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The role of radio, television and mobile phones in disseminating information on occurrences of wildfire in Uluguru Mountains Nature Reserve – Morogoro Tanzania

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Abstract

This study sought to determine the contribution of radio, television and mobile phones used by local communities in disseminating and accessing information about wildfire hazards in the Uluguru Mountains Nature Reserve and assessed the extent of their usage in disseminating wildfire information. It also aimed at identifying barriers to their use in reporting wildfire incidences in the Uluguru Mountains and determined the available wildfire reduction strategies which can be improved by use of other types of ICTs. A descriptive survey method and purposive and conveniently sampling techniques were employed to select a sample of 15 key informants and 90 villagers from the three villages that were purposively selected. Questionnaires, focus group discussions, interview with key informants and participants observations were used to collect both quantitative and qualitative data. The finding show that the community living around Uluguru Mountains Nature Reserve own Radio and mobile phones although few of them owned televisions. Very few respondents reported wildfire incidence using their mobile phone, while the majority used their mobile phone for other social-economic activities. However, internet based AFIS Meraka system and handheld GPS were the most common technologies used to disseminate wildfire information. In general radio, mobile phones and televisions are not fully beneficial to the local communities. Based on the results, it was recommended that the role of modern ICTs in detecting and disseminating wildfire be encouraged among the authorities.

Keywords

Wildfire, Uluguru Mountains, radio, mobile phones, television, climate change, wildfire information, AFIS Meraka

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Introduction

Information and communication technology (ICTs) is a term which encompasses all electronic media used in communicating information (Chandler and Munday, 2012). Ratheeswari (2018) describes ICTs as a generic name used to refer to technologies that provide access to information through telecommunications. ICT is the product of the convergence of digital technologies encompassing computers, telecommunications, audio-video and publishing. It covers mobile phones, personal computers, and

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internet-mail, imaging technology, digital broadcasts, cable television and others. Before the emergence of ICT, African communities had their own means of disseminating information and gathering people. When there was any emergency information like war, death, invasion of wild animals and fire outbreak, Community were calling each other through traditional media like (*ngolo, ukunga,mwano,lukemo*), traditional burglar alarm made by animal horn and sound of special drums (Akpojivi and Fosu, 2016).

Though traditional means of disseminating information are still in use, there are some drawbacks associated with the same including inefficiency and low coverage (Hesseln, 2018). Much of these and other traditional methods being in place; it has not been clear as to how effective these technologies are to communicate information on events such as the presence of wildfire once it erupts. Hence, there is still work to be done to make sure that technologies available are used at local community levels for the available full benefit. As such, this study attempted to assess and recommend ways by which radio, mobile telephones could be effectively used for information transfer and communication to reduce fire hazards as a way to conserve water catchment forests in Uluguru Mountains.

The Uluguru Mountains are part of the Eastern Arc Mountains found in Tanzania. They are located south of Morogoro town between latitude 7° and 8°S and longitude 37°–38°E (Nkombe, 2003). The efforts of preserving the Uluguru Mountains from fire started far back during German colonial rule in 1908. This was due to economic, social and scientific importance of the Uluguru Mountains Nature Reserve. The three parts forming Uluguru nature reserve were formerly known in colonial rule as Uluguru North Territorial Forest Reserve, Uluguru South Territorial Forest Reserve and Bunduki Territorial Forest Reserve. Government Notice No 578 of 1963 and Government Notice No. 44 of 1946 which created the territorial forest reserve were revoked by Government Notice No 296 of year 2008 (Forest Act, 2008). The colonial rule did not involve rural dwellers in conserving the mountains and as a result there was conflict between forest officers and the community. Despite the government's effort to prevent forest fire the action of burning forest continued at the higher rate. A study by William (2010) mentions the conflict between forest officers and the community. In the recent years due to community involvement in preventing fire hazards, conflicts between the community and the forest officers have decreased to a significant degree.

Uluguru Mountains contain animal species not found elsewhere in the world including bush shrike (*Malacotonus alius*). Also Uluguru Mountains have Water Catchment forests which have water streams and rivers which supply water to Ruvu River used by the people and industries in Dar-es-salaam (Burgess et al., 2007; Kayombo et al., 2020). The town of Morogoro which has a number of industries and big institutions also depends on the water streams flowing from the Uluguru mountains. The existence of Mindu dam depends on the water coming from Uluguru Mountains. The forest also serves as a carbon sink and helps to regulate the climate of the Morogoro region. Research has indicated that after bad cultivation practice bush fire (wildfire) is the second largest contributor to soil erosion in the area (Kagosi et al., 2020). Wildfire cause deforestation, destroy flora and fauna, increase global warming through carbon emission from burning forest biomass and cause soil erosion to the area left uncovered due to fire. The eroded soil goes to the water resources and reduces depth of water resources for example in Mindu dam situated in Morogoro region. Wildfire is still one of the major threats which cause drying up of water streams and springs in the Uluguru mountains natural reserve (Forconsult, 1995; Mvena et al., 2020). Also the amount of water supply from these mountains continues to decrease and the rate of regeneration of the forests is still low. Under normal practices, when fire erupts, it spreads very fast and sometimes it takes days for the community members around the mountains to notice it. According to Forest Act No.7 of Tanzania (2002) community in the area are expected to cooperate and inform one another to go to extinguish the fire or ask support from other relevant authorities (URT, 2013). Hence the need to use radio, mobile phones and television which would help them to transfer fire information fast and to a wider area and many people at once since most rural populations are known to possess an use these media of communication. Ways by which the reporting is done relies mostly on traditional means including word of mouth locally termed as Ngolo, drums and in some places through burglar alarm, and beating gong-gong. Advanced Fire Information System detection Software (AFIS) which downloads location of active fire, time and images has been installed at the ministry of natural resources and tourism (MNRT) and

TAFORI centre Morogoro (Bastola and Shakya, 2020). Much of this and other traditional method being in place was not very clear on the extent to which radio, mobile phones and televisions would help to communicate appropriate information on the presence of wildfire once it erupts. Hence, there is still work to be done to make sure that the technology available is used at the local community for the full benefit available. As such, this study realized the need to protect the mountains from the destruction of wildfire by using these three medium of communication due to their availability and wider use in rural areas around Uluguru Mountains**.** Specifically, this study aimed to:

1. Examine ways by which radio, television and mobile phones have been used in disseminating information on occurrences of wildfire in Uluguru Mountains Nature Reserve
2. Assess barriers to the use of radio, television and mobile phones in disseminating information on occurrence of wildfires in Uluguru Mountains Nature Reserve

Review of related literature

Use of radio, television and mobile phones in disseminating wildfire information

Information and communication technologies has a role to play in preserving environment especially from fire, erosion, destruction of unique animal species and production of green gases. Studies around the world have demonstrated the role of various forms of ICTs in communicating information on wildfires to various stakeholders (Kelly and Addo, 2023; Stipani, 2011; Sutton et al., 2008).

ICT play a role in raising awareness and detection of hazards to environment and dissemination of information through communication devices (Kelly and Addo, 2023). A number of ICT facilities such as radio, television, mobile phone, internet, social media, loudspeakers and other related electronic devices have a role to play in preserving environment from fire hazards.

Use of radio. Radio play a very important role in communicating information about fire hazards in forests (Mvena et al., 2020). The role of media (Radio) in the conservation of Uluguru Mountains forest particularly in Morogoro is not well noticed. Radio and television have been used by urban population on weather forecasts and to some extent, on climatic changes and environmental protection. However in many cases rural populations hardly pay attention to such broadcasts as most times they use these media for other purposes. For example, the study by Lwoga (2010) and Atkinson and Sullivan (2011) show that local radios and community radios are most listened by many rural people and they broadcast music, advertisement and religious session. (Zacharia and Andindilile, 2020) also found that radio has been the source of information in rural areas for many years, and has been used to communicate information on forest conservation. The study by Mtega (2018) found that majority of community members in villages use radio as their source of information in agriculture, social and National news. Hence, radio has one of the ICT device can broadcast information to many people living in village. Community radio using FM station are now thought to be closer to community than National Radio, but the problem with community radio is low coverage and in order to standardize message then it has to be spread to all community radio in the area. Nevertheless, evidence from the literature reveal that community radio play an important role in creating awareness among rural communities on events of bushfires. In Ghana for example, community radio is used as a wildfire prevention medium through providing information on fire and its effects on annual basis Kosoe et al. (2015). In South Africa, community radio have played a big role in conveying reports about effects caused by bushfires in terms of losses to properties, fires in rural parks, paying much attention to updates on current fires, suppression of these fires and the loss, damage or threat of these fires to infrastructure and human health or lives. This is quite opposite to the cases of Tanzania where community radio play very little role in providing such details, particularly information about current fires.

Use of television. Television is one of the ICTs the audio visual tool that uses high technology to capture and display images to people. It integrates the use of radio and cinema into one medium, hence becoming a very useful tool for disseminating information and educating societies. When there is no signal from satellites, video screen with recorded Compact Disc (CD) or tapes can still provide the intended information and, hence becoming a useful tool even when there is no live signal. In absence of electricity, TV/Video can be operated with a generator. In a survey study conducted by Mwantimwa (2020) in Bunda District in Tanzania, it was

discovered that television is one of the preferred information tool by rural communities. Contrary to the situations in Tanzania where fewer studies on use of televisions for wildfire information, in other countries such as the US, television is considered as one of the most useful media to the same (Velez et al., 2017). Following low use of television in this regard, various methods have been suggested to utilize televisions to raise awareness to rural communities in Tanzania on causes, effects and preventive measures of uncontrolled forest fires (Erkkilä et al., 2022). Despite such suggestions, more studies need to be carried out to find out ways by which such channels are used to communicate information about wild fires in mountainous areas such as Uluguru in Morogoro, since literature on this aspect is scant.

Use of mobile phones. Mobile phones have shown a significant use in villages for various purposes such as helping farmers to get markets for farm produces and increase productivity through accessing relevant agricultural information (Mittal et al., 2009). Several studies such as (Bioco and Fazendeiro, 2019) have indicated that mobile phones are very important devices in supporting forest fire prevention by volunteers who report on fire incidents in forests. Mobile technologies such as Mobile Ad-Hoc Network (MANET) have been in use in developed countries to monitor and communicate information on forest fires (AL-Dhief et al., 2017). However, in Tanzania, very few studies (apart from (Tack et al., 2022)); Erkkilä et al. (2022) which reported on the use of mobile phones to communicate information on wildfire. For example, Mwantimwa (2019) focused on mobile telephone used as marketing tools, in improving livelihood of rural communities as well as improving access to information. Fewer studies in Tanzania have attempted to demonstrate the role of mobile phone as information tool during fire disaster, hence calling for more studies in their use.

Use of social media tools. Beyond radio, mobile phones and televisions, other communication media such as social medial like Blogs, twitter, Facebook have been in use to report research information, photos of wildfire incidence (Sweeney and Craig, 2010). Studies such as the one by (Boulton et al., 2016) have demonstrated the use of social media data to detect and characterize fire hazards and the associated social impacts. By using this data, it has been possible to predict and locate wild fires based on previous events of such disasters. In Turkey, social media platforms have been used to communicate information on the forest fire among the communities (Unal Colak and Yllmaz, 2021). In addition, data from Instagram has been used to reveal that environmental organizations in Australia and Amazon wildfire incidents had less engagement than popular cultural individuals. Whereas popular cultural figures had posted more pictures and other forms of information on Instagram, environmental organizations did not do so frequently during wild fire events (Fabiana Meijon Fadul, 2019). Based on the above cases, it is still not quite obvious that in Tanzania studies which demonstrate the use of social media to communicate wild fire information have been exhaustively conducted. Therefore need to ascertain the usage of such media was considered important in future studies.

Other technologies used to disseminate wildfire information

Apart from the above types of ICTs, the use of other technologies such as GIS for detecting and communicating wildfires have been reported by previous researchers in Tanzania. For example, a study by (Mgina and Wawa, 2020) who proposed their use as the most appropriate way of detecting and communicating forest fire information to communities. In addition a study by (Lutakamale and Kaijage, 2019) proposed a wildfire monitoring and detection system based on wireless sensor network that detects fire by monitoring surrounding temperature, humidity and smoke, after which, a warning message containing location of the fire is communicated to the responsible authorities using a cellular network. Whereas these and other systems have been proposed, the use of radio, mobile phones and televisions to disseminate information and prevent wildfire have not been popularly published. This calls for further studies to determine the extent to which these communication methods can be effectively used to disseminate information on wildfire and its prevention to safeguard water resources along Uluguru Mountains in Tanzania. However, for the purpose of the current study, the focus was on radios, mobile phones and televisions due to their availability and wide use in rural areas around Uluguru Mountains.

Barriers to the use of radio, television and mobile phones in disseminating information on occurrence of wildfires

Various studies have revealed a number of barriers to using radio, television and mobile phones to disseminate

information on various issues including wildfire incidents. Spread of false information and rumors are one among the factors that prohibit effective usage of such media to spread information on wildfire incidents. Due to the spread of false information and rumors, communities tend to develop little trust regarding their reliability and effectiveness (Zander et al., 2022). In addition, due to different geographical locations, some sources may seem more relevant and efficient than others may, whereas some being more relied upon than other sources, while some sources are considered less reliable and not up to date (Velez et al., 2017). Furthermore, other barriers include political, economic and social aspects of life in rural areas in Africa where the majority of rural populations do not afford to possess certain devices due to being unable to afford them (Aruleba and Jere, 2022; Ayim et al., 2022). Based on these and other challenges, the use of such media to communicate wildfire information may be considered not very effective.

Theoretical and conceptual frameworks

This study was guided by Berlo's model of communication (SMCR model) (Janse, 2018). The SMCR model stands for S = Source, M = message, C = channel, R = Receiver. Based on the specific objectives, the source of forest wildfire information include individual/Forest Officers/NGO staff/Elders/VEC that can capture information about of fire outbreaks and their locations. The medium are Radio, TV, Mobile Phones, social-media. Receiver include local fire fighters, forest officers, NGOs raising awareness, journalists, village environmental committee or fire brigades. The result of this message is the change in the behavior of burning forests, reduction of carbon emissions, which contributes to increase in global warming, hence affecting forest reserves. Below is a representation of Berlo's Model of Communication Figures 1 and 2.

Since Berlo's model does not include aspects such as barriers, use and the outcomes of the message transmitted, a modification was made to the model and below is a representation of a conceptual framework that guided the study:

The researchers added effects, barriers, use and outcomes to using the medium as part of the modification. In a nutshell, sources includes farmers with fire information, forest officers, NGOs staff, elders and MODIS satellite. Messages include, fire outbreak, areas with fire, fire effect and GPS codes. Medium includes radio mobile phones, computers, internet and social media. Receivers includes crews prepared to step down fire, forest officers, VEC team, fire brigades, NGOs raising awareness and journalist. On the other hand, barriers to utilize the medium include irresponsibility among people, fear to report fire incidents, infrastructure issues and being unable to own devices. The information received is used for creating awareness, for fighting against fire, reporting fire incidents to authorities or

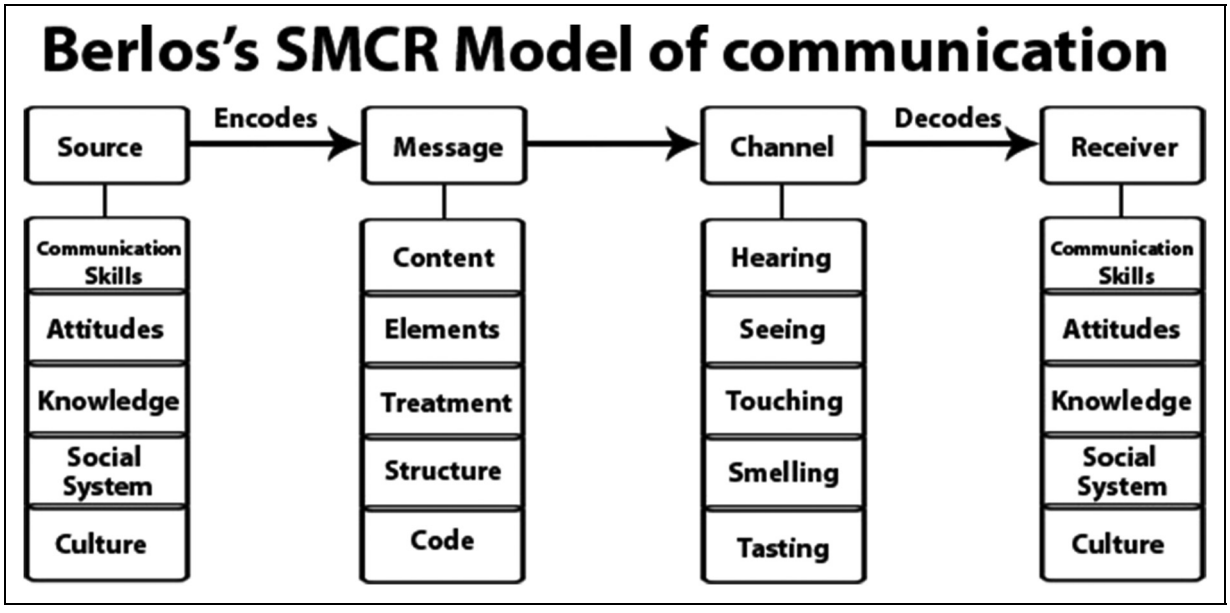

Figure 1. Berlo's SMCR Model of Communication.

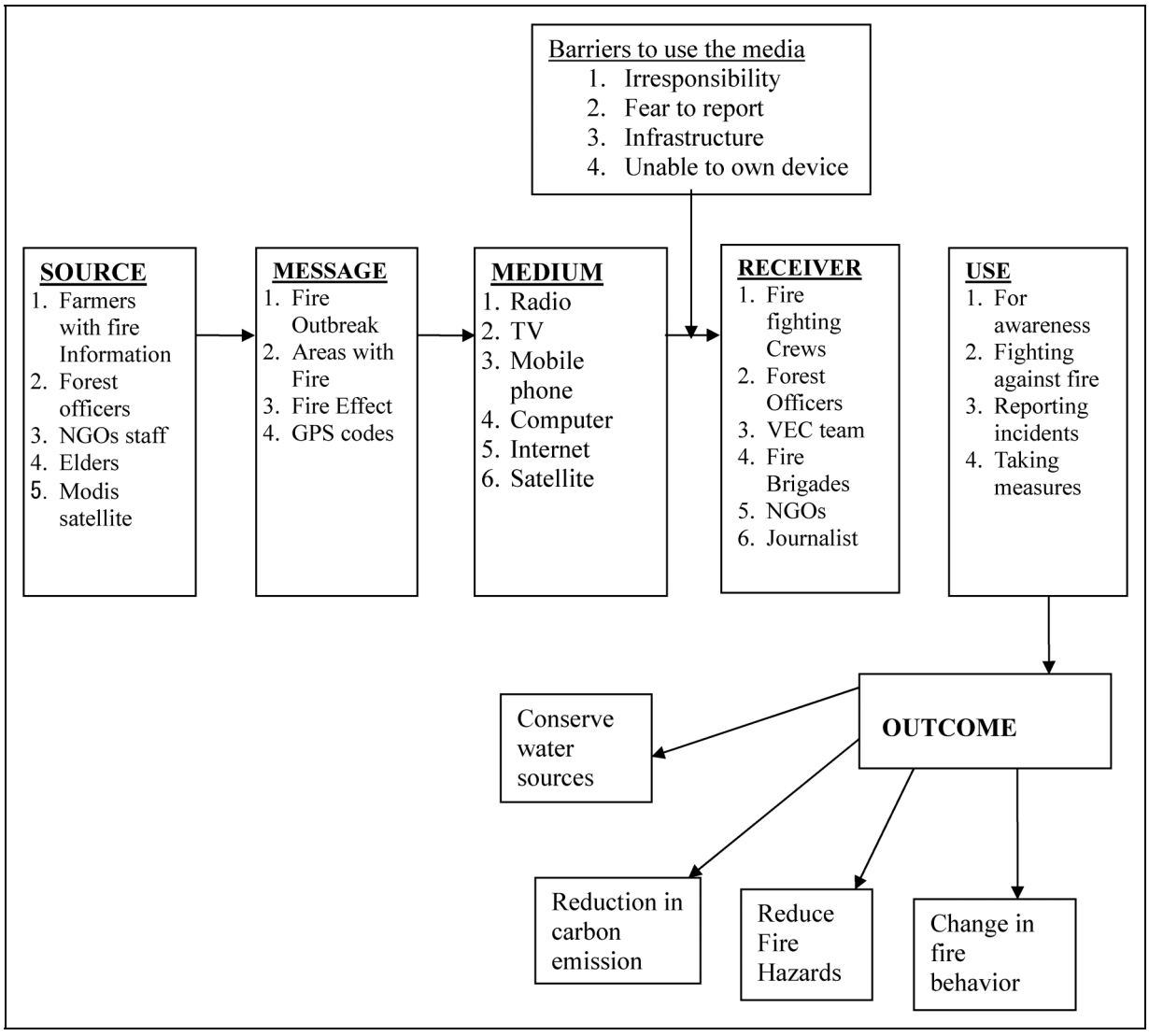

Figure 2. Conceptual framework: Modified Berlo's SMCR Model of Communication.

taking action such as running to safety or minimizing fire incidents. Furthermore, effect consist of reduction in carbon emission, reduction of fire hazards, change behavior about fire and conservation of water sources. Based on the specific objectives, this framework guided the study through developing data collection instruments through formulating questions based on the variables, presenting and discussing results based on the main variables namely sources, messages, medium, receivers and barriers.

Research methodology

Since this study was explanatory in nature and aimed to determine the role of radio, television and mobile phones in disseminating wildfire information, a survey approach was used to gather quantitative and some qualitative data. A survey approach was used in this study to obtain information from among villagers on ways in which radio, television and mobile phones were used in villages around Uluguru mountains to receive and disseminate information on wildfire occurrences around the mountains. This approach was found to be suitable for this study since it was conducted in the real world situation where wildfire incidents were reported to be the major problem among the population. This approach helped the researcher to gather data on facts, opinions and attitudes of the villagers in the villages under the study. The study was conducted in three villages found along Uluguru Mountains Nature Reserve, Morogoro in Tanzania, which is part of the Eastern

Arc Mountains. Uluguru Mountains are located within Morogoro Rural District, Mvomero District and Morogoro Municipality all within Morogoro Region. Uluguru Mountains are divided into three parts: Uluguru North, Uluguru South and Bunduki Catchment Forest. Uluguru Mountains rise up to 2630 meters (8600 ft) above sea level at its highest point. Fifty (50) villages touch the forestry boundary and over 151,000 people are living within the mountain area, increasing at higher attitudes up to the forest boundary (Kilawe et al., 2021).

Data for this study were collected from three (3) villages namely: Mvuha village which is close to Chamanyani catchment forest which is connected to Uluguru Mountains Nature Reserve. Kinole–Tandai village found in Uluguru North in Matombo Ward, and Tchenzema-Nyandira village found in Uluguru South in Mvomero ward. These villages were selected purposively, criteria being that a village should be close to the Uluguru Mountains nature reserve and had incidences of wildfire and should also have water catchment forest, which can be reachable by telephone signals. Also Mvuha was selected due to its land structure of submontane forest and was reported to have many incidences of wildfire compared to Kinole and Chenzema. The information about the villages was obtained from the forest catchment office and Uluguru Nature Reserve Office.

The secondary data were collected by reviewing similar related studies within Tanzania and outside the country. It involved review of Dissertation, reports, journals and other document print and electronic material. Primary Data were collected using questioners, interviews with key informants and focus group discussions. The data were collected in three villages of Mvuha, Kinole and Chenzema/Nyandira.

Quantitative data collection techniques were used to gather information on demographic details of respondents such as gender and villages where respondents were drawn. Other information collected through questionnaires included the degree of occurrence of wildfire incidences across villages, types of devices used to receive and disseminate wildfire information, awareness about wildfire incidents and barriers to using the devices in receiving and disseminating wildfire information. Questionnaires included closed-ended questions in form of multiple choice and a few open-ended questions that sought information regarding respondents' views on solutions to barriers in using radio, television and mobile phones to receive and disseminate wildfire information. Questions were piloted among conveniently selected 10 villagers in Maseyu Village which is located along Kitulagh'alo Forest Reserve, along Dar es Salaam – Morogoro road. The Village Leader helped the researcher to locate and distribute the questionnaires to the villagers. A few observations such as grammatical errors were observed and corrected. The village was not part of the three villages under the study as it was not from the Uluguru Mountains catchment area but had similar characteristics as the other three villages. On the other hand, some qualitative data was collected whose information focused on follow up questions regarding types of devices used to receive and disseminate wildfire information, awareness about wildfire incidents, barriers to using the devices in receiving and disseminating wildfire information and the role of radio, television and mobile phones in receiving and disseminating wildfire information.

The study involved 90 villagers who were obtained conveniently through the respective Village Executive Officers (VEO) from the three villages. The VEOs helped the researchers to identify 30 respondents from each village by passing house to house and requesting their participation into the study by issuing (and sometimes assisting) them to fill the questionnaires. This method was considered suitable because most villagers were farmers who spent most of their time in the farms and also due to the remote nature of the villages. In addition Face to face interviews were conducted to 15 key informants from the three villages including village elders (3), forest officers (3), staff from UMADEP – Uluguru Mountains Agricultural Development Project, an NGO (4) agricultural officers (3) and two (2) key informants from the Ministry of Natural Resources and Tourism. This made a total of 105 respondents who participated in the study. Questions included in interviews were different from the ones in questionnaires as they sought to gather in-depth clarifications and opinions from questions asked to villagers through questionnaires, whose answers could not allow further questions for clarity on issues such as reasons for not using televisions to receive wildfire information, and so on. Furthermore, observations were made to determine whether the villages had water sources and whether they were affected by wildfires. Observations were done to identify radios, mobile phones, television sets, mobile phones charging facilities, radio masts and towers together with human activities going on

in the area of study. This method enabled a researcher to study and record facts, conditions, events and activities rather than relying on collecting information through questionnaires and interviews. Quantitative data was analyzed using Microsoft Excel to obtain frequencies which were presented in tables and charts. Interview data was analyzed through identifying, categorizing and organizing comments made by key informants in matrices. The comments were presented in form of narratives to further support the findings. Respondents for interviews were coded as Village Leader 1and so on, in order not to reveal the identities of respondents. The numbers used did not represent the order of the arrangement of the villages or other respondents in this regard.

Findings of the study

Respondents for this study were drawn from three (3) villages which were: Kinole, Mvuha and Nyandira. A total of 57 (63%) males and 33 (36.7%) females from all villages responded to the questionnaire (see summary in Table 1 below):

Ninety (90) questionnaires were distributed to 90 respondents and all of them were returned. There were more men who responded to questionnaires than women. This was probably contributed by the fact that women were more involved in farm and family work than men who could spare time to respond to questions. Almost all respondents indicated that they were aware of wildfire outbreaks in the villages surveyed and provided their ranking in terms of occurrences of outbreaks as summarized in Table 2 below.

The above findings indicate that the degree of wildfires were average (34; 37.8%) of the respondents. However the table shows that Mvuha village had more incidences of wildfire by 16 (53.3%) of the respondents of Mvuha, followed by Nyandira being average15 (50%) and Kinole very small by 14 (46.7%).

Use of radio, mobile phones and televisions to receive and disseminate wildfire information outbreaks

Results from the study reveal that from the three Villages, 78(86.70%) of respondents owned radios, 75(83.30%) owned mobile phones, and 11(12.20%) possessed television sets. Table 3 summarizes the results.

Among the respondents surveyed, Mvuha Village indicated to have more TV owners by 6(6.7%) compared to Nyandira (4, 4.4%) and Kinole (1, 1.1%) villages. It was observed Mvuha village was reachable by many business people of different categories; being a pass way to other villages namely Kisaki and Dutumi. The researcher observed a group of people attending Video shows at night and football matches to individual with TVs. However, none of the television owners indicated that they used televisions to receive or disseminate information on wildfire outbreaks. One village leader confirmed this when asked to comment:

> Most television shows in this village are provided by kiosks owners who introduced a small charge to allow people to watch football matches and other programs but no such programs on wildfire outbreaks are shown. [Village Leader 2 Kinole]

The village elders also echoed the above comment when they were asked to comment whether televisions were used to receive or disseminate information on wildfire outbreaks. Respondents were asked to indicate whether they used radio, mobile phones and television to receive or disseminate forest fire information. Table 4 below summarizes their responses.

Results in Table 4 above indicate that the number of respondents who used the three methods was lower.

Table 1. Distribution of respondents by village and gender.

	Village							
	Kinole		Mvuha		Nyandira		Total	
Gender (N = 90)	F	%	F	%	F	%	F	%
Male	22	73.3	20	66.7	15	50	57	63.3
Female	8	26.7	10	33.3	15	50	33	36.7
Total	30	100	30	100	30	100	90	100

Source: Field Data 2020.

Table 2. The degree of occurrence of wildfire incidences across villages.

	Kinole		Mvuha		Nyandira		Total	
N = 90	F	%	F	%	F	%	F	%
Very high	0	0	16	53.3	3	10	19	21.1
High	0	0	4	13.3	5	16.7	9	10
Average	9	30	10	33.3	15	50	34	37.8
Very small	14	46.7	0	0	6	20	20	22.2
Not at all	7	23.3	0	0	1	3.3	8	8.9
Total	30	100	30	100	30	100	90	100

Source: Field Data 2013.

Table 3. Devices owned by villagers.

	Village names							
	Kinole		Mvuha		Nyandira		Total	
Devices	F	%	F	%	F	%	F	%
Radio	25	27.80	29	32.20	24	26.70	78	86.70
Mobile phone	22	24.40	31	34.40	22	24.4	75	83.30
Television	1	1.10	6	6.70	4	4.40	11	12.20
Total	32	35.60	31	34.40	27	30.00	90	100.00

Source: Field Data 2020.

Table 4. Use of radio, mobile phones and television to receive or disseminate forest fire incidents.

	Kinole		Mvuha		Nyandira		Total	
N = 90	F	%	F	%	F	%	F	%
Used	6	20	11	36.7	9	30	26	28.9
Not used	24	80	19	63.3	21	70	64	71.1
Total	30	100	30	100	30	100	100	100

Source: Field Data 2020.

For example only 6(20%) out of 30 people in Kinole village used the three methods, the same was the case for 11(36.7%) in Mvuha and 9(30%) in Nyandira villages. This made only 26(28.9%) out of 90 respondents in the three villages who used radio, mobile phones and television to receive or disseminate forest fire information.

This is further summarized by Figure 3 below:

It was observed that the only available radio station that could broadcast information on wildfire was the one owned by the government, which however, was not reachable as one respondent commented:

> "We have a problem in accessing National Radio, We only get easily local radio which broadcast religion or business issues .Local radio have few or no radio programs with environmental session compared to those stations owned by government." [Villager Elder 3 Mvuha].

When forest officers were asked to comment on the access to the national radio by villagers on wildfire information, it was revealed that the radio had specific programmes on wildfire information national-wide, however its access to mountainous areas such as Uluguru was challenging. The broadcasts of wildfire information by the national radio was also echoed by the Ministry of Natural Resources and Tourism who however, commented on its poor coverage along Uluguru Mountains due to weak signals.

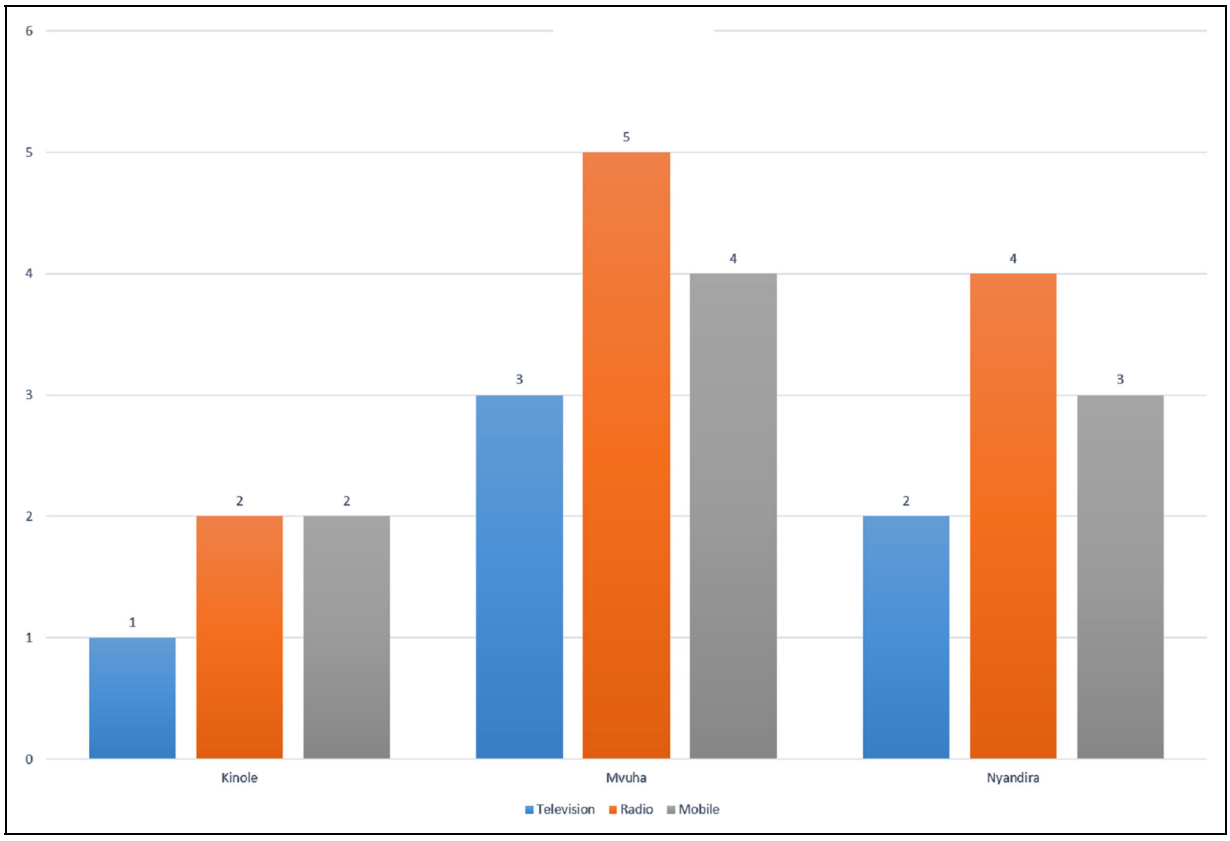

Figure 3. Use of radio, mobile phones and television to receive or disseminate forest fire incidents.

Generally, it was noted that radio broadcasts on wildfire information were quite rare. In addition, respondents were asked to mention the purposes of using mobile phones, the reason being that these devices could be used as radios and televisions as well. In order to ascertain the purpose of using mobile phones, respondents were first asked to indicate the capabilities of their mobile phones to establish whether they could be used for other purposes besides making calls. Table 5 below provides a summary for the above question.

Results from the study indicate that most respondents, in this case 50(55.6%) had mobile phones which could make calls while very few, i.e., 15(16.7%) had mobile phones that could be used for radio and camera and none had television functionality. After having established the functionalities of their mobile phones, respondents were then asked to indicate various purposes for which they used mobile phones. Their responses are summarized in Table 6 below.

Results as summarized in Table 6 above indicate that 72(80%) respondents used mobile phones for communicating with relatives and friends while only 8(8.9%) used the radio functionality available on mobile phones besides making calls.

Apart from the use of radio, mobile phones and television, the researcher asked respondents to point at methods used to disseminate information about wildfire. All villages mentioned the use of loudspeakers. This method was preferred due to its low running costs and could give sounds like traditional media such as local drums or horns. Further interviews with one village leader in Kinole came up with a comment like this one:

> In our environmental committee we own loudspeakers which we use to gather people once forest fire happen; I don't see the need to have mobile phone or radio for this one. [Village Leader 1 Kinole]

In addition, during face to face interviews with a forest officer and staff at the Ministry of Natural Resources and Tourism the researcher was informed that a system called Advanced Fire Information System (AFIS) Meraka for detecting wildfire data was currently installed at the Ministry of Natural Resources and Tourism and Tanzania Forest Research Institute

Table 5. Features available in mobile phones.

	Kinole		Mvuha		Nyandira		Total	
N = 90	F	%	F	%	F	%	F	%
Verbal communication ability only	16	53.3	18	60	16	53.3	50	55.6
Verbal communication ability and Radio	2	6.7	1	3.3	2	6.7	5	5.6
Verbal communication ability, Camera, Radio	5	16.7	6	20	4	13.3	15	16.7
Verbal communication ability, Camera, Internet, Radio	0	0	3	10	0	0	3	3.3
Not applicable	2	6.7	0	0	8	26.7	10	11.1
Verbal communication ability with camera	4	13.3	2	6.7	0	0	6	6.7
None	1	3.3	0	0	0	0	1	1.1
Total		30	100	30	100	30	100	90

Source: Field Data 2020.

Table 6. Usage of mobile phone by villages.

	Village							
	Kinole		Mvuha		Nyandira		Total	
N = 90	F	%	F	%	F	%	F	%
Communicate with relatives, friends	26	86.7	27	90	19	63.3	72	80
Radio & Comm.	2	6.7	3	10	3	10	8	8.9
Not applicable	2	6.7	0	0	8	26.7	10	11.1
Total	30	100	30	100	30	100	90	100

Source: Field Data 2020.

(TAFORI)-Morogoro. AFIS Meraka system has the ability to send automatic short messages (SMS) to forest officers about wildfire outbreak and its location. In addition, GPS receivers were used to guide the officers to reach the coordinates of an area where there was a wildfire outbreak. In an interview with key informant from the ministry, one respondent made the following comment:

> "I am managing wildfire detection system, and I do download the information of areas with wildfire from a satellite. I then translate downloaded coordinates to identify specific area with wildfire, then I call the staff in respective area to take appropriate actions. I communicate the coordinates by using a mobile phone" [Ministry Staff 2]

However the researcher noted that although the system was effective forest officers tended to ignore the messages or the messages reached their mobile phones when they were switched off.

Respondents were asked to indicate whether they attended any wildfire-fighting awareness training course or seminar. Training was considered as important in this regard since it was expected that trainees could be introduced to various ways through which they could receive or communicate wildfire outbreak information. Results as summarized in Table 7 below indicate that only 23(25.6%) out of 90 respondents attended such sessions.

Results as summarized in Table 7 above indicate that many respondents did not attend seminars or workshops on wildfire-fighting awareness programs despite their availability. During face to face interview sessions with village leaders and fire fighters from the ministry, it was revealed that such seminars or workshops were organized but with low turn-up among local residents in villages. This was further confirmed by one village leader who commented as follows:

> We have been trying vain to organize training on fire fighting and information management processes. Very few people attend and even the attendance itself is very low [Village leader 2 Nyandira].

In addition, the staff from UMADEP commented as follows:

Table 7. Attendance of seminar or workshops in raising wildfire awareness.

	Kinole		Mvuha		Nyandira		Total	
N = 90	F	%	F	%	F	%	F	%
Attended	7	23.3	8	26.7	8	26.7	23	25.6
Not attended	23	76.7	22	73.3	22	73.3	67	74.4
Total	30	100	30	100	30	100	90	100

Source: Field Data 2020.

> The training on wildfire fighting and how to control it, including reporting systems s being organized by us working together with village leaders. The attendance is always very low among the villagers. [UMADEP 1].

Observations made during the study and through interviews carried out among village leaders, staff from UMADEP and authorities from the Ministry of Natural Resources and Tourism revealed that radio, mobile phones and televisions were important means through which information on wildfire outbreaks could be disseminated. However, knowledge on their use and fewer programs were the main reasons for low usage. Since television programs such as football, boxing, music concerts attracted majority of local communities, it also was possible to introduce wildfire awareness sessions, however short, in form of advertisements or public notices.

Barriers in accessing and disseminating wildfire information and intervention strategies

Respondents were asked to indicate barriers they face in accessing and disseminating wildfire information. Table 8 below summarizes their results.

Results obtained, as summarized in Table 8 above indicate that infrastructure problems (including electricity, poor network) was one of serious problems affecting local communities (30, 33.3%) where as 15(16.7%) respondents indicated that they did not know where to report about wildfire outbreaks (i.e., responsible persons to receive such information). On the other hand, 11(12.2%) respondents indicated financial ability to own the devices, 9(10%) pointed at ignorance (lack of knowledge) in using trhe devices and 7(7.8%) reported that members in the community were irresponsible on issues to do with reporting or receiving wildfire outbreak information and others had feared to report on such incidents to authorities. A village elder in Mvuha Village commented as follows:

> Some villagers see a fire but mind their own business rather than either taking action by putting it out or reporting to authorities for further action. They consider this to be the responsibility of village leaders or the ministry. [Village Elder 1 Nyandira].

Similar concerns on fear to report fire incidents were echoed by staff from UMADEP and forest officers who added that people feared to report about fire incidents for fear of being arrested for questioning.

Discussions of the findings

Results from the study indicated that all villages had wildfire incidents, Mvuha village having more incidences of wildfire than other two villages. Respondents owned radios, mobile phones and television sets. Mvuha village being accessible to a mixture of business people and travelers; was well placed to utilize the three means of communication on reporting wildfire incidents. Generally, majority of the respondent from the three villages owned radios and mobile phones. It was possible for the respondents to own radios and mobile phones due to livelihood diversification and changed information needs of rural populations in Tanzania (Baird and Hartter, 2017). Due to livelihood diversification of rural populations, radios and mobile phones are useful tools to support various economic and social activities carried out by rural communities. It was observed that radios were suitable for listening to news and other forms of information while mobile phones were used for for communication purposes. These findings show that the villagers were active in receiving information and news and communicated with each other over other issues. To some extent, this concurs with the conceptual framework that guided this study. The source of wildfire information included the villagers who had information on where fire was located, forest officers, elders and also from officers from the ministry. The message received included information about fire outbreak and the area it covered

Table 8. Barriers in accessing and disseminating wildfire information.

	Kinole		Mvuha		Nyandira		Total	
N = 90	F	%	F	%	F	%	F	%
Financial ability to own devices	3	10	0	0	8	13.3	11	12.2
Irresponsibility of individual community members	1	3.3	1	3.3	5	16.7	7	7.8
Not knowing where to report	5	16.7	4	13.3	6	20	15	16.7
Infrastructure problems	14	46.7	14	46.7	2	6.7	30	33.3
Ignorance in using devices	3	10	2	6.7	4	13.3	9	10
Fear to report fire incidents	3	10	2	6.7	2	6.7	7	7.8

Source: Field Data 2020.

together with its effects. The medium of communicating wildfire information was the radio and mobile phones.

However, out of 90 respondents, only 26(28.9%) of them indicated to use radio and mobile phones to receive and disseminate wildfire information and there was no one who used televisions for the same. These results are contrary to the trend in developed countries where televisions are considered most reliable sources to communicate wildfire outbreak information (Velez et al., 2017). It was observed that radios were not suitable in disseminating wildfire education or information. This was because most radios received FM transmissions from local radio stations around Morogoro town. They broadcasted music, religious sessions and business advertisements while the national radio TBC1, which had such sessions, was not received by many local communities around the three villages due to weak signals. These observations are similar to studies by Lwoga (2010) and Sullivan (2011) who observed that rural radios are used for listening to music, advertisements and religious sessions. On the other hand however, a study by Zacharia and Andindilile (2020) contrast with the above by the fact that radios have been used to communicate information on forest conservation, this perhaps could also imply information on wildfire. One of the contributing factor behind a lack of information on whether radios communicate information on wildfire could be due to the nature of the programs that some local residents might not be able to comprehend the information being communicated.

It was noted that most men listed to radio compared to women, who spent most of their time in agricultural activities and household chores. Women were considered as key players in preventing wildfire from burning their farms, since listening to radios could provide them with prior information about wildfire outbreaks in areas surrounding their farms. Other studies have demonstrated that radios and mobile phones play an important role in empowering them through discussing various issues that affect their lives and for improving their livelihood (Githaiga and Wildermuth, 2022). However, this was not the case for women in the three villages who did not make maximum use of radios and mobile phones to receive and disseminate wildfire information.

Although the number of people who reported about wildfire incidences using mobile phones was low, the study still demonstrates the importance of using such tools among wider user community. In Mvuha village which had high percentage of wildfire incidences, there was also more number of respondents who used mobile phones on such incidents. In a way, this demonstrated the usefulness of the conceptual model on the issue of the medium of communicating information on wildfire incidents, mobile phones being the medium mostly used than the others. Observations revealed that the village was undertaking a project on environment; which might have aroused villagers' awareness on wildfire fighting as well.

Previous studies have shown that very few countries in Africa (except South Africa) where the use of mobile phones to communicate wildfire information has taken the advantage of wider access to the devices by rural populations (Ngombane et al., 2022). Much as the usage of mobile phones was reported in Mvuha village, there is still a need to maximize their utilization due a wide usage by rural populations in Morogoro and beyond. Results from the study reveal further that there was little use of other functionalities available in mobile phones such as radio and cameras to disseminate and receive wildfire information. As was noted in other studies on mobile phone use among rural populations in Africa, poor technological infrastructure and low level of usage

skills hamper maximum use of such devices (Ayim et al., 2022). This could explain low usage of other functionalities found in mobile phones such as radio and cameras to disseminate and receive wildfire information.

On the other hand, televisions were not commonly used to disseminate wildfire information to villagers in the three villages. However, it was observed that in Mvuha village, several people who owned televisions had kiosks where people gathered to watch football and other kinds of entertainments. This medium of communication has been important in disseminating information on weather, climate and environment as revealed by previous studies in Africa such as (Agyekum et al., 2022). In this regard, rural populations in Africa make use of radio and television to access information related to rainfall and temperature. The two media could produce positive impact to dissemination of wildfire information along Uluguru mountains particularly around water reserves.

Apart from radios, mobile phones and televisions, the study reveal that effective use of other communication channels such as word of mouth, loud speakers and satellites contributed greatly to dissemination and access to wildfire information by rural populations in the three villages. Word of mouth has been a popular way of dissemination information on various issues particularly in the African context (Takashina et al., 2023). Loudspeakers powered by dry cell batteries were observed being used in Nyandira village during wildfire incidences.

The usage of loudspeakers in calling people to go and fight wildfire was preferred presumably due to having similar that resembled traditional devices such as local drums or horns. This is similar to findings by (Abdulai et al., 2023) who reported that rural people prefer devices that gave sound like their traditional communication devices such as drums or gong-gong which signify a call for an emergency or meeting. Despite the sounds of such traditional devices is not as loud as loudspeakers, wildfire-fighting campaigns should sometimes use devices similar to the indigenous devices for which local populations are familiar with. Much as the conceptual framework did not take this medium of communication into consideration, its significance still prevailed for use in such environments where ICT-related medium of communication was not fully utilized. In addition, focus group discussions with the forest officers and staff at the Ministry of Natural Resources and Tourism revealed that, a system called Advanced Fire Information System (AFIS) Meraka was installed at the ministry and Tanzania Forest Research Institute (TAFORI) in Morogoro. AFIS Meraka was used for prevention, monitoring, management and assessment of wildfire as a risk or danger to the villages around Uluguru Mountains. Unlike other methods, this system seemed to be more reliable due to its ability to detect and deliver information on locations of active fires in real time; through a GPS system. This is a satellite-based fire information tool, developed in collaboration with Eskom telephone firm. The system is integrated with cellphone technology, which is capable of distributing alert messages through SMSs to provide active fire location data and the ability to acquire burnt area estimates from the satellite images. Through observations, it was possible to note some smart phones with GPS receivers being owned by some forest officials at the ministry and TAFORI. Although it was not possible to observe local populations using this technology, information systems such as this is more ideal in areas such as the ones along Uluguru mountains where due to difficult terrain, the use of modern ICT facilities would facilitate easy access and dissemination of wildfire information (Jain et al., 2012; Mohapatra and Trinh, 2022). Nevertheless, appropriate use of AFIS Meraka would enable local populations to utilize mobile phones by receiving real time wildfire alerts from authorities.

Apart from the above, a number of shortcomings were noted, that hampered effective utilization of radios, mobile phones and televisions to receive and disseminate wildfire information. The most striking barriers were infrastructure problems, financial constraints, irresponsible communities, fear to report wildfire events and lack of skills to use the devices. In a focus group discussion, villagers of Nyandira reported to have no connection by mobile phone with other environmental committee teams, of neighboring villages and once wildfire crosses to the other side of the village there was no information sent to alert the authorities. Perhaps this was caused by a lack of appropriate utilization of the available means of communication between the villagers and the responsible wildfire fighting teams. Many of the above barriers have also been reported by previous studies such as Aruleba and Jere, (2022), Ayim et al. (2022) who attributed the challenges to political,

economic and social aspects of life in rural areas in Africa. According to the conceptual framework that guided this study, the challenges above were considered as barriers to effective communication on wildfire outbreaks. From this analysis, it can be considered that the conceptual framework that guided the study worked well although a number of ICT-related variables termed as medium (radio, mobile phones and television) were not effectively used to communicate wildfire information. Yet others such as word of mouth, loudspeakers and satellite systems were considered as more applicable in the operating environment.

Conclusion and recommendations

The purpose of this study was to assess the role of ICT in communicating wildfire information in the Uluguru Mountains Nature Reserve. Generally, research findings showed that to some extent, radios and mobile phones were utilized to receive and disseminate wildfire information. While the usage of the three methods was considered as low, other methods such as word of mouth, loud speakers and use of satellites seemed to be more effective. Due to some technological and other challenges, the utilization of the three methods, particularly television was low. What needs to be taken into account is to alleviate the barriers observed by encouraging the community to make effective use of their devices for communicating wildfire information and related environmental issues. Since dissemination of wildfire incidences by the local communities seems to be low, there is a need to encourage the responsible authorities to link with local communities through the available ICT facilities to share information. Local Radio stations are the most heard in villages; hence the most available means for disseminating wildfire information and other environmental management issues. In addition, the Government should encourage village local leaders and their committees to work hand in hand with the ministry and other responsible agencies towards reducing wildfire incidents through appropriate use of modern ICTs. In addition, owing to environmental factors affecting the usage of the three methods for communicating wildfire outbreak information, the most effective methods such as the word of mouth, loud speakers and satellites be more improved. While this being the case, the role of the authorities in encouraging local communities to embrace the aforementioned technologies, i.e., radio, television and mobile phones remain as important.

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