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Determine Communication channels used by smallholder farmers to access climate services in Musanze district

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Abstract

There is a significant threat on the African continent caused by climate change and limited practical options for adaptation and mitigation. Food security is becoming a serious problem and the agricultural sector which is the backbone of the Rwandan economy is severely impacted by climate shocks. The Musanze district's smallholder farmers access and use climate services to lessen the effects of extreme events of weather and climate. The conceptual structure is one method used by Rwanda Meteorological Agency to provide farmers with climatic services. Farmers employ a variety of modes to acquire climate services from the service providers for the purposes of planning, adaptation, and mitigation. Researchers, development partners, Ministries/Agencies, and others get climate products, which are then made available to farmers to support them make informed decisions. The survey was also carried out by engaging smallholder farmers using open-ended questions from key-format interviews, providing thorough information on how climate services are very vital and essential to the farmers. The findings indicated that the most commonly used products in planning and decision-making of agricultural activities are monthly bulletins, impact-based early warning information, daily weather forecasts and seasonal forecasts. The age, farmer's income and the availability of equipment's for accessing climate services contributed greatly to the readiness to use climate information. The availability of climatic services contributed to better selection of seeds and timing of pests and disease prevention. The most widely used modes of accessing climate services were radio, television, social media, and short messaging services. The objective of the study is to determine communication channels used by smallholder farmers to access climate services.

Keywords: *accessing climate information; climate change; climate services; communication channels; smallholder farmers*

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Introduction

Climate change is becoming a major societal concern for the world in the twenty-first century, there is great need to make public awareness on the value of utilizing climate services (Sander *et al.,* 2015). The communication of climate services requires an all-encompassing strategy involving all stakeholders. The media and telecommunications sectors have a significant role in distributing climate services to the end users (Stockwell, 2010). To effectively communicate climate services to the community, especially farmers, it demands a systematic strategy, clear and precise information, and preferably in clusters (Morrison *et al.,* 2017). Weather and climatic data must be shared across climate scientists in order to balance climate uncertainty, guarantee the accuracy of the data, and support management and decision-making in industries that are vulnerable to climate change (Wilkes *et al.,* 2015). Farmers and other interested parties can access weather and climate products through the services that make up the whole value chain of climate information. To model and create products, information must be collected from a wide range of stations spread around the country as well as regional and international centers. Packaging of information in user-friendly formats which is considered as decision support tools at all levels, based on the weather parameter(s) of interest in deciding to implement a specific project in a given selected location across the nations (WMO-No.1242). Climate services, in the eyes of the Economic Commission of the African Union, are very pertinent when weather and climate data are produced and made available to all possible users (Kadi *et al.,* 2011). According to the European Commission, using climate data and products is crucial for estimating the community's potential future

economic and social advantages in sustainable development (European Commission, 2015). Climate services involves a comprehensive process of gathering information and materials to be used in developing climate information, delivered to the final users, and gaining feedback for more accurate, trustworthy information for public education (Vaughan *et al.,* 2014). The farmers require prompt access to climate services in order to adapt and mitigate against destructive climatic extremes. In order to deliver services effectively, climate services require planning ahead and do recruitment of various practitioners through a joint effort between information suppliers and users (Isadora *et al.,* 2016). The usage of climate data and information is determined by the need for specific sector-specific operational requirements to address contemporary challenges that demand climate services (Larsen *et al.,* 2021). Future trends must be projected at several timeframes, including hourly, monthly, seasonal, decades, and any other specified longer extended periods, based on analysis of the past and present data (WMO, 2014). It is critical to have precise, reliable climatic information packaged according to the demands of the user for more efficient planning, safety, and results-based outcomes. High-level decision-makers need climate information to plan for the long term and make investments that will lead to revolutionary growth. In order to integrate and implement the climate policy framework for climate services, public-private partnerships must work together to meet user expectations. Governments and business partners in many African nations rely largely on the provision of climate services to promote development (Machingura *et al.,* 2018). Climate services are crucial for lowering risks associated with climate extremes on Rwanda's agriculture sector and boosting community resilience (Nyasimi *et al.,* 2016). Climate data is a tool that greatly facilitates the completion of various activities, hence reducing risks and losses that affect farming systems, such as crop output, adaptation and other coping strategies (Meybeck *et al.,* 2012). When selecting a better variety of crops and effective farming techniques, climate services help to remove ambiguity and enable informed decisions (Tall *et al.,* 2018). The information can be used to calculate the amount of funding that should be allocated for each farming activity as well as the quantity and type of labor, whether it is human or machines that should be used. Climate services are more valuable when users of the information are empowered and have easy, free access to that information (Solomon *et al.,* 2016). The agriculture sector is incredibly vulnerable to climate change and variability since these factors are linked to weather fluctuations that are associated with disasters. The world as a whole and individual nations continue to be impacted on by the effects of weather and climate extremes, which are influenced by regional as well as global variables. Typically, climate shocks are perceived as depriving farmers of a decent harvest, which leads to crops and livestock performing poorly (Abass *et al.,* 2014). Due to significant property losses and damages, which drive up prices and elevate interest rates, the public's susceptibility to climate change impedes further economic expansion. By establishing regulations to lessen the effects of unfavorable seasons, farmers should try to concentrate on risk optimization (FAO, 2021). A number of initiatives should be implemented to embrace cutting-edge technologies that would enhance the usage of the information by taking gender into consideration and encourage stakeholder participation (Ramasamy, 2012). Climate unpredictability is an issue for the agricultural industry notwithstanding all scientific efforts and international collaboration efforts to raise and maximize funds to mitigate such repercussions (Reilly *et al.,* 1996). The gender imbalance that prevails in the majority of African countries is a cause of the lack of access to and utilization of weather and climatic services to enhance social welfare (Diouf *et al.,* 2019). Studies show that creating risk management strategies is essential to responding to climate change and preventing losses due to climate change in the agriculture sector (Akhter *et al.,* 2017).

Utilizing climate services involves the entire value chain process, taking into consideration the work done on data collection, generation, and packing in user-friendly formats for various sectors, such as energy, disaster preparedness, agriculture, water resources, infrastructure, aviation, and transport (GFCS 2015; WMO, 2014). The use of climate services in sub-Saharan Africa is not given much attention, despite the necessity of adapting to the changing climate that affects smallholder farmers who mostly rely on rain-fed agriculture (Naab *et al.,* 2019). Farmers need access to better, more dependable, accurate weather and climate information that is tailored for their particular sectors in order to decrease losses and damages caused by climatic extremes (Hewitt *et al.,* 2012). Experts noted that there is a need to raise awareness of developing a strategy for implementation of a roadmap and bridging the gaps between the producers and users of climate information given the importance of climate services for the resilience and sustainable development of European nations (Street, 2016).

The objective of the study was to determine the communication channels used by farmers in Musanze district to access climate services. The study provided a complete analysis and suggested corrective measures to be made to close the gap that could result in poor access and consumption of climate services. Farmers who don't have much access to climate services are more vulnerable to weather and climatic extremes, which can result into losses and damages that are common in the context of climate change. The study detailed the current pathways used to get climate services and make suggestions for the critical strategic participation of pertinent partners.

Material and methods

Study area

Musanze districts is located in the northern parts of the country with a series of volcanic mountains. The five volcanic mountain ranges in Musanze district are Muhabura, Sabyinyo, Karisimbi, Gahinga, and Bisoke. The local topography makes it clear for the gorillas to be found in this location and that they attract tourists to the region.

Musanze has a humid climate with bimodal rainfall that peaks in April for the season from March to May and in December for the season from September to December, respectively and between the two rainy seasons, there are dry spells.

The yearly rainfall in Musanze ranges from 1400 mm to 1800 mm, which is more than the national average. Musanze has a climate that is generally cool at night, warm during the day and windy throughout the day. The average minimum temperature is 13^{o}C, however there are certain locations where it can be lower, especially at high altitudes, while the average maximum temperature is 20^{o}C (Siebert *et al.,* 2019). The region typically receives a lot of rain, which occasionally cause landslides, flooding and soil erosion (Twagiramungu, 2006). Extreme weather and climate events can result in damage of property as well as other serious effects on agricultural productivity. However, there are some seasons that are badly impacted by dry spell conditions, such as the two consecutive seasons 2008A and 2008B, where smallholder farmers produced extremely affected.

Methodology

The conceptual framework explains how Rwanda Meteorological Agency disseminate climate information to farmers. Farmers uses different channels to access climate services for the purpose of planning, adaptation and mitigation to climate change. The information generated by agency is provided to a number of partners, including Ministries/Agencies, researchers and development partners who avails it to the farmers and use it as a tool for taking informed decisions.

Sampling and data collection

Interviews with farmers about the best ways to access climate services were conducted as part of the purposeful homogeneous sampling in the Musanze district. Heads of households who make decisions about the farm were given the structured questionnaire. The structured questioner touched on channels and climate services accessed, impacts of climate change,

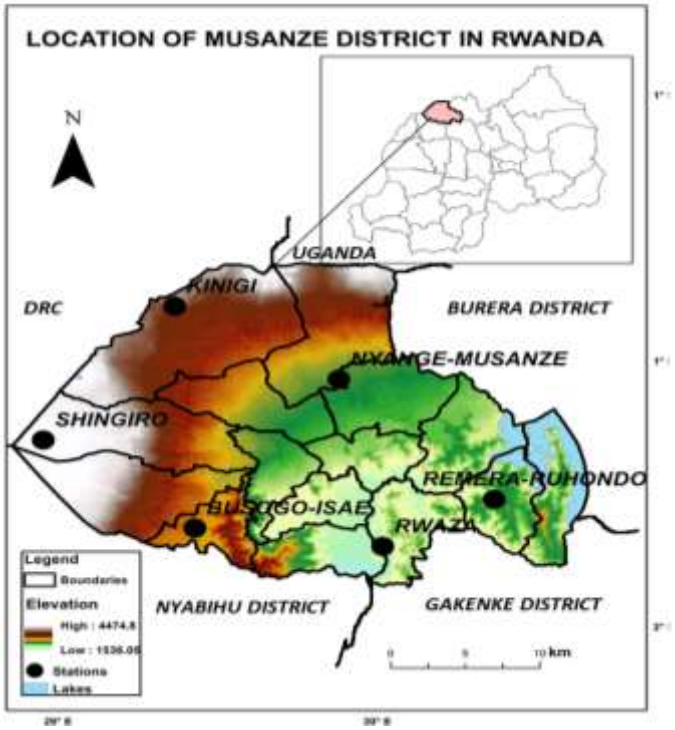

Figure 1. Location of Musanze district on map of Rwanda (Source Author)

demography, importance of climate services and how much they would pay as cost for climate services. The homogenous sampling was limited to farmers in order to identify the channels of communication that farmers utilize to access climate services for effective operations. A total of 100 farmers in the district who are involved in agriculture and impacted on by climate change and variability were interviewed. Most of the questions were administered during the community sessions of communal works commonly known as Umuganda, which always happen every last Saturday of the month across the country, where community gather to discuss developmental projects in their locality.

The survey data was examined using SPSS version 29, and the findings showed how several factors, including communication methods, age, education, products are relevant to farmers for accessing climate services.

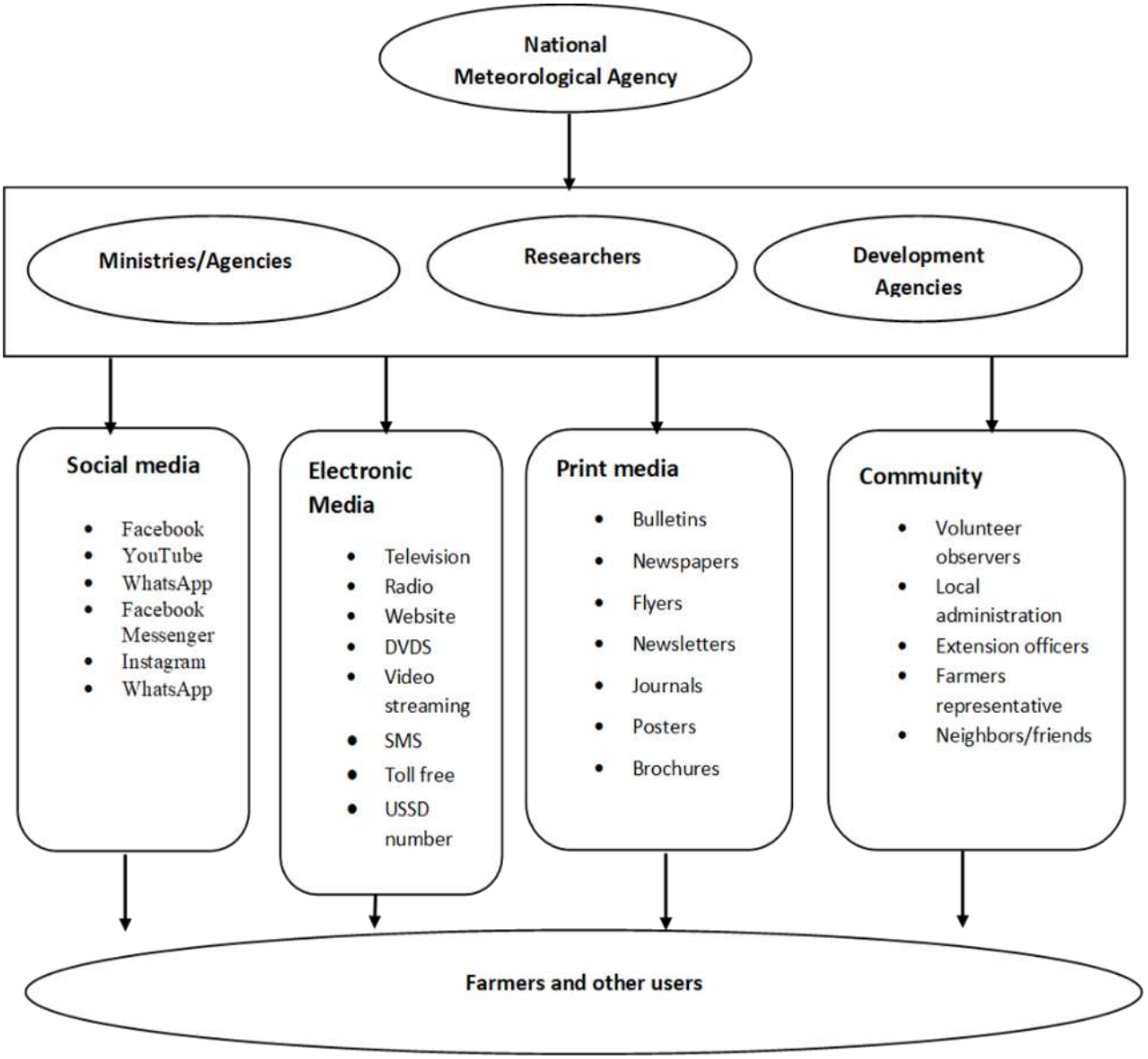

Figure 2. Conceptual Framework for accessing climate services (Source author)

Results

Household Demographic

The findings indicated that 61 percent of the household interviewed were men and 39 percent were women. The age range was 18 to 30 years, where 36 percent of the total was between 31 to 50 years, 40 percent was above 50 years of age whereas 24 percent was the lowest compared to other categories. According to the sampled data on education, the farmers were classified into three education levels: Primary school, high school (secondary), and university. The findings showed that 48 percent of the farmers had completed primary school education, 36 percent had completed high school, and 16 percent had completed university which is indicated in Table 1.

Table 1. Household Demographic of farmers participating in the study

Variables	**Sex**		**Age (Years)**			**Education**		
	Male	**Female**	**18-30**	**31-50**	**>50**	**Primary school**	**High school**	**University**
Numbers (%) N=100	61	39	36	40	24	48	36	16

Channels used to access climate services

According to the sample data, 35% of farmers use radio to access climate services, 18% of farmers use social media, 12% of farmers use friends and family, 11% of farmers use short message service (SMS), 9% of farmers use television, 8% of farmers attended meetings and workshops, 6% of farmers use newspapers and documentation from agriculture extension services. Most farmers use cost effective communication channels to access climate services, however some farmers prioritize the benefits over the costs. Figure 3 and Table 2 show the most popular channels used by farmers.

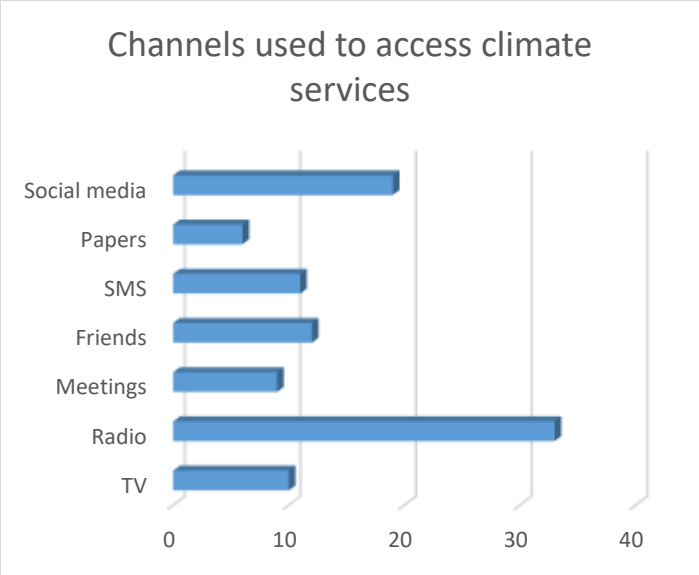

Figure 3. Channels used to access climate services

Table 2. Accessing climate services using communication channels

Statistical measures	Access of climate services				
	Gender	Age	Education	Climate information	Importance
Minimum	39	24	16	6	16
Maximum	61	40	48	20	27
Std. Error	11.0	2.8	9.3	3.5	3.4
Mean	50	33.3	33.3	16.7	20.3
p-value	.069	.010	.04	.002	.001

Climate services accessed by smallholder farmers

Farmers require a range of climate services depending on the tasks they are performing, and timely information access is very crucial. Figure 4 below shows a representation of the climate products utilized by smallholder farmers. 19% of the daily weather forecasts is accessed by farmers for planning and decision-making every day, while 17% of the seasonal forecast is accessed by the farmers who prepare their land at every beginning of the season. These forecasts are always generated in collaboration with user institutions and other interested parties for effective decision-support, notably smallholder farmers. Impact-based early warning (IBEW) information is accessible at a rate of 23% in order to prevent extreme weather and climate events through mitigation and adaptation strategies. Smallholder farmers have 7% access on five-day weather forecast, which is used in planning of various activities on weekly basis. Ten-day predictions generated three times per month at an interval of ten days and is accessed by 6% of farmers whereas 27% of farmers access the monthly bulletin, which incorporates analysis of the long-term mean and forecast of upcoming month.

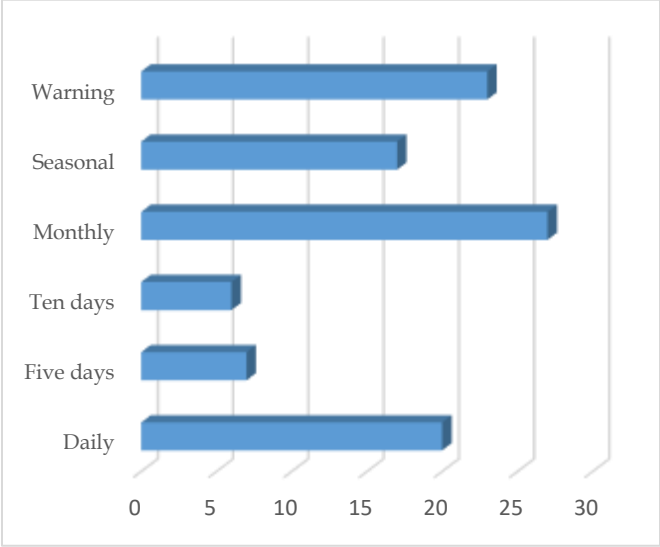

Figure 4. Climate services accessed by the farmers

Importance of climate services

The farmers indicated the importance of using and acquiring climate services, as well as the value attached to the use of climate services. Planning and decision-making was highlighted by of 27% farmers, followed by 22% as the best option of selecting good seeds, 17% on spraying drugs, 16% on best time for harvesting, and 15% on management of pest and disease. Climate services is

considered as one of the best decision support tools used by farmers in Musanze district.

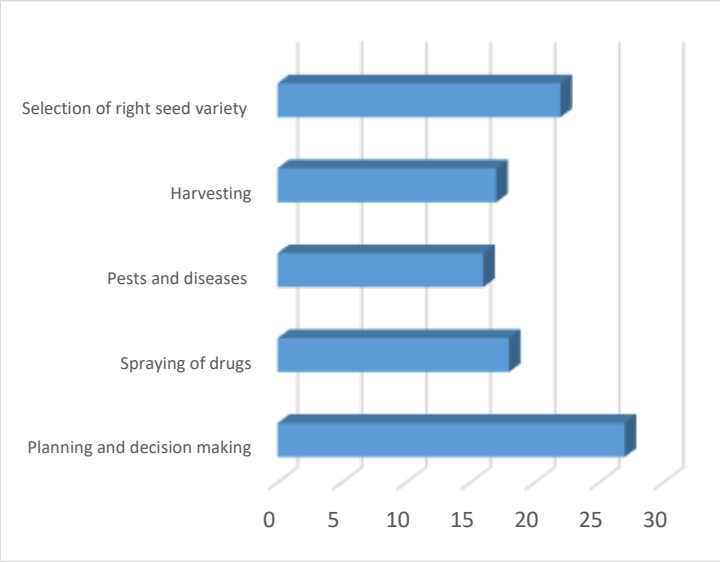

Figure 6. Importance of climate services

Discussion

Studies indicated that the use of climate data considerably increased recently and it represents around 2.8% of the adaptation to climate change (Deressa *et al.,* 2008). The agricultural sector's access to meteorological information has led to the establishment of more farms, reducing losses and harm to the sector (Oyekale, 2015). The farming community is better equipped to survive extreme weather and climate because media sources have a significant impact on how individuals can obtain information on weather and climate (Oyekale, 2012). The findings revealed that regions with financial constraints, the household income increases the cost of getting climate information by 7% (Ingram *et al.,* 2002). Contrary to farmers who continue to employ traditional farming methods without adopting cutting-edge technology, widespread usage of technology of climatic services has increased the harvest (Muema *et al.,* 2018). Smallholder farmers are given access to climate services to aid their agricultural undertakings, demonstrated their trust in and use of climate data (Mudombi *et al.,* 2014). Climate services must embrace collaborative component of interdisciplinary approach in order to support decision-making for effective community sustainable development (Donkora *et al.,* 2019). The semi-arid study in Kenya showed the importance of building community support capacity for successful interpretation and usage of climate information (Cherotich *et al.,* 2012). The study carried out in Kisii, Kenya, demonstrated the need to improve the capability of packaging climatic information into accessible, user-friendly formats (Wamalwa *et al.,* 2016). The results of a study on the availability of climate services in Zimbabwe's Seke and Murewa districts demonstrated a high sensitivity to climate extremes as a result of inadequate timely access to climate information (Mundombi *et al.,* 2014). Although it is severely impacted on by climate change, however policy makers should work towards implementation of adaption solutions for agriculture in Ethiopia in support of socioeconomic development of the nation (Deressa *et al.,* 2008). Farmers in three agro-ecological zones in Burkina Faso shared and used seasonal forecasts on comparative analysis of climate data which revealed that farmers have knowledge and understanding in making decisions based on climate information which is occasionally associated with the uncertainty posed by climate variability and change (Roncoli *et al.,* 2009). According to a World Bank study carried out in Kenya, climate information services is very helpful and considered as supplemental tool to reduce the risks that farmers encounter due to climate extremes that are becoming worse due climate change (Ngari *et al.,* 2016)

Conclusion

The monthly forecast and Impact Based Early Warning (IBEW), which were a little bit high compared to other predictions, are the most popular forecasts in Musanze, according to the survey data. Radio, which is typically utilized by many farmers in the area, was the favored route for getting climatic information. The social media, which is used by some cooperative members who disseminate information to the entire group, was the other favored medium for obtaining climate services. A number of farmers also have additional ways to receive climate services, including friends and the Short Service Message (SMS). The survey's findings also showed that although men still outnumber women and the active age range for using climate services is between 31 and 50 years, farmers with postsecondary educations are leading users of these services. A number of agricultural activities that farmers are engaged in were able to see the actual effects of climate services, which was considered as very crucial for enhancing productivity, that is sometimes hampered by climatic variability and change.

The study highlighted the inadequate use and understanding of climate services, most farmers lack specific channels of obtaining weather and climate information. Strategic recommendations by the authority on potential mitigation of the adverse effects of climate change on the agricultural sector and more research is needed to ascertain how farmers perceive using climate services in other parts of the country.

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