



Trust, climate information sources, and adaptation actions among frontline communities in Bukoba Municipality, Tanzania

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ABSTRACT

Climate change continues to affect vulnerable communities, yet many frontline populations still receive climate risk information that does not effectively translate into adaptation action. This study examined the influence of trusted sources of climate risk information on adaptation actions among frontline communities in Bukoba Municipal, Tanzania. Specifically, the study identified trusted sources of climate risk information and assessed their influence on climate change adaptation behaviour. Guided by Berlo's SMCR Model, the study employed a mixed-methods research approach involving 265 household respondents selected through multistage sampling and 14 key informants selected purposively. Quantitative data were collected using structured questionnaires and analysed using descriptive and inferential statistics, while qualitative data were obtained through key informant interviews and analysed thematically. The findings revealed that government authorities (63.3%), climate experts (55.3%), and local community leaders (42.8%) were the most trusted sources of climate risk information. Trust was mainly attributed to perceived expertise, accuracy, and the ability to communicate information that reflected local realities. However, most respondents (58.5%) demonstrated low levels of climate change adaptation. Logistic regression analysis showed that trust in community members significantly increased the likelihood of undertaking adaptation actions (OR = 4.407, $p = 0.031$). The study concludes that while institutional sources remain important for disseminating climate risk information, trust embedded within community networks is more effective in promoting adaptation behaviour. The study recommends strengthening community-based climate risk communication by actively engaging trusted local actors through community meetings, local radio programmes, and participatory awareness campaigns to enhance adaptation among frontline communities.

Keywords: Climate Risk Communication, Climate Change Adaptation, Frontline Communities, Tanzania, Trusted Information Sources

I. INTRODUCTION

Human activities have significantly increased greenhouse gas emissions, resulting in changes in the Earth's climate system (Kanna et al., 2024). Global ocean surface temperatures have risen, while glaciers and major ice sheets continue to retreat (Rounce et al., 2023). These changes have altered temperature, precipitation, and humidity patterns, leading to more frequent and intense climate-related hazards such as floods, storms, droughts, heatwaves, and landslides (Jha & Dev, 2024). According to the Intergovernmental Panel on Climate Change in 2023, climate change is already affecting both natural and human systems through declining agricultural productivity, increasing water scarcity, coastal flooding, and displacement. These impacts are particularly severe among vulnerable populations and frontline communities (FLCs), which are disproportionately exposed to climate-related risks and often have limited capacity to respond effectively.

Strengthening adaptation among frontline communities requires access to resources, technology, and credible climate information. Climate communication plays a critical role in helping communities understand climate risks, prepare for extreme events, and make informed adaptation decisions (Clark et al., 2023). However, the effectiveness of climate information depends not only on its availability but also on how it is communicated, who communicates it, and whether recipients perceive it as trustworthy and useful. Communication processes, therefore, influence how climate messages are understood, interpreted, and translated into adaptation actions (Maibach et al., 2023).

Climate information reaches communities through a variety of formal and informal sources, including government agencies, extension officers, non-governmental organisations, experts, and fellow community members. Previous studies have shown that these sources differ in accessibility, trustworthiness, and perceived usefulness. For example, Yona et al. (2025) found that smallholder farmers obtain climate information through extension officers, development agents, non-governmental organisations, and fellow community members. Similarly, Tola et al. (2025) reported that climate information services support adaptation efforts but continue to face challenges related to accessibility and user relevance. In Tanzania, farmers frequently rely on neighbours, extension officers, and other semi-formal information channels when making adaptation decisions (Mwalukasa, 2013).

Beyond information sources, message characteristics also shape how climate information is received and acted upon. Information that is perceived as accurate, understandable, timely, and relevant is more likely to be trusted and used in decision-making processes (O’Callaghan et al., 2025). Consequently, adaptation actions may be influenced by the sources that deliver climate information, the content and tone of the messages communicated, and the credibility attributed to those sources.

Despite recognition of climate risk communication as an important component of climate adaptation, limited evidence exists on how trusted information sources influence adaptation behavior among frontline communities. Previous studies have primarily focused on access to climate information, adaptation outcomes, and agricultural climate information sources (Badullovich et al., 2020; Mwalukasa, 2013; Stewart, 2024), while paying less attention to the role of source credibility and message characteristics in shaping behavioural responses. This knowledge gap limits understanding of how trusted climate risk information sources can effectively promote adaptation actions among vulnerable populations. Therefore, this study examined the influence of trusted climate information sources on adaptation behaviour among frontline communities in Bukoba Municipality, Tanzania.

1.1 Statement of the Problem

Adaptation requires that climate risk information is not only available but also trusted and acted upon by intended users. Ideally, frontline communities should be able to identify credible sources of climate risk information and use the information received to support adaptation decisions. Despite the availability of climate risk information from both formal and informal sources, frontline communities in Bukoba Municipality face frequent vulnerability to climate-related hazards. Adaptive capacity among many households remains limited, even with repeated exposure to climate information (Food and Agriculture Organisation [FAO], 2022). This suggests a disconnect between access to information and actual use of the information in adaptation decision-making. Research gap: existing studies in Tanzania have largely focused on access to climate information and adaptation practices among farmers (Badullovich et al., 2020; Mwalukasa, 2013; Stewart, 2024), with limited empirical attention to the role of trust in information sources. As a result, there is insufficient understanding of how trusted climate information sources influence adaptation actions among frontline communities, making it difficult to identify the most effective communication approaches for strengthening community resilience to climate change risks. Therefore, this study addressed this gap.

1.2 Research Objectives

- i. To identify the sources of climate risk information trusted by frontline communities in Bukoba Municipality.
- ii. To examine the types of climate messages and message tones commonly received by frontline communities.
- iii. To determine the factors influencing perceptions of credibility of climate information sources among frontline communities.
- iv. To assess the influence of trust in climate risk information sources on adaptation actions among frontline communities.

II. LITERATURE REVIEW

2.1. Theoretical Review

2.1.1 Berlo’s SMCR Communication Model

Berlo’s Source, Message, Channel and Receiver (SMCR) Communication Model provides the theoretical foundation for this study. The model explains communication as a process involving four interrelated elements: the source, message, channel, and receiver. It proposes that effective communication depends on the interaction between these elements and how they influence the receiver’s understanding and interpretation of information. Among these elements, the source is particularly important because it initiates the communication process and influences the nature and quality of the information communicated (Chen et al., 2024). In this study, the source component of the SMCR model was adopted to examine how different information providers, including government authorities, climate experts, local leaders, non-governmental organisations, and community members, provide climate risk information to frontline communities. The message component was used to examine the types of climate risk information communicated by

these sources and how message characteristics influence community understanding. Furthermore, the receiver component was adopted to understand how frontline communities interpret received information and translate it into climate change adaptation actions.

Therefore, the SMCR model provides a useful framework for examining how climate risk information sources influence the way communities receive, interpret, and respond through adaptation actions (Mapuwei, 2024). Despite its relevance, the SMCR model provides a limited explanation of why receivers develop greater trust in some information sources compared with others. Although the model recognises the importance of the source in the communication process, it does not sufficiently explain how perceptions of source credibility influence information acceptance and behavioural responses. This weakness is addressed by Source Credibility Theory.

2.1.2 Source Credibility Theory

Source Credibility Theory provides further explanation of why individuals trust some information sources more than others. The theory argues that information is more likely to be accepted and acted upon when it originates from sources perceived as knowledgeable, trustworthy, and reliable (Zagona & Harter, 1966). Source Credibility Theory emphasises the characteristics of the source that influence audience confidence and acceptance of information. The theory is particularly relevant to this study because frontline communities receive climate risk information from multiple sources that may differ in their level of perceived credibility. Decisions regarding whether to rely on information from government authorities, climate experts, local leaders, community members, or other actors are often influenced by perceptions of expertise, reliability, accuracy, and the ability of these sources to provide information that reflects local realities. Previous studies have demonstrated that these credibility attributes influence the level of trust placed in information sources and the likelihood of adopting recommended actions (Rabjohn et al., 2008; Sui & Zhang, 2021). In this study, Source Credibility Theory complements Berlo's SMCR Model by explaining the role of trust in shaping the influence of information sources on adaptation actions. While the SMCR model identifies the source as a key element in the communication process, Source Credibility Theory explains why certain sources are considered more trustworthy than others and how this trust influences adaptation decisions among frontline communities.

2.2. Empirical Review

2.2.1 Trusted Sources of Climate Risk Information

Trust is a critical element in climate risk communication because it influences whether information is accepted and considered useful for decision-making (Paton, 2008). Existing studies indicate that communities do not place equal trust in all information providers; instead, trust is shaped by perceptions of competence, reliability, and relevance (O'Neill, 2018). As a result, certain sources can emerge as more trusted than others when communicating climate-related risks and adaptation information. Evidence from different regions shows that formal sources are regarded as trusted sources of climate information. Chapagain et al. (2026) found that scientific institutions and community-based organizations were among the most trusted providers of climate information in Bangladesh, India, and Nepal due to their perceived expertise and access to scientific knowledge. Similarly, Mabon (2020) reported that scientists and local government authorities were widely trusted in Japan because they were viewed as credible sources of risk-related information.

In African contexts, trust extends beyond formal sources to include actors who maintain direct engagement with communities. Amoak et al. (2023) observed that farmers in Malawi and Ghana trusted information received from government agencies, extension officers, and farmer networks because these sources provided practical and timely guidance. Likewise, Belay et al. (2022) reported that extension officers and community meetings were trusted channels among Ethiopian farmers due to their accessibility and familiarity. Evidence from Tanzania also indicates that extension officers and the Tanzania Meteorological Authority remain important and trusted providers of climate-risk information, although community members often complement official information with advice obtained from neighbours and local leaders (Mwalukasa, 2013). Therefore the literature suggests that trust in climate information is distributed across both formal and informal sources. While formal institutions derive trust from their technical expertise, informal sources often gain trust through social relationships, familiarity, and shared local experiences. This demonstrates that trusted climate information sources are not determined solely by institutional authority but also by the extent to which communities perceive the source as relevant and dependable.

2.2.2 Types and Tone of Climate Risk Messages

Climate communication encompasses a wide range of messages intended to improve awareness, preparedness, and adaptation to climate-related risks. Previous studies show that the most common climate-risk messages include seasonal weather forecasts, drought warnings, flood alerts, extreme weather advisories, preparedness guidelines, and recommendations on adaptation practices (Partey et al., 2020; Weitkamp et al., 2020). These messages provide information that enables communities to anticipate climate hazards and take appropriate preventive actions. Beyond

message content, researchers have increasingly emphasized the importance of message tone in shaping audience responses.

Climate messages may be communicated using warning-oriented, urgency-based, loss-framed, gain-framed, or solution-oriented approaches. Mittermeier et al. (2025) found that urgency-framed messages increased perceptions of climate risks and encouraged adaptation intentions. Similarly, Ngo (2021) reported that gain-framed messages emphasizing potential benefits of adaptation were more effective in motivating behavioural change than messages focusing solely on climate threats. However, evidence suggests that excessive emphasis on risks and negative consequences may generate anxiety or disengagement, particularly when messages do not provide clear response options (Hmielowski et al., 2019). Consequently, communication scholars increasingly advocate for solution-oriented messages that combine risk information with practical adaptation recommendations. The literature, therefore, indicates that both the type of information communicated and the tone used to communicate it influence how climate messages are interpreted and acted upon.

2.2.3 Factors Influencing Perceived Credibility of Climate Risk Information Sources

The credibility of climate information sources has received considerable attention because credibility shapes public confidence in climate information. Existing studies suggest that perceptions of credibility are influenced by multiple factors rather than by source identity alone. One commonly reported factor is expertise. Kresin et al. (2024) found that scientific institutions were perceived as credible because of their technical knowledge and ability to generate evidence-based climate information. Similarly, Crick (2021) noted that competence, transparency, and consistency strengthen confidence in information providers. These findings suggest that individuals are more likely to trust sources that demonstrate professional knowledge and accuracy.

Studies conducted in African contexts reveal additional factors that influence credibility perceptions. Amoak et al. (2023) found that timeliness, accessibility, and usefulness of information contributed significantly to trust in climate information sources. Likewise, Kalemera et al. (2025) and Yona et al. (2025) reported that locally relevant information, clear communication, and previous positive experiences with information providers enhanced perceptions of credibility among farming communities. Therefore, the literature indicates that credibility is shaped by a combination of expertise, accuracy, timeliness, accessibility, transparency, and local relevance. These factors influence whether climate information is viewed as trustworthy and whether recipients are willing to rely on it when making adaptation decisions.

2.2.4 Influence of Trusted Information Sources on Adaptation Actions

Literature suggests that trusted information sources play an important role in translating climate information into adaptation actions. Trust increases confidence in the information received and reduces uncertainty associated with climate-related decision-making, thereby increasing the likelihood of behavioural responses (Wei & He, 2026). Empirical studies consistently report a positive association between trusted information sources and adaptation outcomes. Owen (2020) found that adaptation initiatives were more successful when communities relied on trusted information providers. Similarly, Bridges et al. (2024) reported that trust-based interactions among scientists, governments, and local communities enhanced climate-informed planning and decision-making processes.

Evidence from Africa further supports this relationship. Amoak et al. (2023) found that farmers who trusted information obtained from extension officers, government agencies, and community networks were more likely to adopt adaptation measures. Likewise, Yona et al. (2025) reported that trust in extension services and community-based communication channels encouraged the adoption of practices such as changing planting schedules and diversifying livelihood activities. Although existing studies demonstrate that trusted information sources contribute to adaptation behaviour, most have focused on agricultural settings and specific adaptation practices. Consequently, limited evidence exists on how trusted sources influence adaptation actions among frontline communities exposed to multiple climate-related risks. Furthermore, the combined influence of trusted sources, message characteristics, and credibility perceptions remains insufficiently explored. Addressing this gap is essential for improving climate risk communication strategies aimed at strengthening community resilience.

III. METHODOLOGY

3.1 Research Design

The study employed a cross-sectional mixed-methods research design. A mixed-methods approach was considered appropriate because it enabled the collection of both quantitative and qualitative data, thereby providing a comprehensive understanding of trusted climate information sources and their influence on adaptation actions among frontline communities. Quantitative data were collected and analysed first, followed by qualitative data collection to facilitate interpretation and explanation of the quantitative findings. This approach enhanced the depth, contextual understanding, and overall validity of the study findings.

3.2 Study Area

The study was conducted in Bukoba Municipal Council, located in Kagera Region in north-western Tanzania. The municipality is located along the western shores of Lake Victoria and is characterised by a tropical climate with high rainfall and moderate temperatures. Despite these favourable climatic conditions, the area has frequently experienced climate-related hazards, including flooding, strong winds, irregular rainfall patterns, and climate-sensitive disease outbreaks. These hazards have affected community livelihoods, infrastructure, health conditions, and other socio-economic activities.

Bukoba Municipal Council was selected as the study area because of its vulnerability to climate-related impacts and the continued exposure of local communities to climate risks. The municipality provides an important context for examining how frontline communities access, perceive, and respond to climate risk information from different sources. In addition, the presence of diverse information providers, including government authorities, climate experts, local leaders, and community networks, makes the area suitable for assessing the influence of trusted climate information sources on adaptation actions among frontline communities.

3.3 Target Population

Based on population, the study targeted frontline communities residing in climate risk-prone wards within Bukoba Municipality. Frontline communities were defined as populations highly exposed to climate-related risks whose livelihoods and well-being are directly affected by climate variability and extreme weather events (Wahid et al., 2024). The selected wards were identified based on municipal records indicating recurrent exposure to climate-related hazards such as floods, strong winds, landslides, and disease outbreaks. Eligible participants were identified through ward office records and local leaders' knowledge of households affected by climate-related events. Inclusion criteria required respondents to be permanent residents of the selected wards and to have direct experience with climate-related impacts. The study population comprised household members, local leaders, community representatives, and disaster management personnel.

3.4 Sampling Procedures and Sample Size

A multistage sampling procedure was employed to select study participants. In the first stage, five climate-vulnerable wards out of the 14 wards in Bukoba Municipal Council were purposively selected based on their documented exposure to climate-related hazards. The selected wards were Bakoba, Kashai, Nshambya, Miembeni, and Bilele. In the second stage, streets within the selected wards that had experienced climate-related risks were purposively identified to ensure that the study captured communities with direct experiences of climate impacts and adaptation challenges. In the third stage, households within the selected streets were selected using simple random sampling. This approach provided all eligible households with an equal opportunity to participate in the study and helped minimise selection bias.

In addition to household respondents, 14 key informants were purposively selected to provide detailed information on climate risk information sources and adaptation practices. The key informants included ward leaders, community development officers, environmental officers, and disaster management personnel. They were selected based on their institutional responsibilities, local knowledge, and practical experience related to climate risk information dissemination and adaptation activities within Bukoba Municipal Council.

The sample size for household respondents was determined using Cochran's formula for large populations: $n_0 = (Z^2pq) / (e^2)$

Where:

n_0 = required sample size

Z = standard normal deviate corresponding to the selected confidence level (1.96 at 95% confidence level)

p = estimated proportion of the population possessing the characteristic of interest (0.5)

$q = 1 - p$ (0.5) and

e = acceptable margin of error (0.06).

Using these values: $n_0 = (1.96^2 \times 0.5 \times 0.5) / (0.06^2)$

$n_0 = 266.78$

The calculated sample size was approximately 267 household respondents. During data collection, 265 household respondents were successfully interviewed, representing a response rate of 99.3% of the calculated sample size.

3.5 Data Collection Instruments and Procedures

Both quantitative and qualitative data were collected in this study. Quantitative data were collected using a structured questionnaire administered to household respondents. The questionnaire was designed to capture information on trusted sources of climate risk information, characteristics of climate messages received, perceived credibility of information sources, climate change adaptation actions, and respondents' socio-demographic characteristics. The

questionnaire was administered directly to selected household respondents to obtain information on their experiences, perceptions, and responses related to climate risk information and adaptation practices. Qualitative data were collected through key informant interviews conducted with selected individuals who had relevant knowledge and experience related to climate information provision and community adaptation. The interviews explored participants' experiences regarding climate information sources, factors influencing trust in information providers, characteristics of climate messages, and how communities respond to climate-related risks. The qualitative information provided a deeper contextual understanding and helped explain patterns observed in the quantitative findings.

The study measured four main constructs: trusted information sources, message characteristics, perceived credibility of information sources, and adaptation actions (see Annexed Table 1). Trusted information sources included government authorities, local community leaders, climate experts, non-governmental organisations, family members, community members, and religious leaders. Message characteristics were assessed based on climate message content and message tone. Perceived credibility of information sources was measured using four dimensions: expertise, accuracy, understandability, and timeliness of the information provided. Adaptation actions represented the dependent variable of the study. An adaptation index was developed based on adaptation measures reported by respondents across different areas of climate change response. The resulting adaptation scores were used to classify respondents into low and high adaptation categories, which were subsequently applied in the binary logistic regression analysis to examine factors associated with adaptation actions.

3.6. Data Analysis

Quantitative data were analysed using IBM SPSS Statistics version 27. Descriptive statistics, including frequencies and percentages, were used to summarize respondents' socio-demographic characteristics, trusted climate information sources, message characteristics, perceived credibility attributes, and adaptation actions. Binary logistic regression was employed to measure the influence of trusted climate information sources on adaptation actions among frontline communities. The dependent variable was adaptation status, categorized as either low adaptation or high adaptation. Independent variables included trusted climate information sources, while socio-demographic characteristics were incorporated as control variables.

The logistic regression model was specified as:

$$\ln [p / (1-p)] = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \dots + \beta_{12} X_{12} + \varepsilon$$

Where:

p = probability of high adaptation;

$\ln [p / (1-p)]$ = log odds of high adaptation;

β_0 = intercept;

β_1 – β_{12} = regression coefficients;

X_1 = Government authorities;

X_2 = Local community leaders;

X_3 = Climate experts;

X_4 = Non-governmental organizations;

X_5 = Family members;

X_6 = Community members;

X_7 = Religious leaders;

X_8 = Ward;

X_9 = Gender;

X_{10} = Age;

X_{11} = Education level;

X_{12} = Marital status;

ε = error term.

Odds ratios (OR), 95% confidence intervals (CI), and p-values were used to determine the strength, direction, and statistical significance of associations between predictor variables and adaptation outcomes. Qualitative data were transcribed, coded, and analysed thematically. Emerging themes were organized around climate information sources, message characteristics, source credibility, and adaptation behaviour. The qualitative findings were integrated with quantitative results to facilitate the interpretation and explanation of observed patterns.

3.7 Validity and Reliability of the Instrument

Moreover, several measures were undertaken to ensure the validity and reliability of the research instruments. Experts in climate communication and adaptation research established content validity through the adaptation of questionnaire items from previously validated studies and subsequent review. Feedback obtained from the experts was used to refine the instrument and ensure alignment with the study objectives and local context. A pilot study involving

30 respondents was conducted to assess the clarity, relevance, and consistency of questionnaire items. Reliability was evaluated using Cronbach's alpha coefficient. The analysis produced a Cronbach's alpha value of 0.87, indicating a high level of internal consistency among questionnaire items and demonstrating that the instrument was reliable for data collection. Additional quality control measures included clarification of questionnaire items during data collection, verification of completed questionnaires before data entry, and data cleaning procedures to identify and correct inconsistencies, missing values, and entry errors before statistical analysis.

3.8 Ethical Consideration

Ethical principles were observed throughout the study. Participation was voluntary, and informed consent was obtained from all respondents before data collection. Participants were informed about the purpose of the study, confidentiality procedures, and their right to withdraw from participation at any stage without any consequences. Confidentiality and anonymity were maintained throughout the research process. Information obtained from respondents was used solely for academic purposes, and personal identifiers were excluded from data analysis and reporting. The study also respected local community procedures and adhered to accepted research ethics standards throughout data collection, analysis, and dissemination of findings.

IV. FINDINGS & DISCUSSION

4.1 Socio-Demographic Characteristics of Respondents

A total of 265 frontline community members participated in the study. The respondents varied in terms of age, gender, education level, marital status, occupation, and ward of residence (Table 1). This diversity provided a broad representation of climate-vulnerable populations within Bukoba Municipality.

Table 1

Socio-demographic Characteristics of Respondents

Variable	Category	Frequency(N)	Percentage (%)	Variable	Category	Frequency(N)	Percentage (%)
Ward	Kashai	65	24.5	Marital status	Married	187	70.6
	Bakoba	35	13.2		Single	21	7.9
	Nshambya	43	16.2		Widowed	18	6.8
	Miembeni	70	26.4		Divorced	25	9.4
	Bilele	52	19.6		Cohabitation	14	5.3
	Total	265	100.0		Total	265	100
Street	Kashai halisi	27	10.2	Education	Informal	14	5.3
	Katatorwansi	16	6.0		Primary	154	58.1
	National Housing	22	8.3		Secondary	85	32.1
	Nyakanyansi	35	13.2		Certificate	7	2.6
	Migera	43	16.2		Diploma	1	.4
	Nyamukazi	70	26.4		Bachelor	3	1.1
	Omukigusha	52	19.6		Masters	1	.4
	Total	265	100		Total	265	100
Sex	Male	97	36.6	Source of income	Small business	161	60.8
	Female	168	63.4		Agriculture	27	10.2
	Total	265	100		Fishing	25	9.4
Age group	18-24	23	8.7		Employed	21	7.9
	25-34	51	19.2		Transport services	12	4.5
	35-44	78	29.4		Tailoring	10	3.8
	45-54	70	26.4		Agent services	5	1.9
	55-64	33	12.5		Construction	4	1.5
	65+	10	3.8		-	-	-
	Total	265	100		Total	265	100

The socio-demographic characteristics are important for understanding climate communication and adaptation because access to information, perceptions of source credibility, and adaptation responses may differ across population groups. Previous studies have shown that factors such as education, age, and social position influence how individuals access, interpret, and respond to climate information (Wolf & Moser, 2011).

4.1.1 Trusted Climate Information Sources

Table 2 presents respondents' trusted sources of climate risk information. Government authorities were identified as the most trusted source, reported by 167 respondents (63.3%), followed by climate experts (55.3%) and local community leaders (42.8%). In contrast, community members (6.4%), non-governmental organisations (4.9%), religious leaders (4.2%), and family members (1.9%) were less frequently identified as trusted sources.

Table 2

Trusted Climate Information Sources

Information Sources	Frequency (N)	Percentage (%)
Government authorities	155	58.5
Local community leaders	96	36.2
Climate expert	143	54.0
Non-Governmental Organizations	13	4.9
Family members	7	2.6
Community members	12	4.5
Religious leaders	11	4.2

The findings indicate that frontline communities largely rely on formal and authoritative sources when seeking climate risk information. The high level of trust in government authorities and climate experts may be associated with perceptions of technical knowledge, institutional responsibility, and access to scientific information. This finding is consistent with previous studies showing that government institutions and scientific actors are often considered credible sources of climate information because of their expertise and authority (Lahsen, 2016). Similarly, Chapagain et al. (2026) reported that scientific institutions and community-based organisations were among the most trusted providers of climate information in Bangladesh, India, and Nepal due to their perceived expertise and access to reliable knowledge. Mabon (2020) also found that scientists and local government authorities were highly trusted sources of risk information in Japan because of their perceived credibility and competence.

However, the findings also demonstrate the continued importance of local social networks, as local community leaders were among the commonly trusted sources of climate risk information. Community leaders may support the interpretation and sharing of climate information by connecting formal information providers with community members and presenting information in locally understandable ways. The quantitative findings were further supported by qualitative findings. One key informant explained that government authorities were trusted because of their visible involvement during climate-related emergencies:

“Government authorities are trusted sources because, when flooding occurs, the support provided to protect people's lives comes directly from the government. They help move affected people from flooded areas to safer places” (KII-03, 15 January 2026).

This finding supports source credibility theory, which suggests that information acceptance is influenced by perceptions of expertise, reliability, and trustworthiness. The results indicate that while technical expertise remains an important basis for trust, the ability of information providers to demonstrate support and relevance within local contexts also contributes to their influence on adaptation-related decisions.

4.1.2 Climate Risk Message Received by Frontline Communities

Table 3 presents the multiple response of the types of climate risk messages received by frontline communities. The findings show that warnings related to extreme weather events, including floods, strong winds, and droughts, were the most commonly reported messages, by 77.4% of respondents. Messages related to climate-sensitive health risks were reported by 41.9% of respondents, while information promoting personal environmental actions, such as tree planting and environmental conservation, was reported by 20.8%. Fewer respondents reported receiving messages related to migration and displacement (9.8%), experiences of communities affected by climate impacts (6.4%), and climate-related innovations and solutions (2.6%). Only two respondents (0.8%) reported they had not received any climate-related messages.

Table 3*Climate Risk Message Content Received by Frontline Communities*

Climate risk message communicated	Frequency (N)	Percentage (%)
Warnings about extreme weather events such as floods, heavy winds and droughts	205	77.4%
Information about health risks, such as disease spread, heat-related illness	111	41.9%
Messages encouraging personal action (like recycling, planting trees)	55	20.8%
Migration or displacement message due to climate impacts	26	9.8%
Stories of people or communities affected by climate change	17	6.4%
Solutions or innovations (e.g., green technology, renewable energy)	7	2.6%
I don't receive any climate change risk messages	2	0.8%

The findings indicate that climate risk information received by frontline communities in Bukoba Municipality is largely centred on hazard warnings and immediate risks, while messages focusing on adaptation options, innovations, and long-term resilience remain limited. This suggests that climate information dissemination currently emphasises informing communities about threats rather than providing sufficient guidance on practical actions that can reduce vulnerability.

Similar observations have been reported in previous studies, which found that climate communication frequently focuses on hazard awareness and emergency preparedness, with comparatively less attention given to adaptation solutions and behavioural change (Partey et al., 2020; Weitkamp et al., 2020). The dominance of warning messages may be linked to the role of authorities and disaster management institutions in communicating urgent information during periods of increased climate risks. Quantitative findings showed that climate messages received by communities were mainly related to extreme weather warnings. This was further supported by key informants, who explained that most communication activities focus on informing communities about immediate risks such as floods and strong winds. One key informant stated:

“During periods of heavy rainfall, we usually inform people about possible flooding risks and advise those living in vulnerable areas to move to safer locations” (KII-02, 15 January 2026).

Another participant highlighted that adaptation guidance is also provided, although less frequently:

“We encourage communities to clean drainage systems, avoid disposing of waste in water channels, and participate in environmental conservation activities to reduce risks” (KII-05, 15 January 2026).

These findings highlight the importance of message content in shaping how communities understand climate risks and respond to them. According to Berlo's SMCR Model, the effectiveness of communication depends not only on the source providing information but also on the nature of the message delivered and how it is interpreted by receivers. Therefore, climate risk communication that combines early warnings with practical adaptation guidance may be more effective in supporting communities to move from awareness of climate risks towards sustained adaptation actions. Table 4 presents respondents' perceptions of the tone of climate risk messages received. The majority of respondents reported receiving messages communicated in an urgent or alarming tone (64.5%). Messages encouraging action and preparedness were reported by 32.1% of respondents, while only 2.3% indicated receiving messages communicated calmly and factually. A small proportion of respondents (1.1%) reported not noticing any particular tone in the messages they received.

Table 4*Perceived Tone of Climate Risk Messages*

Tone	Frequency (N)	Percentage (%)
Urgent alarm	171	64.5%
Calm and factual	6	2.3%
Encouraging action and preparation	85	32.1
I don't notice any particular tone	3	1.1
Total	265	100.0

These findings indicate that climate communication in the study area is predominantly framed in ways that emphasize urgency and potential risks. Although such messages may attract attention and raise awareness, their dominance suggests limited emphasis on solution-oriented and explanatory communication approaches. Previous studies have demonstrated that climate messages framed around risks and threats often generate attention and concern about climate change (Diamond & Urbanski, 2022). However, adaptation behaviour is frequently strengthened when communication combines risk awareness with efficacy-enhancing information that promotes confidence in adaptation measures. Therefore message tone may influence perceptions of credibility and relevance. Within the revised conceptual framework, message tone represents an important intermediary factor linking information sources to behavioural

responses. Communication that combines urgency with practical guidance may be more effective in supporting adaptation actions than messages that focus exclusively on risks and threats.

4.1.3 Perceived Credibility Attributes of Climate Information Sources

Table 5 presents respondents' perceptions of the factors that contributed to the credibility of climate information sources. The findings show that expertise was the most frequently cited credibility attribute, reported by 71.3% of respondents. This was followed by accuracy (50.2%), understanding ability (24.9%), and timeliness (8.7%). The findings indicate that respondents assessed the credibility of climate information sources based on both technical competence and communication-related characteristics. Sources perceived as knowledgeable, accurate, easy to understand, and capable of providing information promptly were more likely to be trusted. The prominence of expertise suggests that respondents attached considerable importance to the perceived knowledge and competence of information providers. At the same time, substantial proportions of respondents emphasized understanding and timeliness, indicating that communication effectiveness extends beyond technical expertise. The findings support source credibility theory, which argues that information acceptance is influenced by perceptions of source expertise and trustworthiness. Sources perceived as knowledgeable and competent are generally considered more credible and therefore more likely to gain audience trust.

Table 5

Perceived Credibility Attributes of Climate Information Sources

Perceived Credibility Attributes	Frequency (N)	Percentage (%)
The source is knowledgeable about climate-related disasters and climate change	189	71.3%
The source provides information that is correct and up-to-date	133	50.2%
The source explains climate risks in a way that is easy to understand	66	24.9%
The source presents information without bias or political influence	26	9.8%
The source gives consistent information over time	23	8.7%
The information from this source fits my situation and daily life	31	11.7%
The source provides information on time when it is needed	13	4.9%

The importance attached to accuracy suggests that respondents valued information that was perceived as reliable and consistent with observed environmental conditions. Similar observations have been reported in climate communication studies where confidence in information providers was strongly associated with perceptions of information reliability and correctness (Crick, 2021; Kresin et al., 2024). The findings further highlight the importance of understandability in climate communication. Climate information frequently contains scientific concepts that may be difficult for non-specialist audiences to interpret. Information communicated in clear and accessible language is therefore more likely to be trusted and used in decision-making processes. Similar patterns have been reported among farming communities and vulnerable populations where localized and easily understandable information enhanced information uptake and use (Yona et al., 2025).

Timeliness also emerged as an important credibility attribute. Climate information is often required to support decisions regarding preparedness and response to climate-related hazards. Information received after critical decisions have already been made may have limited practical value regardless of its technical accuracy. Previous studies have similarly shown that timely information enhances trust and increases the likelihood that climate information will be incorporated into adaptation planning (Amoak et al., 2023; Kalemera et al., 2025). These findings suggest that perceptions of credibility are shaped by a combination of expertise, accuracy, understanding ability, and timeliness. These attributes appear to influence trust in climate information sources and may subsequently affect the extent to which climate information is translated into adaptation actions. The findings therefore support the conceptual proposition that perceived credibility acts as an important intermediary between climate information sources and behavioural responses among frontline communities.

4.1.4 Adaptation Actions among Frontline Communities

Table 6 presents the level of climate change adaptation among frontline communities in Bukoba Municipality. The findings indicate that 155 respondents (58.5%) were categorised as having low adaptation levels, while 110 respondents (41.5%) demonstrated high adaptation levels. These findings suggest that despite the availability of climate risk information from different sources, many frontline community members have not implemented a wide range of adaptation measures.

Table 6*Adaptation levels among Frontline communities*

Adaptation level	Frequency (N)	Percentage (%)
Low adaptation	155	58.5
High adaptation	110	41.5
Total	265	100.0

The relatively high number of respondents with low adaptation levels indicates that access to climate information alone may not be sufficient to encourage adaptation actions. The translation of climate information into practice may depend on additional factors, including the availability of resources, supportive institutional conditions, and the practicality of recommended adaptation measures. This finding is consistent with previous studies showing that awareness and access to climate information do not automatically result in behavioural change, as adaptation decisions are also influenced by individuals' capacity and opportunities to implement recommended actions (Van Valkengoed & Steg, 2019).

The findings are also important in relation to the trust placed in different climate information sources. Although government authorities and climate experts were identified as highly trusted sources of climate risk information, the observed adaptation levels suggest that trust in information providers alone may not guarantee adaptation behaviour. This implies that the effectiveness of climate information may also depend on whether messages provide practical guidance and whether communities have the capacity to act upon the information received. Qualitative findings further explained the factors limiting adaptation among frontline communities. Key informants highlighted challenges related to community participation, economic constraints, and difficulties in implementing recommended adaptation measures. One key informant explained:

“Adaptation efforts here are affected by low community participation. Some people continue to live in flood-prone areas because housing costs are cheaper, even though they are aware of the risks” (KII-04, 15 January 2026).

From the perspective of the study framework, adaptation actions represent the outcome of interactions between information sources, message characteristics, credibility perceptions, and the ability of communities to respond to available information. Therefore, understanding the influence of trusted climate information sources requires consideration of both communication factors and the broader conditions that enable or constrain adaptation behaviour.

4.1.5 Influence of Trusted Climate Information Sources on Adaptation Actions

Binary logistic regression analysis was conducted to examine the influence of trusted climate information sources on adaptation actions among frontline communities. Trusted information sources and selected socio-demographic variables were entered into the model as explanatory variables. The results in Table 7 indicate that trust in community members was significantly associated with adaptation actions among respondents (OR = 4.41, 95% CI: 1.14–17.02, $p = 0.031$). Respondents who trusted community members as sources of climate information were approximately four times more likely to undertake adaptation actions than those who did not trust community members.

Table 7*Logistic Regression Results for Trusted Climate Information Sources and Adaptation Actions*

Predictors	B	OR (Exp(B))	95CI(lower)	95CI(upper)	P-value
Government authorities	.491	1.635	.831	3.215	.154
Local community leaders	-.106	.899	.506	1.598	.718
Climate expert	.559	1.750	.914	3.348	.091
NGOs	.501	1.650	.511	5.324	.402
Family members	.317	1.373	.286	6.599	.692
Community members	1.483	4.407	1.141	17.024	.031
Religious leaders	.711	2.036	.506	8.193	.317
Name your ward	-.033	.967	.842	1.110	.636
What is your gender	-.252	.778	.442	1.367	.382
What is your age	.160	1.173	.950	1.450	.139
What is your education level	.129	1.138	.814	1.590	.451
Marital status	-.050	.951	.757	1.195	.666
Constant	-1.259	.284			.201
Model fitness	$\chi^2 = 16.992$, $df = 8$, $P \text{ value} = < 0.030$, Nagelkerke $R^2 = 0.072$, Accuracy = 62.1				

The findings demonstrate a distinction between trust in climate information sources and their influence on adaptation behaviour. Although government authorities and climate experts were identified as the most trusted sources of climate information, trust in these sources was not significantly associated with adaptation actions. Instead, trust in community members emerged as the only significant predictor of adaptation behaviour, while trust in government authorities, local leaders, NGOs, family members, religious leaders, and socio-demographic characteristics showed no significant influence.

This finding suggests that behavioural responses to climate information are shaped less by institutional credibility alone and more by the social relevance and practical usefulness of information within local contexts. Community members may have greater influence because they communicate through everyday social interactions and share adaptation experiences grounded in local realities. Information exchanged through these networks is therefore more likely to be perceived as understandable, applicable, and responsive to immediate climate-related challenges. The findings are consistent with previous studies that highlight the importance of informal communication networks in supporting adaptation decisions. For example, Amoak et al. (2023) and Yona et al. (2025) found that locally embedded information sources enhanced adaptation because they provided context-specific knowledge that communities could easily interpret and apply. The results also extend these studies by demonstrating that highly trusted institutional sources do not necessarily generate behavioural change when information is not sufficiently contextualized to local circumstances.

From a theoretical perspective, the findings support Berlo's SMCR Model, which emphasizes that communication effectiveness depends not only on source credibility but also on how messages are interpreted by receivers within their social environment. Similarly, Source Credibility Theory suggests that credibility alone may be insufficient to drive behavioural outcomes. Rather, adaptation actions appear to depend on the extent to which information is perceived as relevant, practical, and actionable. Overall, the findings underscore the need for climate communication strategies that integrate institutional expertise with community-based communication networks to enhance the translation of climate information into adaptation practices.

V. CONCLUSION & RECOMMENDATIONS

5.1 Conclusion

This study examined trusted sources of climate risk information and their influence on climate change adaptation among frontline communities in Bukoba Municipality. The findings indicate that government authorities and climate experts were the most trusted providers of climate risk information. Trust in the sources was influenced by perceptions of the sources' expertise, accuracy, understandability, and the timeliness of the information provided. The study further found that climate communication in the area focused mainly on warning messages and information about climate risks, while information promoting adaptation options and long-term resilience received comparatively less attention. Correspondingly, most respondents reported low levels of adaptation, indicating that awareness of climate risks alone may not be sufficient to encourage adaptation actions.

A key finding of the study was that trust in community members was the only information source that was significantly associated with adaptation behaviour. Respondents who trusted community members were more likely to implement adaptation measures than those who relied primarily on other sources. Therefore, the study concludes that effective climate communication requires more than the delivery of accurate information. Climate information is more likely to influence adaptation behaviour when it is communicated through trusted community networks, linked to local realities, and accompanied by practical guidance that enables communities to take action.

5.2 Recommendations

Based on the findings, the study recommends that climate information providers, including government authorities, climate experts, and development partners, should strengthen climate risk information programmes by integrating practical adaptation guidance with climate warnings. Such information should focus on actionable measures that enable frontline communities to respond effectively to climate-related risks. Secondly, climate risk communication initiatives should incorporate trusted community-based actors, including local leaders and community members, in the planning and dissemination of climate information. Strengthening community participation through local awareness programmes, community meetings, and participatory information-sharing approaches can enhance the effectiveness of adaptation interventions.

Thirdly, Bukoba Municipal Council and other stakeholders involved in climate adaptation should strengthen support for community-based adaptation programmes, with greater focus given to environmental adaptation practices. These initiatives should promote locally appropriate solutions and encourage active community involvement in implementation processes. For future research, further studies should investigate how trust in different climate information sources develops over time and how it influences long-term adaptation behaviour. Future research should

also consider comparative studies across different geographical and socio-cultural contexts to provide a broader understanding of the role of trusted information sources in shaping climate change adaptation actions.

Declaration of Interest

The authors declare that they do not have any known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Annex1: Operationalization of Study Variables

Conceptual Variable	Operational Variable	Measurement/Indicator	Scale of Measurement	Role in Analysis
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Trusted Information Sources	Government authorities	Respondent identifies source as trusted provider of climate information	Binary (Yes/No)	Independent Variable
	Local community leaders	Respondent identifies source as trusted provider of climate information	Binary (Yes/No)	Independent Variable
	Climate experts	Respondent identifies source as trusted provider of climate information	Binary (Yes/No)	Independent Variable
	Non-governmental organizations (NGOs)	Respondent identifies source as trusted provider of climate information	Binary (Yes/No)	Independent Variable
	Family members	Respondent identifies source as trusted provider of climate information	Binary (Yes/No)	Independent Variable
	Community members	Respondent identifies source as trusted provider of climate information	Binary (Yes/No)	Independent Variable
	Religious leaders	Respondent identifies source as trusted provider of climate information	Binary (Yes/No)	Independent Variable
Message Characteristics	Message content	Type of climate information received (e.g., warning messages, preparedness messages, adaptation guidance, climate impacts, solution-oriented messages)	Categorical	Descriptive Analysis
	Message tone	Tone of climate messages received (e.g., urgent, informative, encouraging, warning-oriented)	Categorical	Descriptive Analysis
Perceived Credibility	Expertise	Perceived knowledge and competence of information source	Categorical/Multiple Response	Descriptive Analysis
	Accuracy	Perceived correctness and reliability of information provided	Categorical/Multiple Response	Descriptive Analysis
	Understandability	Extent to which information is easy to understand and interpret	Categorical/Multiple Response	Descriptive Analysis
	Timeliness	Perceived promptness of information delivery	Categorical/Multiple Response	Descriptive Analysis
Adaptation Actions	Adaptation index	Composite score based on adaptation measures undertaken by respondents	Continuous Index	Dependent Variable
	Adaptation status	Categorized adaptation index score (Low adaptation = 0; High adaptation = 1)	Binary	Dependent Variable
Control Variables	Age	Age of respondent in years	Continuous	Control Variable
	Gender	Sex of respondent	Binary	Control Variable
	Education level	Highest level of education attained	Ordinal	Control Variable
	Marital status	Marital status of respondent	Categorical	Control Variable
	Ward	Ward of residence	Categorical	Control Variable