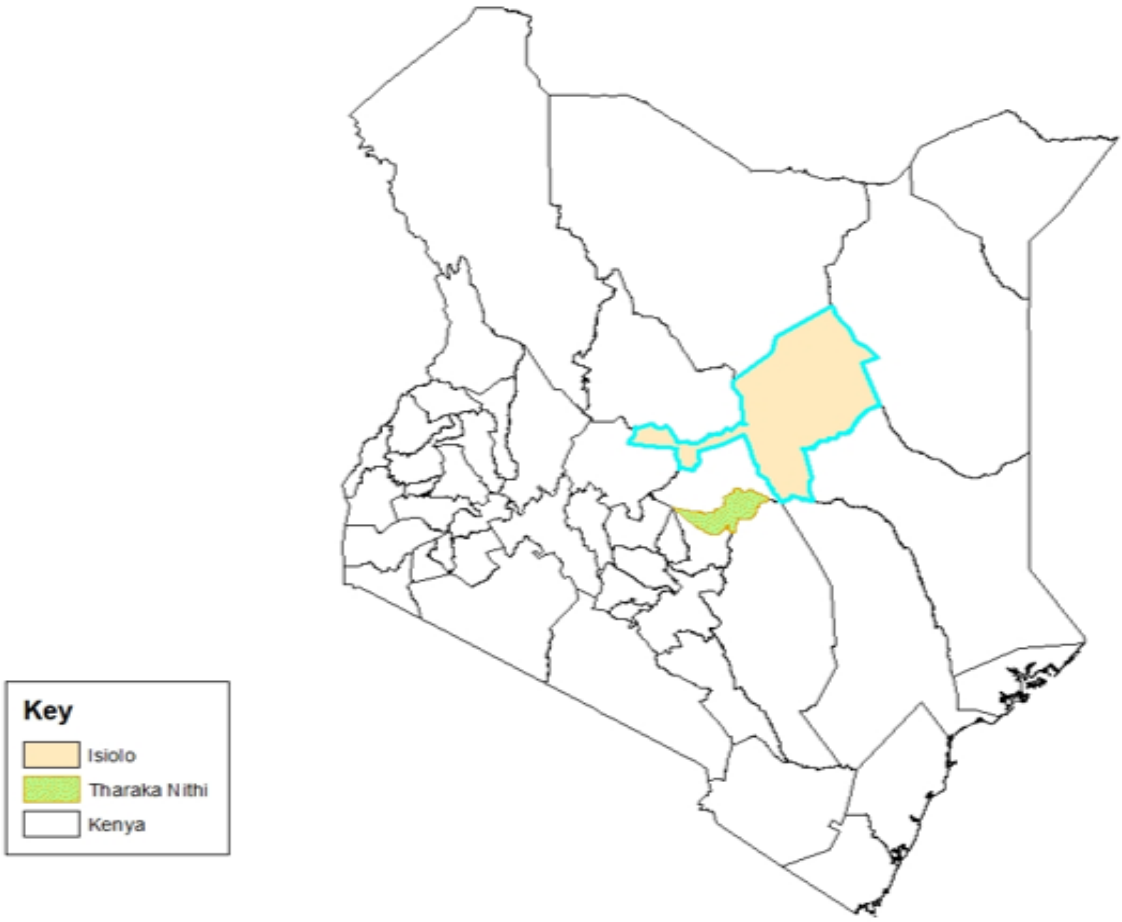
To complement the desk-based policy review outlined above, field research was undertaken in Kenya to gather community-level perspectives on early warning systems and anticipatory action.

This approach was driven by the need to understand how national systems are experienced on the ground, identify gaps between policy design and local realities, and explore how communities interpret and act on early warning information. Conducting fieldwork also enabled the research team to capture the role of Indigenous knowledge in climate preparedness, and to identify context-specific barriers and enablers of timely response. The following section outlines the methodology used to select study sites, gather data, and engage with community stakeholders.

3.1 Study sites and sample

The study utilized a multistage purposive sampling method to capture the experiences of a broad range of pastoralists and agro-pastoralists, particularly regarding the effectiveness of EWS communication systems for impending droughts and other hazards. While this approach does not yield statistically representative results for the population of Kenya, or even for pastoralists and agro-pastoralist groups, it still provides rich, context-specific insights from relevant groups. The fieldwork was conducted in two communities in Kenya: The Borana and Tharaka.

Figure 1: Study sites in Isiolo and Tharaka Nithi, Kenya



Purposive sampling is commonly used in qualitative research because it enables researchers to select participants with specific characteristics or experiences aligned with the study's objectives. In this case, it includes individual pastoralists and agro-pastoralists, community leaders, and local authorities, offering a comprehensive view of the communication methods and channels used in early warning systems.

The Borana and Tharaka communities, located in Isiolo County and Tharaka Nithi Counties respectively, were selected for this study for several reasons. Both regions face adverse climate shocks that are worsening over time, making EWS crucial for adaptation. In terms of livelihoods, the two communities represent the dominant systems in the Horn of Africa's (HoA) drylands: pastoralism and agro-pastoralism. Table 1 outlines the key differences between the two study locations.

Table 1: Comparative profile of Isiolo and Tharaka Nithi Counties

Category	Isiolo County	Tharaka Nithi County
Rainfall seasons	Bimodal, with long rains from March to May and short rains from October to December.	Bimodal, with long rains from March to May and short rains from October to December
Average annual rainfall amount	250-500mm (arid to semi-arid)	500-900mm (semi-arid to semi-humid)
Primary livelihoods	Pastoralism	Agro-pastoralism (mixed farming with cropping and livestock)
Main livestock types	Camels, goats, sheep	Cattle, goats, sheep, poultry
Key crops	Rain-fed farming is limited	Rely on drought-resistant crops such as cowpeas, sorghum, green grams
Accessibility	Highly remote	Moderate accessibility
Infrastructure and access to telecommunications, radio, and services	Road networks: Poor and seasonally impassable Mobile network coverage: Limited Radio: Mainly reliant on vernacular stations	Road networks: Moderate, with some paved roads linking with neighbouring counties Mobile network coverage: Relatively better Radio: Wide availability for both national and local stations
Primary source of water	Boreholes, seasonal rivers	Perennial rivers, springs, and rainwater harvesting
Land tenure rights	Communal land ownership	Private ownership
Proximity to social services	Few and poorly equipped healthcare facilities, low-density schools	Numerous health facilities, higher density schools

The Borana of Isiolo County are a Cushitic-speaking pastoralist community whose livelihoods depend on livestock and seasonal migration in a highly arid environment marked by scarce water, climate variability, and limited access to services. Their social organization is strongly shaped by the Gadaa system, with elders playing a central role in decision-making, conflict resolution, and the use of Indigenous forecasting methods—although these practices are increasingly threatened by modernization and weakened intergenerational transmission.

The Tharaka of Tharaka South Subcounty are a Bantu-speaking agro-pastoral community relying on drought-tolerant crops and small livestock in a semi-arid to semi-humid environment with more reliable rainfall than Isiolo, but still vulnerable to droughts and flash floods. Their farming decisions draw heavily on Indigenous ecological indicators, and their mixed livelihood system offers a contrasting perspective to pastoral groups like the Borana, illustrating how EWS communication and needs differ across diverse climate-vulnerable communities.

3.2 Data collection

This research used two qualitative data collection methods: focus group discussions (FGD) and key informant interviews (KIIs).

3.2.1 Focus group discussions

FGDs were organized with community members from several villages within the sub-counties, including farmers, pastoralists, and other vulnerable groups. The research team conducted a minimum of four FGDs in each village. These discussions explored participants' experiences, perceptions, and needs related to EWS. They provided a platform to share and compare views, highlight challenges, and propose locally relevant solutions, while also helping identify knowledge gaps and assess the extent of community engagement with current early warning systems. Each FGD included between six and eight participants, a size that allowed for meaningful interaction and in-depth discussion.

In Garbatulla Sub-County, Isiolo County, the FGDs comprised members of the Borana pastoralist community, who are primarily engaged in rearing camels and small ruminants. In Tharaka South Sub-County, Tharaka Nithi County, discussions focused on how EWS influence both agricultural and livestock practices, with participants drawn from the Tharaka community.

To capture diverse perspectives, FGDs were stratified by both age and gender, with separate discussions for older adult men and adult women (over 35 years old), as well as male and female youth (under 35). Participants were also selected from different economic backgrounds to ensure inclusivity. This diversity provided valuable insights into how varying levels of economic well-being influence community members' views, priorities, and decision making. The FGD discussion questions are included in Annex 2.

In total, 54 people participated in the FGDs, with a slightly higher number of females (28) compared to males (27). The age distribution was balanced, with 27 older participants and 27 younger participants. Among the men, participation was evenly split, with 13 older males and 14 younger males, similarly there were 14 older females and 14 younger females.

3.2.2 Key informant interviews

KIIs were conducted with a diverse group of stakeholders involved in EWS in the pastoral and agro-pastoral areas targeted by the field study. In total, 20 interviews were conducted. A list of interviewees is provided in Annex 1. These interviews were designed to gain in-depth insights on the communication methods and channels currently used to disseminate early warning information, as well as to identify potential areas for improvement.

They also documented community practices and Indigenous knowledge (IK) used to anticipate climate shocks and disasters. A standardized interview guide and script was developed in line with accepted KII norms to ensure consistent data collection. The KII discussion questions are included in Annex 2.

3.3 Research ethics

The project received ethical approval from multiple bodies: the Human Ethical Review Committee (HERC) at the University of Edinburgh (Ref: HERC_2024_091) for both Kenya and Ethiopia; ILRI's Institutional Research Ethics Committee (IREC) for both countries (Ref: ILRI-IREC2024-35); and the National Commission for Science, Technology and Innovation (NACOSTI) in Kenya, which includes an ethical assessment as part of its research approval process.

4. Findings

In this section, we report the findings from the FGDs and KIIs. In accordance with our objectives of focusing on the perspectives of community members and actors in the region, the majority of our research was open ended, meaning we did not pursue lines of inquiry on specific EWS or channels of delivery. Rather the participants were asked about their experiences with EWS. Therefore, the results provide a description of selected experiences and perceptions and should therefore not be interpreted as a comprehensive description of the EWS operating in the region.

4.1 Organizations involved in early warning information

Various key organizations were identified during the FGD and KIIs as playing important roles in EWS and AA. These include the KRCS, the Ministry of Interior and Coordination of National Government, the NDMA, the KMD, and the Merti Integrated Development Programme (MIDP), a local NGO based in Isiolo. Discussions were held with representatives from several of these organizations to understand their roles in EWS, which are summarized below.

The collaborative initiatives of these institutions are crucial to the effectiveness and sustainability of Kenya's multi-hazard EWS. While their specific responsibilities vary, their joint efforts are essential for enhancing preparedness, reducing losses, and building resilience in vulnerable communities.

Ministry of Interior

Through the NDOC and affiliated agencies, the Ministry of Interior provides overall policy direction and coordination for disaster risk management, including EWS operations. The Ministry oversees the integration of hazard monitoring into national security and development planning and ensures rapid and coordinated responses during emergencies. It also initiates national emergency response mechanisms based on data from relevant agencies and manages coordination frameworks at both national and county levels.

Kenya Meteorological Department (KMD)

The KMD serves as the country's primary institution for weather and climate information, forming a critical component of the EWS through the provision of accurate and timely forecasts. Its services include daily weather predictions,

seasonal climate outlooks, and alerts for severe weather events. To ensure broad access to this information, KMD collaborates with media outlets, development partners, and mobile networks.

The Department also provides training for key stakeholders to improve their understanding and use of meteorological data in sectors such as agriculture, disaster response, and water resource management. To enhance the precision and accessibility of the forecasts, KMD is increasingly adopting advanced technologies such as geographic information systems (GIS) and artificial intelligence (AI), the latter of which is currently being piloted for its potential in modelling weather patterns.

National Drought Management Authority (NDMA)

The NDMA serves as the lead institution for managing drought risks, particularly in Kenya's ASALs. It oversees the Drought Early Warning System (DEWS), which integrates satellite data, ground observations, and community input to monitor drought conditions. NDMA issues monthly drought bulletins that inform decision-making at both national and county levels. Additionally, the Authority plays a key role in coordinating drought preparedness efforts and working with development partners to support long-term resilience initiatives.

Kenya Red Cross Society (KRCS)

The KRCS plays a crucial role in translating early warning information into practical actions at the community level. Through its extensive network of regional offices and local volunteers, it has earned strong community trust, enabling swift dissemination of alerts via SMS and rapid mobilization during emergencies. KRCS has also been instrumental in the rollout of anticipatory action in Kenya. In addition, it provides community-based disaster risk reduction (CBDRR) training, ensuring that local populations are informed and prepared to respond effectively. By combining scientific forecasts with Indigenous knowledge, KRCS strengthens the accuracy and impact of early warning communication.

Merti Integrated Development Programme (MIDP)

MIDP plays an essential role in bridging the gap between local communities and scientific climate information. Working with local leaders, local government bodies, and agencies such as KMD and NDMA, it delivers relevant and timely early warning messages that are easily understood. A key strength is its focus on localizing early warnings, using channels such as community radio, public gatherings, and trained local monitors to share information on droughts, livestock diseases, and resource-based conflicts in local languages. MIDP also empowers pastoralist communities to

integrate Indigenous knowledge with modern forecasts, supports proactive measures such as migration planning, water management, and conflict resolution, and engages in policy advocacy to ensure community perspectives are reflected in county climate strategies.

4.2 Early warning communications

In Isiolo and Tharaka Nithi, community members reported that early warning information is transmitted through a blend of formal and informal channels. These include mobile phones (SMS and calls), local FM radio, community meetings (chief's barazas), and, where available, television. Radio remains a particularly valued source for older community members and in rural areas, while mobile phones dominate among younger, more connected groups.

Religious leaders play a key role in communicating early warning information in Isiolo by reinforcing messages and legitimizing information. In Tharaka Nithi, older respondents also highlighted traditional oral forms of warning, such as elders interpreting environmental signs. Stakeholders emphasized the importance of maintaining a multi-channel approach to communication, noting that using a combination of different methods helps ensure messages are received even when one mode fails (e.g. during network outages or limited radio coverage).

4.2.1 Knowledge sharing within and between communities

Both community members and key informants highlighted that information sharing within and across communities is crucial for strengthening the impact of early warnings. In the focus group discussions, women frequently mentioned sharing alerts through informal social circles, with pastoral networks and extended family ties commonly identified as important channels for disseminating warning messages. These interpersonal and kinship-based forms of communication create a powerful informal information system that effectively supports and extends the reach of formal early warning mechanisms. This type of peer-to-peer sharing significantly improves access to information, especially where official channels are delayed or disrupted.

In both communities the role of churches and mosques in information dissemination was repeatedly emphasised, particularly for women and families who attend regularly. While initial alerts might come via SMS or local radio, trust and actions were most often catalysed when the same message was repeated during religious gatherings. This layering of communication demonstrates how religious spaces are vital for relaying early warning information.

"The religious leader attends the chief's baraza, and then disseminates the information received from the chief to the congregants."

— Older man, Isiolo

Interestingly, respondents in Tharaka Nithi stated that Indigenous knowledge - such as insect appearances, tree flowering, or wind shifts - is also integrated into the early warning information shared by religious leaders.

4.2.2 Barriers to communicating early warnings

Respondents described a wide range of barriers that limit the effective communication of early warnings, many of which disproportionately affect women, older people, and households living in remote areas. These challenges reduce the likelihood that timely, actionable information reaches those who need it most, and in turn undermine communities' ability to prepare for or respond to hazards.

Infrastructure was a key constraint identified in the KIIs and FGDs. Participants consistently noted that unreliable or absent mobile network coverage, particularly in Tharaka Nithi, makes it difficult to receive alerts, especially for those living far from trading centers or main roads. Even where coverage exists, limited access to electricity, mobile devices, and reliable SMS systems further restrict the flow of information. Women and older people are especially affected, as they are less likely to own personal phones or have dependable access to charging facilities.

Language and literacy barriers compound these challenges. Several respondents reported that early warning messages are not always issued in local languages, meaning that large segments of the community cannot understand them without assistance. High rates of illiteracy in certain areas mean that written warnings, whether on posters, SMS, or social media, must often be interpreted by literate neighbours. This dependence on others increases the likelihood of delays, misinterpretation, or missed information altogether.

Issues of inclusivity also emerged strongly. Women are often excluded from early warning communication due to both structural and social factors. As one older woman in Tharaka Nithi explained:

> *"Women in the community are always busy with farm work, taking care of the family, trying to have a social life, and important communication like early warning may pass them — especially those given through radio, TV, or in the chief's baraza."*
>
> **– Older woman, Tharaka Nithi**

This sentiment was echoed by a woman in Isiolo, who observed that warning messages are often tailored to men because they are traditionally responsible for livestock, and therefore perceived as the primary decision-makers. As a result, women may receive information later or second-hand, reducing their ability to act early.

Trust also plays a central role in shaping how communities respond to alerts. Many respondents voiced scepticism toward government-issued messages, particularly when past forecasts did not materialize or failed to reflect local conditions. In contrast, warnings relayed by trusted intermediaries, such as chiefs, elders, or religious leaders, were consistently seen as more reliable and more likely to prompt action. This reliance on locally credible messengers highlights the importance of embedding communication channels within established community networks.

Finally, respondents frequently emphasized concerns about the timing and specificity of alerts. Many reported receiving warnings too late for meaningful preparation, while others noted that messages were vague, failing to specify which areas were at risk or when the threat was expected to occur. This lack of actionable detail makes it difficult for households to make informed decisions, reducing the overall effectiveness of early warning systems.

4.3 Empowering community response

4.3.1 Message content and timing

Across both communities, participants described how early warning messages contain a range of information, though with notable variations in clarity, timing, and specificity.

The timing of early warning information was a key concern for community members in both Isiolo and Tharaka Nithi. Focus group discussions reported that early warning information sometimes arrived too late to enable meaningful action, or did not detail specific timelines, leaving communities uncertain about how long they had to

prepare. In both communities, participants said they had been caught unaware by floods, highlighting the poor timing of early warning messages and the need for greater consistency and early delivery of information. Community members in both areas also noted that receiving warnings at the start of a season, such as those delivered by the KMD, enabled long-term or strategic anticipatory actions.

The lack of clarity and specificity of early warning messages also limited communities' ability to take anticipatory actions. While community members reported that early warning messages often included forecasted rainfall levels or the onset of drought or floods, it was not always clear what these messages contained in terms of wording or technical information. They explained that the level of detail varied widely: some were brief and general, while others were more actionable, for example, advising communities to destock livestock, relocate to higher ground, or move cattle away from rivers ahead of anticipated flooding. As such, members of both communities repeatedly emphasized that including suggested anticipatory actions within early warning messaging would strengthen community response and preparedness.

4.3.2 Trust in early warning systems

Trust plays a central role in determining whether early warnings translate into action. Across the focus groups in both communities, many participants stated that they trusted local leaders, particularly chiefs and religious figures, to provide reliable and timely information. When early warnings were communicated through these channels, especially during church or mosque gatherings, they were more likely to be taken seriously. However, local leaders face reputational risk when they promote early warnings that turn out to be inaccurate or irrelevant.

Trust in government

During the focus groups, both communities acknowledged the efforts of local government and administrative officers in disseminating warnings and coordinating response. However, messages originating directly from government or scientific institutions were met with varying degrees of scepticism, and trust in these EWS was generally lower than in NGO or religious-led efforts. Formal institutions were often perceived as slow, inconsistent, and unresponsive to community needs.

In particular, trust in government EWS was eroded when previous forecasts had been inaccurate or when there was no follow-up information provided. As one youth in a Tharaka Nithi focus group noted, inaccurate warnings led to a lack of response to later alerts. Staffing gaps, presumably reducing dissemination activities, were noted

as a major barrier across both communities, mentioned by both county leaders in Isiolo and younger members of the community in Tharaka Nithi. Both communities often relied instead on NGOs, such as MIDP, which used local radio to fill communication gaps. Concerns were also raised about the exclusion of women, older people, and those with limited mobility, since alerts delivered through radio or barazas often failed to reach these groups. Feedback mechanisms were almost non-existent, further limiting community input and trust and reinforcing a top-down approach.

Across both communities, similar challenges were reported in relation to disaster response. Post-disaster support was viewed as unreliable, unfair, and inconsistent, with some households receiving aid on time while others experienced delays. Logistical barriers such as washed-out roads further slowed aid delivery in remote areas. Participants recommended stronger coordination, clearer communication about aid, and community validation of beneficiary lists to enhance trust and fairness.

4.4 Anticipatory actions taken based on early warnings

Across both communities, the anticipatory actions taken in response to forecasted shocks underscored the critical importance of early warning information. In the following examples, drawn from the focus group discussions in each community, when messages are timely, specific, and trusted, communities not only understand the risks but also act to reduce potential impacts and strengthen their resilience.

4.4.1 Anticipatory actions for drought

Tharaka Nithi

In Tharaka Nithi, anticipatory actions in response to drought predications focused on agriculture and livestock. Community members described a mix of traditional and modern techniques aimed at improving crop survival and managing livestock resources in preparation for expected drought conditions.

Agricultural measures included planting drought-tolerant and early-maturing crops such as cowpeas, applying fertilisers and herbicides, using ripping instead of conventional tilling to preserve soil moisture, and constructing zai pits to retain water around plant roots. Meanwhile, livestock management actions included purchasing crop residues for animal feed and destocking livestock in advance of deteriorating conditions.

However, community members were not clear about which type of early warning system, Indigenous or formal, had prompted these actions, or what specific type of information would trigger them. Both community members and key informant stakeholders indicated that anticipatory actions are generally taken when a drought is forecasted but did not provide further clarity on exactly when this information was received and which sources were involved. Although warning timing can be inconsistent, FGD participants noted that long-range information typically arrives at the start of the season, allowing them to take anticipatory actions in these instances.

Isiolo

In Isiolo, destocking was reported as a key anticipatory action ahead of droughts, with some individuals selling up to half of their livestock in anticipation of pasture shortages and declining animal health. However, its uptake may be limited due to cultural and social factors and further evidence would be required to determine how consistently destocking is implemented. The dataset is limited and it is unclear what specific information triggered this action and when exactly it was received - beyond the general indication of "at the beginning of the season" or "before a shock"- or whether it was confirmed by multiple sources.

One FGD respondent reported that some use the proceeds from selling livestock to start a small business as a financial buffer during the drought period. Other community members reported moving livestock to neighbouring counties where grazing pressure was lower, while others mentioned storing animal feed from crop residue after harvest – although it was unclear whether this is practice was linked to specific early warning information or was a routine strategy.

Households also reported reducing expenditures to save for the upcoming crisis:

> *"Households try and minimize their expenditure budgets to save for the tough drought season"*
>
> **– Man, Isiolo**

Pastoralist movements were also adapted in response to drought early warnings. Dedha committees - community-based managers of grazing pasture and water resources in Isiolo - played a pivotal role in guiding livestock movements. They advised pastoralists to move herds to more distant grazing areas, while preserving local resources for lactating animals to help safeguard food security for women and children.

4.4.2 Anticipatory actions for floods

Tharaka Nithi

In Tharaka Nithi, community preparations for floods included both relocation and infrastructure management, although agriculture remained the central concern. Community members did not specify which early warning source prompted these actions, only that they were taken in response to a warning of some kind. Common anticipatory actions included relocating away from riverbanks and low-lying areas to reduce exposure to flooding and improving drainage systems on farms and around homesteads to prevent waterlogging and crop damage. In some cases, households expanded cultivation in areas where water was expected to be abundant.

Community members also emphasized the importance of communal planning, particularly regarding drainage and sanitation, with local knowledge guiding how land was prepared to effectively redirect or capture water.

Isiolo

Community members in Isiolo stated that flood preparedness focused on relocation, physical infrastructure improvements, and the strategic use of resources. It remains unclear what type or content of warning prompted these actions, other than that some type of warning was received.

Community members living near rivers or in low-lying areas typically relocated to higher ground when floods were forecasted. One focus group in Isiolo highlighted a successful case from 2015 that illustrates the effectiveness of anticipatory action informed by early warning systems: when ActionAid issued a flood warning, residents living near waterways relocated in advance, allowing them to avoid significant losses.

Other common preparations included constructing gabions and clearing waterways to reduce water velocity and improve drainage, repairing housing infrastructure (such as fixing roofs), and stockpiling food supplies as roads and supply routes are often cut off during flooding.

Pasture and ecosystem management also played a role in preparedness efforts. Grass was planted during the rainy season for later use in dry periods, with some fodder stored in community-managed facilities supported by external partners, such as the European Union.

"Grass is planted in plenty which will later be preserved for use when there is drought. The EU constructed where fodder can be stored by everybody in the community."

-Man, Isiolo

Additional measures were taken to protect livestock health, including the procurement of veterinary drugs to treat diseases like foot and mouth disease, which are more common during wet periods.

4.4.3 Impact of not receiving warning information

In some instances, community members reported not receiving warning information at all or receiving it too late. In the Tharaka Nithi focus groups, communication gaps were especially pronounced, with older individuals and isolated households frequently missing key updates. FGD participants reported that the consequences of not receiving early warning information included livestock deaths, crop losses, and damage to homes. In one instance, a group of older respondents shared that they had not been informed of an impending drought and were therefore unable to prepare adequately, resulting in food insecurity and reliance on external aid.

These findings instead underline the importance of ensuring that early warning messages are both timely, inclusive, and actionable reaching all segments of the community to provide at least some opportunity for anticipatory action.

4.5 Improvements to early warning systems

Communities in Isiolo and Tharaka Nithi offered clear suggestions for how early warning communication could be made more effective. Community members in both geographies called for greater specificity in timing and location, emphasizing that vague or late alerts limited their usefulness. They wanted warnings to include clear guidance on what actions should be taken and by whom. One man in Isiolo explained how this is already being done successfully in some cases, describing how NDMA early warnings often came with advice, which should be replicated in other EWS.

"For example, if it is predicted to be dry, they advise planting early maturing or drought tolerant seed varieties."

- Man, Isiolo

Both community members and key informants highlighted that the format and delivery of messages were critical. Messages delivered through participatory forums - such as chiefs' barazas - were generally seen as more trustworthy than SMS or radio broadcasts, which often lacked explanation or opportunity for discussion. Respondents stressed the importance of involving trusted intermediaries such as chiefs, elders, and religious leaders, who could interpret and contextualise forecasts in culturally appropriate ways.

Community members also emphasized the need for regular updates throughout high-risk periods, rather than one-off alerts at the start of a season. In addition, participants suggested greater brevity in messages, the use of multiple channels simultaneously, and alternative dissemination formats such as pictorial messages for non-literate audiences. Similarly, a woman in Isiolo requested that information be simplified and translated into local languages.

> *"Translate early warnings into simple language/terms and use the local Borana language if possible."*
>
> **- Woman, Isiolo**

Additional suggestions included providing enhanced training for local leaders so they can interpret and contextualise warnings, developing alternative dissemination methods, such as pictorial messages for low-literacy audiences, and combining scientific forecasts with local indicators to make the information more relevant and trusted. Community reflections during the FGD's consistently reinforced that effective early warning is not just about technical accuracy, but also about participatory delivery, cultural resonance, and consistent follow-up.

Institutional and organizational improvements

Alongside community-level suggestions, participants also emphasised changes are needed within county and national organizations to make early warning systems more effective. Suggested improvements include devolving early warning capacity to county and village levels to enable faster decision-making and mobilization, and establishing local preparedness committees that include women, youth, and older people. Participants also emphasised the need to build on existing KMD practices, and strengthen collaboration between the KMD, NDMA, and communities through seasonal debriefs, feedback sessions, and co-designed plans. Finally, they recommended creating feedback channels that allow communities to report on the usefulness of alerts, share their experiences, and suggest improvements.

These gaps underscore the importance of moving beyond top-down information dissemination. By moving to a bottom-up approach, including working with communities to co-produce EWS and incorporating feedback mechanisms, institutional systems can build trust, ensure consistent delivery, and community buy-in, so that early warning messages are tailored to local realities in ways that enable meaningful, timely action.

4.6 Indigenous knowledge in changing contexts

In both Isiolo and Tharaka Nithi, community members described a rich array of Indigenous knowledge systems used to interpret climatic changes and anticipate weather events. These indicators often focus on ecological signals such as animal behaviour, the flowering or budding of specific trees, the positions of stars, and changes in wind or cloud patterns.

In Tharaka Nithi, community members consistently referenced the budding and flowering of trees as key indicators of upcoming rainfall or droughts. For example, one participant noted that if the baobab tree had shoots or greening leaves during the dry season, they would predict excess rainfall. Similarly, one local official described how mango harvests could be used indicate future droughts.

> *"Towards end of 2024, mango trees in the region were observed flowering three times, which is unusual. This was then followed by a bumper mango harvest. The prediction was that drought was meant to happen, and it was accurate. The community members reduced the acreage planted and planted crops that take a shorter time to mature and those that are drought tolerant."*
>
> **- Local official, Tharaka Nithi**

These observations are passed down informally, often discussed among older community members, including both women and men, and continue to shape community-level anticipatory actions, including planting and migration decisions. Even as weather patterns shift, such ecological signals remain deeply embedded in local knowledge systems, coexisting alongside formal early warning mechanisms.

Across the FGDs in both communities, participants repeatedly stated that Indigenous forecasting knowledge is most commonly held by older men and women, particularly those with strong ties to the land, such as pastoralists and subsistence farmers. Older community members were seen as possessing both the knowledge to execute and

interpret Indigenous forecasting methods. Among women, this knowledge often related to plant behaviour and household preparedness, while men more frequently referenced animal movements and astral cues. Some forms of Indigenous forecasting knowledge appear to be led or practised exclusively by women, such as observing shoes thrown in the air. These examples suggest that women possess and practice distinct Indigenous forecasting methods, though these are often undervalued and rarely integrated into broader early warning dissemination strategies.

In both regions, FGD participants expressed concern that such knowledge is becoming less prominent among younger generations, who increasingly rely on mobile phones and formal forecasts. Young people were rarely cited as holders of Indigenous knowledge during the FGD and KIIs.

FGD respondents spoke about how climate change is eroding the reliability of Indigenous knowledge as environmental and climatic patterns are changing. For example, older people in both counties described how animal migrations no longer follow familiar routes and that the wind and clouds behave differently than in the past.

Additionally, climate variability has rendered some indicators less reliable. FGD participants described noticeable changes in local weather patterns, including the increasing frequency of late or erratic rains. They also noted the emergence of unprecedented climatic events for which communities have no traditional means of forecasting. This disruption has not only affected people's ability to take anticipatory action but has also shaken their confidence in previously trusted signs. This uncertainty has led some local officials to question the continued accuracy of Indigenous knowledge in the context of climate change.

> *"The NDMA does not incorporate the Indigenous knowledge by the community when reporting early warnings because the Indigenous knowledge lacks a scientific backing and some may not be very accurate as there has been climate change over time and the practices remained same over the same period."*
>
> **– Local official, Tharaka Nithi**

4.6.1 Trust, integration and adoption of Indigenous knowledge

Despite the expansion of formal early warning systems, Indigenous knowledge continues to be widely trusted and, in some cases, preferred. Several respondents noted that they often act on natural observations even in the absence of formal messages, while others combine both approaches.

> *"Dedha committee is briefed by the county with formal updates forecasted, then they use it together with traditional knowledge when making decisions regarding pasture and waterpoint management."*
>
> **- Woman, Isiolo**

Community members across both Isiolo and Tharaka Nithi generally expressed support for a blended approach, where Indigenous and scientific knowledge could be used in tandem, as many view the systems as complementary. Older people emphasized the value of using nature and traditional observations to validate information received via radio or SMS. One FGD participant voiced support for greater integration through workshops that would foster knowledge exchange between scientists and community foretellers. Several participants suggested that if forecasters engaged directly with older people, or included their input into seasonal predictions, the uptake and trust in early warning messaging would likely improve.

> *"The two entities (scientists and community foretellers) should come together through workshops for knowledge sharing. This will increase message accuracy and acceptability by the community."*
>
> **- Older man, Isiolo**

4.6.2 Current integration methods

From the FGD and key informant interviews, there are some clear examples of integration of Indigenous knowledge and formal EWS taking place. For example, one county official in Tharaka Nithi described how traditional forecasters are engaged by the KMD in participatory scenario planning.

> *"When doing participatory scenario planning, the KMD engages traditional forecasters before the season starts. The forecasters are given priority too to communicate their observations on the forum. The KMD compares their formal*

predictions with those provided using Indigenous knowledge, and they are usually very similar."

– County official, Tharaka Nithi

The available data, however, does not indicate how consistent or widespread this integration is. In Isiolo, for example, several community members explained that local chiefs or village leaders often consult with older people before disseminating formal warnings. In these cases, older people are asked to offer their interpretation of traditional signs, which is then considered alongside meteorological forecasts.

In one FGD, it was described how a chief delayed calling a community meeting until he had verified the seasonal changes with local herders and older people. Once there was alignment between the national forecast and community observations, such as changes in wind direction and livestock behaviour, the warning was shared publicly and acted upon. These kinds of bridging practices show how integration of systems can occur without formal institutional mechanisms.

"Traditional knowledge is shared and passed across in person by the elders who forecast future events. People from the community go to the elders to confirm and have their views on whatever has been predicted and communicated to them."

- Woman, Isiolo

There was also a reference to a Mercy Corps project that documented traditional indicators and combined them with scientific modelling to inform community-based contingency plans. While still an isolated example, it demonstrates how NGO-led initiatives can pilot integration in ways that are locally relevant.

Barriers to integration

Despite many communities' willingness to blend Indigenous and scientific knowledge, several barriers emerged from the FGDs that hinder integration. A key challenge is a sense of exclusion – though some accounts suggest institutions such as KMD are making efforts to include Indigenous knowledge, others indicate the opposite. This is further exacerbated when formal forecasts are delivered in a top-down manner, without consultation or explanation at the community level.

"The NDMA/KMD currently only goes to the community to validate what they have already collected and decided."

- Man, Isiolo

In addition, differences in language, worldview, and evidentiary standards between scientific institutions and Indigenous knowledge holders can further complicate dialogue and mutual understanding. To address this, communities called for closer collaboration between meteorological offices and communities, building on the current KMD feedback sessions and seasonal workshops that bring together forecasters and local older people. There was interest in incorporating Indigenous indicators into formal education and training materials, particularly for extension workers and local climate champions. These ideas point to a desire not only for recognition, but also for ongoing dialogue and mutual learning between systems.

Another barrier to integration identified in the FGDs was the loss of Indigenous knowledge itself. Across both counties, community members believed that younger generations are increasingly urbanized and reliant on digital tools. Therefore, they may lack the skills or interest to learn traditional forecasting methods. Without deliberate efforts to document and transmit this knowledge, it risks being lost over time. Communities proposed documenting Indigenous indicators systematically, so that they can be compared and aligned with scientific forecasts. This documentation could support the transfer of knowledge to younger generations and could contribute towards the systemic documentation required for scaling viable opportunities to the national or regional level.

5. Conclusions and recommendations

EWS are widely recognised by Kenyan pastoral and agro-pastoral communities as essential for preparing for drought, livestock disease, and other recurring shocks. Across the two counties, communities highlighted that Indigenous knowledge, rooted in environmental observation, animal behaviour, seasonal indicators, and the expertise of elders and traditional specialists, remains a trusted and accessible way to predict hazards. This knowledge is deeply embedded in everyday decision-making, especially for mobility, herd management, and assessing local conditions.

However, the reliability of Indigenous forecasting has been increasingly disrupted by climate change. Seasonal patterns are less predictable, traditional indicators are no longer as reliable, and communities report that droughts, floods, and disease outbreaks now occur outside the cycles they previously relied upon. These changes have led to growing interest in complementing Indigenous knowledge with modern forecasting methods.

Despite this shift, perceived value of formal EWS remains uneven. Communities frequently cited late, unclear, or non-localized warnings as key reasons for scepticism, particularly among those who compare scientific forecasts unfavourably to their past experiences. Many participants emphasized that warnings often arrive after hazards have already begun to escalate or do not specify the precise areas at risk, making it difficult to take anticipatory action.

Dissemination barriers further restrict the effectiveness of EWS. Limited network coverage, low levels of mobile phone ownership among certain groups and challenges with charging and maintaining devices, all prevent timely access to information. County officials also face structural constraints, including resource limitations, inconsistent communication systems, and competing responsibilities during crisis periods. These challenges mean that many people still hear about hazards informally through neighbours, markets, chief barazas, or elders rather than directly from official channels.

At the same time, communities are already integrating modern tools into their own information-sharing practices. Mobile phones and local radio remain widely used, especially for cross-community updates, disease alerts, and conflict-related

information. There is strong demand for blended systems that draw on both scientific and Indigenous knowledge, presented in clear, localized formats and communicated through multiple trusted channels.

Overall, strengthening Kenya's early warning landscape requires improving the clarity, timing, and geographic precision of scientific forecasts, investing in reliable communication infrastructure, and involving communities more systematically in the design, interpretation, and feedback processes of EWS. Integrating Indigenous knowledge with modern forecasting, and ensuring marginalised groups have equitable access to information, offers significant potential to build trust, enhance relevance, and support more effective anticipatory action.

5.1 Recommendations

The key recommendations arising from the research are summarized below.

Development

- Engage communities in EWS co-creation and improvement, including ensuring Indigenous knowledge, historical context, existing communication channels, and pastoral mobility patterns inform system design, and shaping how information should be communicated.
- Develop and provide multi-hazard EWS that reflect community-identified priorities.
- Support documentation of Indigenous knowledge to inform anticipatory actions, preserve traditional expertise, and strengthen blended forecasting approaches.

Communication

- Ensure early warning messages are clear, locally tailored and specific, and actionable, including details on expected impacts, locations, timelines, and recommended anticipatory actions.
- Use multiple dissemination channels—including radio, community meetings, call centres, SMS request lines, chief barazas, women's groups, and social media platforms—to reach diverse groups. Ensure that there are mechanisms for requesting specific information.

- Strengthen gender-inclusive communication approaches, ensuring that women, youth, and marginalized groups can access early warning information directly.
- Issue warnings with sufficient lead time, enabling individuals and households to take meaningful anticipatory actions such as relocating livestock, securing feed, or storing water.
- Issue regular communications, rather than one off messages at the beginning of the season.

Process strengthening

- Strengthen organizational capacity, including staff training and community education.
- Host awareness and dialogue sessions in partnership with community leaders to explain forecasts, gather feedback, address mistrust, and improve understanding of scientific EWS.
- Institutionalize feedback mechanisms, enabling community members, elders, and local committees to submit observations, verify forecasts, raise concerns, and identify challenges with disseminated information.
- Collaborate with humanitarian partners to harmonize messaging, avoid conflicting information, and ensure coordinated dissemination across counties and agencies.

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Annex 1: List of stakeholders consulted

KII participants	Isiolo County	Tharaka Nithi County
Local leaders (chiefs from both counties)	1	1
Religious leaders (Muslim sheikh and Christian pastor)	1 (Sheikh)	1 (Pastor)
Agricultural extension officers (both counties)	1	1
Traders (livestock and farm produce)	1 (Livestock)	1 (Farm produce)
Waterpoint managers and Dedha committee members	2	1
County government leaders	1 (Director Livestock Production Directorate)	1 (County Administrator)
NDMA county data analysts	1	1
KMD county directors	1	1
University researcher	1 (The University of Nairobi)	0
NGOs	1 (Merti Integrated Development Programme - MIDP)	1 (Red Cross)

Annex 2: KII and FGD questions

Key informant interview questions

1. Can you describe the early warnings that your community receives?
2. Who within your community receives these messages?
3. Are there early warnings that have led to timely action by the community in the past? Please elaborate.
4. Do you know of any early warnings that are available but not used? If yes, why do you think they are not used?
5. How do various community members prefer to receive early warnings?
6. Do you know of any Indigenous knowledge systems that your community uses to predict hazards such as droughts? If yes, please elaborate on the type of knowledge and how it is used.
7. Do you think Indigenous early warnings should be integrated into formal systems, and if yes why? If no, why not?
8. Do you have any further suggestions for how existing early warnings could be improved to better address your community's needs?

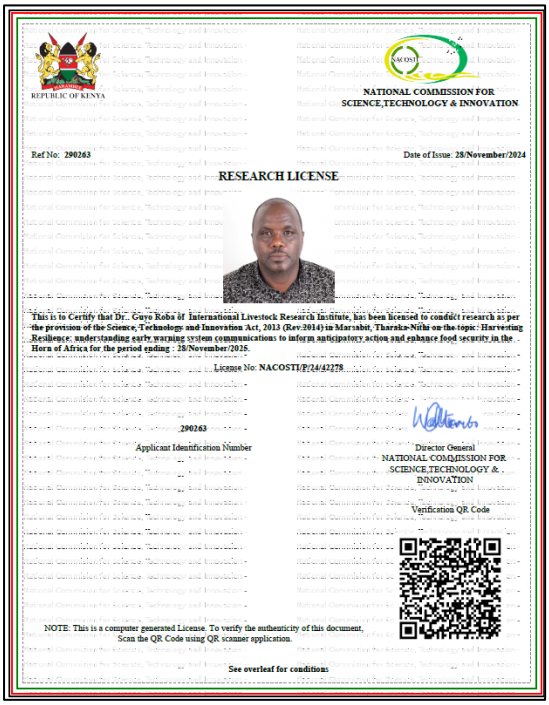
Focus group discussion questions

1. Can you describe whether you receive warnings or information about hazards like droughts or floods before they occur? If yes, how often do you receive these warnings?
2. In what ways have you used the information that you have received?
3. To your knowledge, how are warnings or information about hazards communicated to your community?
4. What is your preferred means to receive warnings or information about hazards, and why?

5. Do you have recommendations on how warnings could be improved?
    - **Prompt:** Please give examples of when warnings have been useful/not useful, inaccurate/accurate. Capture timeliness, and ability to understand the warnings linguistically and ability to make decisions from the information shared. What knowledge exists within the community or among community leaders to anticipate, predict, and communicate events like droughts, erratic rainfall, shortfalls in rain, or floods?
6. Describe what an effective early warning communication system would look like for your community. Do you think others in the community might see it differently? If so, how?
    - **Prompt:** Consider objective criteria like timeliness, accuracy, and whether the warnings are actionable.
      How can existing good practices be strengthened, and what barriers need to be overcome to improve the system?
7. In the last three crisis events, what Indigenous early warning information did you receive, how was it communicated to you, and how did you respond?
    - **Prompt:** Has Indigenous knowledge influenced the decisions your community made about which actions to take?
8. Do you think Indigenous early warnings should be integrated into formal systems, and if yes why? If no, why not?

Annex 3: Ethics approval and research licences

Research license from the National Commission for Science, Technology, and Innovation of the Republic of Kenya



REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **290263**

Date of Issue: **28/November/2024**

RESEARCH LICENSE

This is to Certify that Dr.. Guyo Roba of International Livestock Research Institute, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev 2014) in Marsabit, Tharaka-Nithi on the topic: Harvesting Resilience: understanding early warning system communications to inform anticipatory action and enhance food security in the Horn of Africa for the period ending : 28/November/2025.

License No: **NACOSTI/P/24/42278**

290263

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

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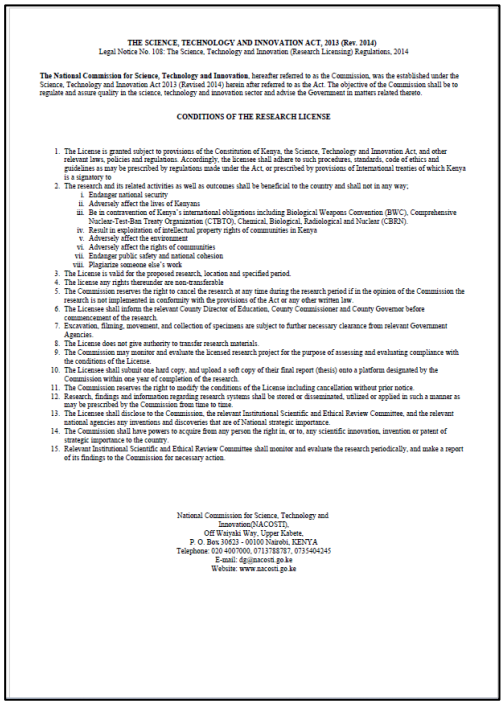
See overleaf for conditions



THE SCIENCE, TECHNOLOGY AND INNOVATION ACT, 2013 (Rev. 2014)
Legal Notice No. 108: The Science, Technology and Innovation (Research Licensing) Regulations, 2014

The National Commission for Science, Technology and Innovation, hereafter referred to as the Commission, was the established under the Science, Technology and Innovation Act 2013 (Revised 2014) herein after referred to as the Act. The objective of the Commission shall be to regulate and assure quality in the science, technology and innovation sector and advise the Government in matters related thereto.

CONDITIONS OF THE RESEARCH LICENSE

1. The License is granted subject to provisions of the Constitution of Kenya, the Science, Technology and Innovation Act, and other relevant laws, policies and regulations. Accordingly, the licensee shall adhere to such procedures, standards, code of ethics and guidelines as may be prescribed by regulations made under the Act, or prescribed by provisions of International treaties of which Kenya is a signatory to
2. The research and its related activities as well as outcomes shall be beneficial to the country and shall not in any way;
   i. Endanger national security
   ii. Adversely affect the lives of Kenyans
   iii. Be in contravention of Kenya's international obligations including Biological Weapons Conventies (BWC), Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO), Chemical, Biological, Radiological and Nuclear (CBRN).
   iv. Result in exploitation of intellectual property rights of communities in Kenya
   v. Adversely affect the environment
   vi. Adversely affect the rights of communities
   vii. Endanger public safety and national cohesion
   viii. Plagiarize someone else's work
3. The License is valid for the proposed research, location and specified period.
4. The license any rights thereunder are non-transferable
5. The Commission reserves the right to cancel the research at any time during the research period if in the opinion of the Commission the research is not implemented in conformity with the provisions of the Act or any other written law.
6. The Licensee shall inform the relevant County Director of Education, County Commissioner and County Governor before commencement of the research.
7. Excavation, filming, movement, and collection of specimens are subject to further necessary clearance from relevant Government Agencies.
8. The License does not give authority to transfer research materials
9. The Commission may monitor and evaluate the licensed research project for the purpose of assessing and evaluating compliance with the conditions of the License.
10. The Licensee shall submit one hard copy, and upload a soft copy of their final report (thesis) onto a platform designated by the Commission within one year of completion of the research.
11. The Commission reserves the right to modify the conditions of the License including cancellation without prior notice.
12. Research, findings and information regarding research systems shall be stored or disseminated, utilized or applied in such a manner as may be prescribed by the Commission from time to time.
13. The Licensee shall disclose to the Commission, the relevant Institutional Scientific and Ethical Review Committee, and the relevant national agencies any inventions and discoveries that are of National strategic importance.
14. The Commission shall have powers to acquire from any person the right in, or to, any scientific innovation, invention or patent of strategic importance to the country.
15. Relevant Institutional Scientific and Ethical Review Committee shall monitor and evaluate the research periodically, and make a report of its findings to the Commission for necessary action.

National Commission for Science, Technology and Innovation(NACOSTI),
Off Waiyaki Way, Upper Kabete,
P. O. Box 30623 - 00100 Nairobi, KENYA
Telephone: 020-4007000, 0713788787, 0735404245
E-mail: dg@nacosti.go.ke
Website: www.nacosti.go.ke

Ethics approval from the Institutional Review Committee at the International Livestock Research institute

ILRI
INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE

CGIAR

31 October 2024

Our Ref: ILRI-IREC2024-35
International Livestock Research Institute
P.O. Box 30709 00100
Nairobi, Kenya.

Dear Guyo Roba,

Ref: Harvesting Resilience: understanding early warning system communications to inform anticipatory action and enhance food security in the Horn of Africa

Thank you for submitting your request for ethical approval to the International Livestock Research Institute (ILRI) Institutional Research Ethics Committee (IREC).

ILRI IREC has reviewed and granted ethical approval to your study titled *'Harvesting Resilience: understanding early warning system communications to inform anticipatory action and enhance food security in the Horn of Africa'* and referenced ILRI-IREC2024-35. The approval period is from 31 October 2024 to 30 October 2025 and is subject to the following conditions:

- Only approved documents (research design, consent forms, survey tools) will be used.
- All changes anticipated or otherwise that may increase the risks or affect the safety and or welfare of study participants and others or affect the integrity of the research must be submitted to ILRI IREC for approval before implementation.
- Death and life-threatening problems, and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to ILRI IREC within 72 hours.
- Request for renewal of approval must be submitted to ILRI IREC at least 30 days prior to expiry of the approval period.
- Executive summary report must be submitted to ILRI IREC within 90 days upon completion of the study.

Note that you will be required to obtain a research license from National Commission for Science Technology and Innovation (NACOSTI) in Kenya and that there may be additional approvals required in Ethiopia prior to commencing the study. Please contact ILRI IREC on ILRIResearchcompliance@cgiar.org for any further assistance you may need.

Yours Sincerely,

Elise Schieck, PhD
Chair, ILRI Institutional Research Ethics Committee

Patron: Professor Peter C Doherty AC, FAA, FRS

Animal scientist, Nobel Prize Laureate for Physiology or Medicine–1996

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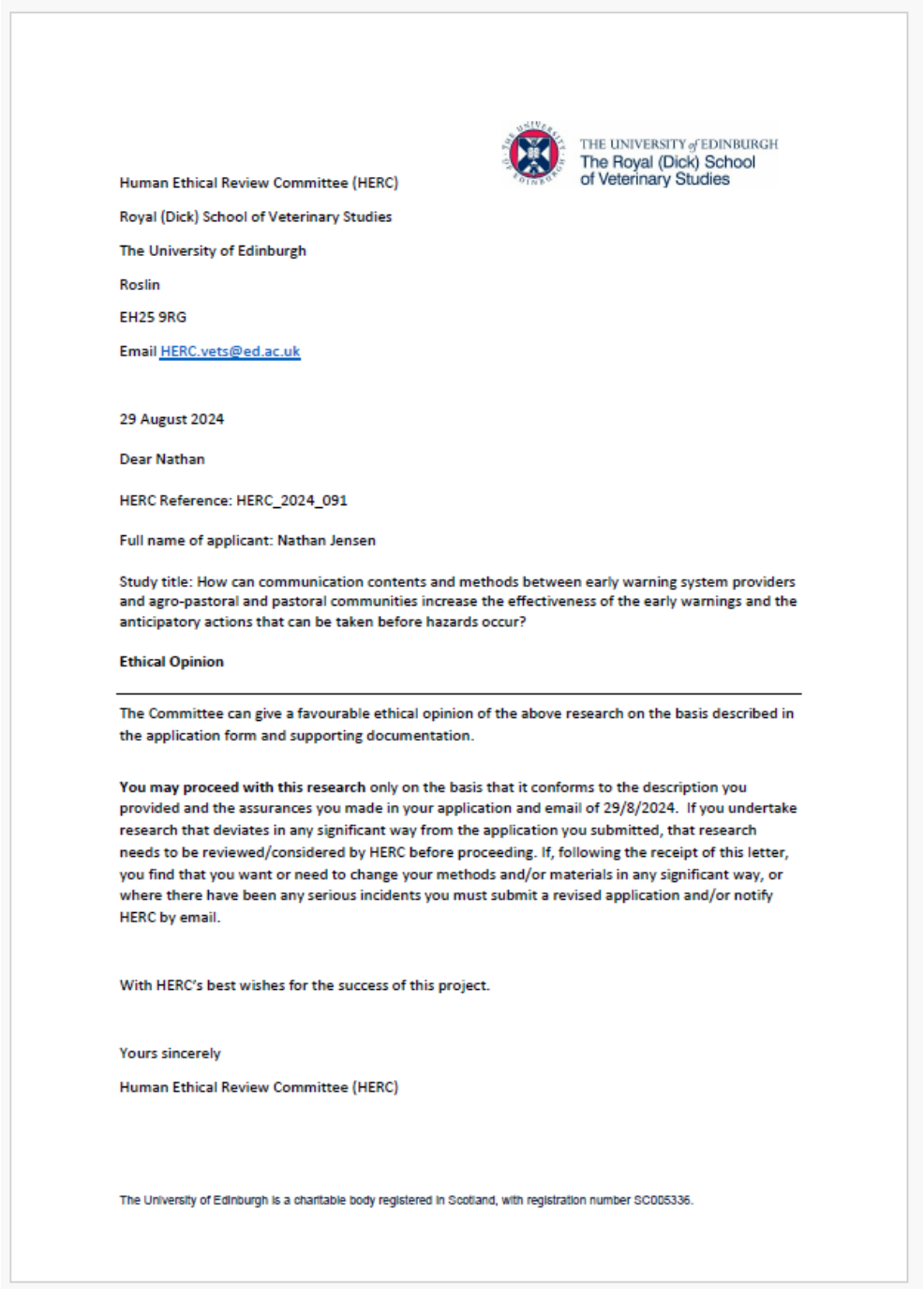
Email ILRI-Ethiopia@cgiar.org

ILRI has offices in East Africa • South Asia • Southeast and East Asia • Southern Africa • West Africa

Ethics approval by the Human Ethics Review Committee at the University of Edinburgh



THE UNIVERSITY of EDINBURGH
The Royal (Dick) School of Veterinary Studies

Human Ethical Review Committee (HERC)

Royal (Dick) School of Veterinary Studies

The University of Edinburgh

Roslin

EH25 9RG

Email HERC.vets@ed.ac.uk

29 August 2024

Dear Nathan

HERC Reference: HERC_2024_091

Full name of applicant: Nathan Jensen

Study title: How can communication contents and methods between early warning system providers and agro-pastoral and pastoral communities increase the effectiveness of the early warnings and the anticipatory actions that can be taken before hazards occur?

Ethical Opinion

The Committee can give a favourable ethical opinion of the above research on the basis described in the application form and supporting documentation.

You may proceed with this research only on the basis that it conforms to the description you provided and the assurances you made in your application and email of 29/8/2024. If you undertake research that deviates in any significant way from the application you submitted, that research needs to be reviewed/considered by HERC before proceeding. If, following the receipt of this letter, you find that you want or need to change your methods and/or materials in any significant way, or where there have been any serious incidents you must submit a revised application and/or notify HERC by email.

With HERC's best wishes for the success of this project.

Yours sincerely

Human Ethical Review Committee (HERC)

The University of Edinburgh is a charitable body registered in Scotland, with registration number SC005336.

Annex 4: Photos

Figure 1: A sit down with an expert from KMD, Tharaka Nithi County

Figure 2: A session with younger men/male youths in Tharaka Nithi County

Figure 3: A session with female youths, Tharaka Nithi County

Figure 4: A session with older women in Tharaka Nithi County

Figure 5: A session with female youths in Isiolo County

Figure 6: A discussion with older men in Tharaka Nithi County

Figure 7: A session with older women in Tharaka Nithi County

JAMEEL OBSERVATORY
FOR FOOD SECURITY EARLY ACTION

Food and Agriculture Organization of the United Nations

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