# USABILITY OF SHORT MESSAGE SERVICE BASED ALERT WARNING SYSTEM IN INCREASING DISASTER AWARENESS AND EMERGENCY PREPAREDNESS.

# CASE STUDY: KIMISAGARA SECTOR NYARUGENGE DISTRICT

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# USABILITY OF SHORT MESSAGE SERVICE BASED ALERT WARNING SYSTEM IN INCREASING DISASTER AWARENESS AND EMERGENCY PREPAREDNESS.

## CASE STUDY: KIMISAGARA SECTOR NYARUGENGE DISTRICT

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# DECLARATION

I hereby declare that this Master's thesis entitled "Usability of Short Message Service Based Alert Warning System in Increasing Disaster Awareness and Emergency Preparedness. Case study of Kimisagara Sector Nyarugenge District" is a presentation of my original research work.

Wherever contributions of others are involved, every effort is made to indicate this clearly, with due reference to the literature, and acknowledgement of collaborative research and discussions. The work was done under the guidance of Dr.TUMUSIIME KABAGEMA David, College of Medicine and Health Science, University of Rwanda.

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Signed…………………………………………..

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## ACKNOWLEDGEMENTS

# ABSTRACT

**Background**: Rwanda is striving toward an efficient early warning system before, during and after a disaster (Republic of Rwanda Ministry of Disaster Management and Refugee Affairs, 2012). The use of SMS to end-users may help to achieve this goal. Short Message Service (SMS) is a text messaging service component of mobile phone communication systems. SMS has the potential to be an effective community messaging system, which is necessary for a synchronized information exchange between the authorities and the citizens particularly during emergencies and in period of disaster.

**Problem statement** :Although The government of Rwanda, has put in place the early warning systems to alert people about the disaster, little is currently known about the influence of early warning systems to households' decisions related to responding and limiting damages when disaster are closer to happening.

**Objectives:** The purpose of this study was to assess the usability of SMS technology in increasing the population's awareness, preparedness and adaptation to disasters in Rwanda, especially in Kimisagara sector of Nyarugenge District. The specific objectives were to investigate about the experience of disaster in surveyed households; to assess the population's awareness of the existing disaster warning system and the knowledge of service contact number, and finally to assess SMS usability for disaster preparedness in Kimisagara sector of the city of Kigali.

**Methodology:** a descriptive cross-sectional study using both quantitative and qualitative methods was conducted in Kimisagara Sector of Nyarugenege District. Quantitative data were collected using a structured questionnaire, while qualitative data were obtained using semi-structured interview. Quantitative data were entered and analysed in SPSS Version 21. Descriptive statistics and cross-tabulation using chi-square test were used. Qualitative data were summarized using Atlas.ti 5.2, content analysis was performed.

**Results**: Data were collected from 120 heads of households. There were 61 (50.8%) males and 59 (49.2%) females. The overall mean age was 33.7±11.1 years. Most participants (47.5%) had been residing in Kimisagara for three years and more. More than one out of two participants (56.7%) had attained secondary education level. 35% of participants had experienced disasters and 32.5% had ever received disaster early warning SMS from administrative authorities. One out of two participants were aware of the existing disaster

warning system. Nevertheless, only 31 participants (25.8%) knew the emergency number to text in case of disasters. Nearly 96% owned a mobile phone. Nearly three out of four (74.8%) participants use their mobile phone almost every time. Of the mobile phone owners, 95.7% had ability to read SMS and 63.5% read SMS from Government sometimes. However, a significant number (37.4%) declared the need for additional training to read SMS. Use of SMS was the most preferred way of communication about disasters (56.7%); this preference was most marked among secondary education graduates (p=0.036).

**Conclusion**: The experience of disasters is real among the studied participants. The requirements for SMS disaster early warning are in place; which would make possible the use of SMS in disaster management. The study recommends that SMS be send directly to end-users without intermediate recipients.

*Keywords:* *SMS, disaster, alert warning system, awareness, emergency preparedness*

## LIST OF SYMBOLS AND ABBREVIATIONS/ACRONYMS

**CMHS:**          College of Medicine and Health Sciences

**DDMC**:          District Disaster Management Committee

**EWS:**          Early Warning System

**ICT**:          Information, Communication Technology

**IHS:**          Institute for Housing and Urban Development Studies

**MIDIMAR:**          Ministry of Disaster Management and Refugee Affairs

**MINAGRI**:          Ministry of Agriculture and Animal Resources

**SDMC**:           Sector Disaster Management Committees

**SMS**:          Short Message Service

**UR:**          University of Rwanda

**VHWW:**          Very Hot Weather Warning

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# CHAPTER I: INTRODUCTION

## 1.1 Background

Short Message Service (SMS) is a text messaging service component of mobile phone communication systems. It uses standardized communications protocols to allow fixed line or mobile phone devices to exchange short text messages (Kelly, 2012). There were over 7.5 billion mobile subscriber in use around the world by the first quarter of 2015, more than the world population 7.34 billion people at the end of 2015. 64% of them in the hands of people living in developing and emerging economies (Jonsson, Bävertoft, & Möller, 2014). 80% of the world's population lives in areas with mobile phone coverage making mobile technology probably the most viable type of technology to reach the largest part of the world's population (Mukund Bahadur & Murrayb, 2010).

Short message service (SMS) provides people with consistent, cheaper and efficient means that facilitate them to react many people, and sententiously quick making it the tool of choice in emergencies where there is rush of and lifesaving (Suaybaguio, 2016). This has the potential to be an effective community message system, which is necessary for a synchronized information exchange between the authorities and the citizens particularly for the period of emergencies and in period of disaster. They can also be exchanged  from a computer to a regular mobile (Mahmud, Akter, & Rawshon, 2012).
SMS Service facilitates text messages to be sent and received from mobile devices. The authority to transmit important messages is using it.

By the end of the year 2014, 63.6% of the population of Rwanda own a mobile phone (National Institute of Statistics of Rwanda, 2014). In this perspective, the use of SMS can contribute much in warning the population about disasters for the population in high risk zones. The technology is expected to give people reliable and cheaper means for them to respond quickly to emergencies (Mahmud et al., 2012).

SMS has a unique and fast way of broadcasting message to large group of people. With the global spread of mobile phones and networks, this technology is now increasingly used to communicate warnings and coordinate preparation activities, particularly SMS alerts for disseminating mass messages.

Across the globe, disasters have been on the rise increase in recent years this be attributed to global warming and other natural factors beyond man's control. Disaster is any event natural or man-made which threatens human lives, damage private and public property, and infrastructure and disrupts social and economic life. (Sabat, n.d.) A quarter of the countries assessed in the 2011 Global Assessment Report for Disaster Risk Reduction reported that communities did not receive any timely warnings for impending hazards. (Pearson, 2012)

Disaster response has always been a challenge during and after major disasters due to the impact of disaster itself, the number of organizations and individuals participating in the response and the lack of rapid social networking to support immediate community response. Disaster, regardless of etiology, exceeds the ability of the local community to cope with the event and requires specialized resources from outside the area impacted. In a large-scale destructive event, one of the greatest challenges to public health workers and rescuing teams is to have stable and accessible emergency communication systems. However, little researches currently exist regarding the use of communication platforms and internet social networks for emergency response (Huang, Chan, & Hyder, 2010).

Warning systems including SMS alert warning system are in place and have proved beneficial for a variety of hazards. In the case of tsunamis, the benefit of an internationally coordinated system was shown in the 2011 earthquake and tsunami in Tohoku, Japan, which threatened many Pacific islands: warnings were more coordinated than in the devastating Indian Ocean Tsunami in 2004, providing time for many people to evacuate to high ground.

Several other countries have significantly reduced deaths by developing effective early warning systems. Cuba's Tropical Cyclone Early Warning System is credited with reducing deaths dramatically for weather related hazards such as tropical cyclones, storm surges and related flooding (Pearson, 2012). In addition. The literature indicates that Bangladesh has a 48-hour early warning system in place that allows people to evacuate to safe shelters hours before cyclones make landfall, which contribute to reducing deaths.

In Rwanda, the early warning system was established in 2012 (Ntaribi, 2014). The system is operating from national level to local level, by which the department of disaster management in the Ministry of disaster management and refuges affairs in collaboration with districts and

sector local leaders inform the community by using radio, TV based warning message as well as send alert messages to the focal person of early warning system who inform the community about the climate change hazards which are closer to happening. In addition to that, local leaders organize the awareness campaigns to the community and sensitization before, during, and after disasters (Ministry of Disaster Management and Refugees Affairs, 2012). Nevertheless, there is, still limited information relating to the influence of the early warning system, to make people to respond and limit the damages that the climate change is likely to bring.

Currently, there is an increase in use of early warning systems covering different geographical area with utmost sophistication, through the use of various communication technologies like television, radio and wireless mobile communication system in order in order to alert communities about the hazards which are likely to happen which leads to emergency preparedness (Mahmud et al., 2012).

## 1.2 Statement of the problem

Information communication and Technology is an important tool which can play a significant role in disaster management including Communicating and transmitting information for disaster relief, early warning, and risk reduction in order to save life of the community. In addition, community relies on messages from government and reputable institutions.

However, the practice indicates that communication channels used by ministries and government departments actually focus on communication between them not directly to the people in high risk communities.

Moreover, scholars show that with the increase of the use of ICT in disaster management, false warning alert is rising too. The high rate of false alarms are likely to undermine public confidence, breeding mistrust, dilute the impact of alerts and reduce the credibility of future warnings.

Although Rwanda has established an Early Warning System which is composed of four operational elements including the disaster risk knowledge, generation and Monitoring of warnings, Dissemination and communication of warnings, building the response capability, it is not known how effective this system is. It is in this context that this study was conducted to

assess the usability of SMS based system in increasing disaster awareness and emergency preparedness in Rwandan community (Ntaribi, 2014).

## 1.3 Aim and objectives

## 1.4 Objectives

### 1.4.1 Aim

The aim of this study is to assess the usability of SMS technology in increasing the population's awareness, preparedness and adaptation to disasters in Rwanda, especially in Kimisagara Sector of Nyarugenge District.

### 1.4.3 Objectives

The following study pursued the following specific objectives:

i.    To investigate about the ever-experience of disaster or emergency of the surveyed households of Kimisagara sector;

ii.   To assess the population's awareness of the existing disaster or emergency early warning system in Kimisagara sector;

iii.  To assess the knowledge of emergency service contact number among the surveyed heads of households of Kimisagara sector;

iv.   To assess the usability of SMS technology for disaster early warning and population preparedness.

## 1.5 Research questions

This study was to respond to the following research questions:

i.    What is the proportion of households that have ever experienced disasters?

ii.   Is the population of Kimisagara sector high risk aware of the existence of an early warning system?

iii.  Does the population residing in high risk zone know the emergency service number to call in case of disaster?

iv.      What is end-user's usability level of SMS for early warning and preparedness?

**1.6 Significance of the study**

This study is recommended to reduce the losses of resource and decrease the risk of disaster-related deaths by warning the population timely using SMS alert warning system.

# CHAPTER II: LITERATURE REVIEW

## 2. 0 Introduction

## 2.1 Definition of key terms

**Hazard:** A potentially damaging physical event, phenomenon or human activity that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation (Baas, Ramasamy, Dey de Pryck, & Battista, 2008).

**Disaster:** A serious disruption of the functioning of a community or a society causing widespread human, material, economic or environmental losses which exceed the ability of the affected community or society to cope using its own resources (Baas et al., 2008). In the same line, a disaster is a serious disruption to the functioning of a community that exceeds its capacity to cope within its own resources (Bradley, McFarland, & Clarke, 2014).

**Risk:** The probability of harmful consequences, or expected losses (deaths, injuries, property, livelihoods, economic activity disrupted or environment damaged) resulting from interactions between natural or human-induced hazards and vulnerable conditions (Baas et al., 2008).

**Risk assessment**: Diagnostic process to identify the risks that a community faces (Baas et al., 2008).

**Disaster Risk Reduction (DRR):** refers to the conceptual framework of elements considered with the possibilities to minimize vulnerabilities and disaster risks throughout a society, to avoid (prevention) or to limit (mitigation and preparedness) the adverse impacts of hazards, within the broad context of sustainable development (Baas et al., 2008).

**Disaster risk management (DRM):** includes but goes beyond DRR by adding a management perspective that combines prevention, mitigation and preparedness with response.

**Vulnerability:** The conditions determined by physical, social, economic and environmental factors or processes, which increase the susceptibility of a community to the impact of hazards (Baas et al., 2008).

**Resilience:** The capacity of a system, community or society potentially exposed to hazards to adapt, by resisting or changing in order to reach and maintain an acceptable level of functioning and structure. This is determined by the degree to which the social system is capable of organizing itself to increase its capacity for learning from past disasters for better future protection and to improve risk reduction measures (Baas et al., 2008).

**Disaster preparedness:** Activities and measures taken in advance to ensure effective response (Baas et al., 2008). Preparedness is defined as actions taken to effectively anticipate, respond to, and recover from the impact of likely or current hazard events or conditions (Paganini et al., 2016).

**Early warning**: Provision of timely and effective information to avoid or reduce risk (Baas et al., 2008). According to United Nations (2006), early warning (EW) is "*The provision of real and accurate information in appropriate time through identified institutions, which allows individuals exposed to a hazard to take action to avoid or reduce their risk and prepare for effective response*" (United Nations, 2006). This information allows communities exposed to danger to take actions to avoid or reduce their risk and prepare for appropriate response to the hazard.

In this study we target the disaster preparedness and early warning using short message service.

**SMS:** SMS text-messaging is a form of written communication that exchanges packets of information between information communication technologies. SMS text-messaging has an exchange limit of 160 characters per message and takes practice to maximize the message content (Gomez, 2008).

## 2.2. Historical background of early warning system

Over the last 50 years, a high number of disasters and associated losses including loss of lives have increased, but, then again, the loss of lives linked to hydro-meteorological hazards has decreased, because of development of early warning systems, emergency preparedness and planning at different levels. Over the past 10 years, international attention has been given to the early warning systems. Moreover, the First International Early Warning Conference, stressed the value of EWS as an important element of risk reduction strategies

Some countries such as Bangladesh, Cuba, Japan, managed to reduce the mortality rate related to climate change hazards through effective EWS. Similarly, in France, the public Vigilant warning system was established in order to inform people about the risks (World Meteorological Organization, 2015). Moreover these early warning systems contributed a lot in serving people to respond to climate change hazards, as we shall discuss in the upcoming sections. In the next section, the author explains the early warning system, its components and operation of early warning systems.

## 2.2.1. Early warning system and its components

## 2.2.1.2. Components of early warning system

Different authors highlight different components or elements of early warning system. Some authors explain these components into three categories, others into four, and again others into six as well. However, it is worth mentioning that all those components have similar functions.

Starting with the first type of classification, Florence (2013) indicates that early warning system has three different components. The first component is detection system, which is responsible for collecting and analyzing the information .The second component is the management system. This component is responsible for managing emergencies. The third component is the response system. This component has a responsibility of transmitting warning to the concerned residents.

The author indicates that, the last component looks complex as its success depends on people's behavior (Florence, Salit et al., 2013).This is because all receivers of warning messages must react and act according to the message transmitted to them.

Moving to the category of components of early warning, other scholars argue that early warning system is composed of six components. The first component is the monitoring and detection component. It is responsible for detecting the environmental conditions, which leads to hazards and predicting the severity of the event such as floods. Therefore from this prediction, actions to reduce the effects can be initiated. As for the second component, this is the interpretation, which is responsible for identifying in advance the impacts of predicted climatic events (Australian government 2009). Regarding the third component, it is the message construction component, which is responsible for deciding the massage which will warn the residents at risk.

Considering the fourth component in this category, it is the communication system whose role is to disseminate the message to the community at appropriate time. The fifth component is known as protective behavior component. It generates appropriate actions, behaviors from agencies involved and exposed communities. As for the six and last component, it is called "Review" a component responsible for examining the various aspects of the system in order to improve its performance (Australian government. 2009).

Another classification of the components of early warning system is known from Birkmann (2013) for early warning system to be complete, it must have four interacting components. The first component is responsible for knowing the threats, people's vulnerability as well as people at risk. The second component is called "Monitoring and warning service". This component is responsible for screening the hazards and forecasting as well as warning issues. The third component which, is disseminating and communication component, is responsible for sharing and communicating the meaningful warning in advance to those who are at risk. This component provides clear messages containing simple and useful information that are critical to enable proper responses that will help to protect lives and livelihoods (Rwanda Environment Management Authority, 2013). The fourth and last component in this type of classification is response capability. This component is responsible of planning appropriate actions and the actions are planned by experts, leaders as well as people at risk (Birkmann, 2013). It is responsible for reinforcing the capacity of the community to respond to natural disasters through education as well as community involvement (Rwanda Environmnet Management Authority, 2013).In addition, literature indicates that early warning systems miss some elements or components such as evaluation of early warning systems in place. It argues that in most cases, communicating the alert message through communication systems and satisfactory response plans are missing.(UNEP, 2012)

## 2.2.1.5. Success of early warning system

Literature argues that the success of the early warning system depends on political, historical, and social economic and cultural context .For instance during floods circumstances in Rumania, even if people were warned, they preferred to risk their lives but save their animals such as dogs and cats (Florence, Salit et al ., 2013). Other scholars argue that the success of early warning system depends on the interaction of its components and system should be

people- centered (Birkmann, 2013). They argue that successful warnings must integrate risk perception in order to have meaningful warning to recipients and encourage risk acceptance and risk reduction behavior (Hayden, 2007). Again, scholars argue that the social structure and cultural context have an influence on the effectiveness of early warning system (Gelders, 2009) .

In this study, the focus was on the influence of early warning message to climate change hazard adaptation, as one of the part of EWS. The next section illustrates the characteristics of early warning message and their impact in responding to the hazards resulting from climate change.

**2.3. Characteristics of early warning messages and their influences to respond to hazards**

## 2.3.1. Access to warning messages

In order to respond to climate change challenges, people need information related to the danger and how to behave before, during and after disasters. Literature argues that access to the warning information is vital in order to make people adaptive to circumstances, in particular for saving lives, (Nagarajan, Shaw, et al., 2012) and this information is delivered through different sources by which people at risk receive the warning information. Different agencies, media, as well as individuals, can be channels of warning message, but only warning from reliable source can be considered as relevant (Mayhorn and McLaughlin, 2014) .In addition, when a community has access to different sources of information, it influences them to take actions for adaptation as conveniently as possible. Literature argues that the more you have many sources of information, the more you take protective actions (Luo Jianjun ., 2015).

In the same point of view, scholars indicate that early warning messages are delivered through different ways such as media (radio-TV) based information, massage from family members and friends, as well as meetings organized by ~~the~~ leaders(Florence, Salit et al ., 2013). Literature also indicates the importance of the use of mobile phone (Australian government., 2009) and internet based as other ways of communicating early warning messages (Hong Kong Observatory , 2015).

Other scholars mentioned the interpersonal networks, mass media, and community networks as ways of communicating early warning messages, without forgetting social media such as twitter, facebook, (Luo Jianjun ., 2015). Door to door knocking by officials was also mentioned as a way of communicating the early warning message (Nagarajan, Shaw, et al., 2012) .

Concerning the precision and specificity of disseminated warning message, it varies according to the channel used. For instance, warning issued through radio, TV, might rapidly reach the population at risk, but it is not precise because the radio or television stations cover a large area than the risk zone. Therefore those who are not at risk will also receive the warning information (Mayhorn and McLaughlin, 2014). The negative impact of these message for those who are not at risk, is that people will intend to ignore repeated and false warnings because they have been informed about the hazard and nothing occurred.

This is why the use of warning channels that are focused such as mobile phones can be important than the use of mass media warning channels.  In addition, other scholars argue that warning messages should be transmitted in adequate way so that  it reaches all people, particularly those who are vulnerable and those living in high risk zones. It is argued that early warnings are not reaching the most vulnerable groups such as elderly, poor groups or cultural minority (Hayden, 2007).

## 2.3.2. Hearing warning messages

Literature indicates that, to respond to the warning, people go through five steps of behavioral model. Hearing warning message is not the end goal of warning system but the first step in responding to the warning. People need to make decision based on the information they hear. It is argued that it is necessary to hear the warning issues by any type of alarm.(Florence, Salit et al ., 2013, Lindell and Perry, 2012). On the contrary, Weber (2007) reveals that, in case people do not hear the warning message, they cannot make any decision to adapt to the hazard resulting from climate change.  Further, the characteristic of the warning channel have a significant impact to the attention that people pay to the warning message (Lindell and Perry, 2012).

### 2.3.3. Understanding warning message

The information that is contained in the warning message itself might influence the disaster response (Mayhorn and McLaughlin, 2014).This is why it is not enough to hear the warning messages, but the message should be clear and phrased in an understandable language, so that it can be interpreted by the concerned people easily. Literature indicates that the message should be understandable with clear instructions which tell people the appropriate actions to take in order to limit damages (Horlick-Jones, Amendola, et al., 1995; United Nations, 2006; Hayden, 2007; Lindell and Perry, 2012). It is also argued that warnings should be issued in words or other kind of signs which can be interpreted by those who are at risk (Lindell and Perry, 2012). In the same point of view, Roy Chandan (2015) in his study indicated that: "*The extent to which the respondents are capable of understanding the information contained in warning messages governs their response to warning.*" To illustrate this point, a research conducted in Bangladesh, respondents mentioned unclear message as one of the reasons of not evacuate when the hazards were close to happen (Roy, Sarkar, et al., 2015).

### 2.3.4. Reliability of warning messages

For a warning message to be useful, people must trust the warning information that has been issued. Scholars affirm that most people do not trust the warnings but they always need to verify the information first. (Florence, Salit et al ., 2013). For instance, in Bangladesh, mistrust in warning information influenced people not to evacuate while they should follow the evacuation instructions (Roy, Sarkar, et al., 2015). Literature argues that information delivery systems for climate change forecasts are inadequate or unreliable in many instances (Hayden, 2007).

Scholars affirm that for warning information to be taken into account by receivers, it has to be reliable and accurate. For instance, in Romania, when there were floods, people were warned, but they did not trust the information (Florence, Salit et al ., 2013). According to

Douglas Paton (2007), when residents have a trust on weather information, it influences their decisions. In a study conducted in Bangladesh, the respondents pointed out that they did not follow the instructions given because they were not satisfied by warning messages provided, due to the content of the messages which contained insufficient information and /or false information (Roy, Sarkar, et al., 2015).

## 2.3.5. Timeliness of warning messages

Warning message should be provided at appropriate time in order to allow people to respond to the warning, as the meaning of early warning system indicates that, it is a provision of timely and effective information that allows people at high risk to take actions in order to reduce the risks (UNEP, 2012). The time by which early warning information is provided plays a big role in influencing people to make certain decisions. It is argued that in case a warning is communicated too late, there will be no time to respond to the warning. Therefore, people are likely to ignore the warning, and they will not take actions to respond to the event (Stephen A. Nelson, 2014, Hitt, Mouloua, et al., , 2000)

To illustrate this point, a study conducted in Arkansas indicated that 58% were dissatisfied with issuance of early warning information, 61% of respondent argued that they become aware of the danger when they saw or heard the danger (Hayden, 2007). Thus, this indicates how the delay in issuing the warning information related to hazards resulting from climate change can cause many losses to those who are at risk.

Similarly, different studies indicate that warning messages are not provided at appropriate time. For instance, in the study conducted in Arkansas about the tornado circumstance, on the issue of the government warnings on the television preceded the tornado by 18–32 min (Hayden, 2007), about 75 % of respondent indicated that they neither receive the warning, nor received later to make them prepared (Hayden, 2007). The same study again argues that 61% of respondent indicated that they became aware of the danger when they saw or heard the danger (Hayden, 2007). However, other scholars indicate that the time to provide the warning message depends on the onset of the hazard, if it is rapid onset or slow (Mayhorn

and McLaughlin, 2014). That is why, the warning messages for those hazards with slow onset should be even issued many days before the event.

The world has witnessed an increase in the frequency and severity of disasters (Baas et al., 2008). Disasters cause losses which are due to several factors. These factors include extreme weather events associated with climate variability and change, the agricultural production systems that increase risk, the increasing pressure on natural resources, and the population growth combined with demographic change and movements leading, for instance, to unplanned urbanization, growing demand for food, industrial goods and services (Baas et al., 2008)

Warning messages dissemination in the Early Warning System (EWS) is one of the essential services that can save many people to avoid becoming a victim of disaster. Receiving the right and factual information about both predicted and current conditions, will make significant advantages for people to make the right decisions to mitigate the impact of the disaster. It can be said the right information can save many lives. (Nugraheni & Vries, 2015).

This chapter consists of a summary of literature on the population's experience of disasters, the awareness about the existing disaster warning system and the ways of communication used, and the role of SMS technology for disaster warning system.

Technology is central to improving early warning systems (IFRC, 2013). When disaster strikes, access to information is as important as access to food and water (IFRC, 2013).

## 2.4 The role of SMS in disaster preparedness

Research suggest that there are different mechanisms for information dissemination in disaster-pre-warning including Cell phones, SMS, microblogs, news portals, TV, and oral communication. Of these mechanisms, SMS have the highest speed (Zhang, Huang, Su, Zhao, & Zhang, 2014). Facebook and Twitter can also be used in alerting or warning people about disasters (Nugraheni & Vries, 2015).

**Proliferation of mobile phones and use of SMS**

Mobile phones are increasingly accessible worldwide (Betjeman, Soghoian, & Foran, 2013). Although the use of mobile phones is over 100 per cent in high income countries, it remains low in low-income countries (Betjeman et al., 2013). This proliferation of mobile phones has enabled aid providers to connect with a volume of affected populations and at a speed that was unimaginable ten years ago (IFRC, 2013). In sub-Saharan Africa (SSA), the penetration of cell phones was estimated to be 63% in 2013 and projected to pass 70% by 2015 (Betjeman et al., 2013).

With the proliferation of mobile phones globally, the use of SMS has become common in several fields, including public health. Text messages have been useful for timely communication during public health emergencies (Magee, Isakov, Paradise, & Sullivan, 2016).

Telephones (fixed and mobile) are useful in disseminating one-to-one disaster warnings (Yap, Heeks, & Ospina, 2011). Short message service (SMS), a feature available in most mobile phones is an additional tool for delivering one-to-many text-based disaster alerts (Yap et al., 2011).

In Aceh, Indonesia, for example, an SMS-based system enabled communities to comment on access to and the quality of the work being carried out by humanitarians (IFRC, 2013).

To-date SMS text-messaging for crisis response has been used primarily as a one-way mass media alert notification. "There is no doubt SMS has the ability to save lives in an emergency (Gomez, 2008)

People who live in a disaster area play a crucial role in the success of EWS. Malaysian, Sri Lankan, Bangladeshi and Indonesian authorities employ mobile phone applications, such as text messages (SMS), as a tool for disaster warning messages (Nugraheni & Vries, 2015).

# CHAPTER III: METHODOLOGY

## 3.1 Study area

This study was conducted in high risk zones of Kimisagara sector. Kimisagara is one of the sectors of Nyarugenge district. It has three administrative cells and 48 villages .This sector has been chosen because of its uniqueness of having two types of climate change hazards (landslide and floods) which come at the same time.
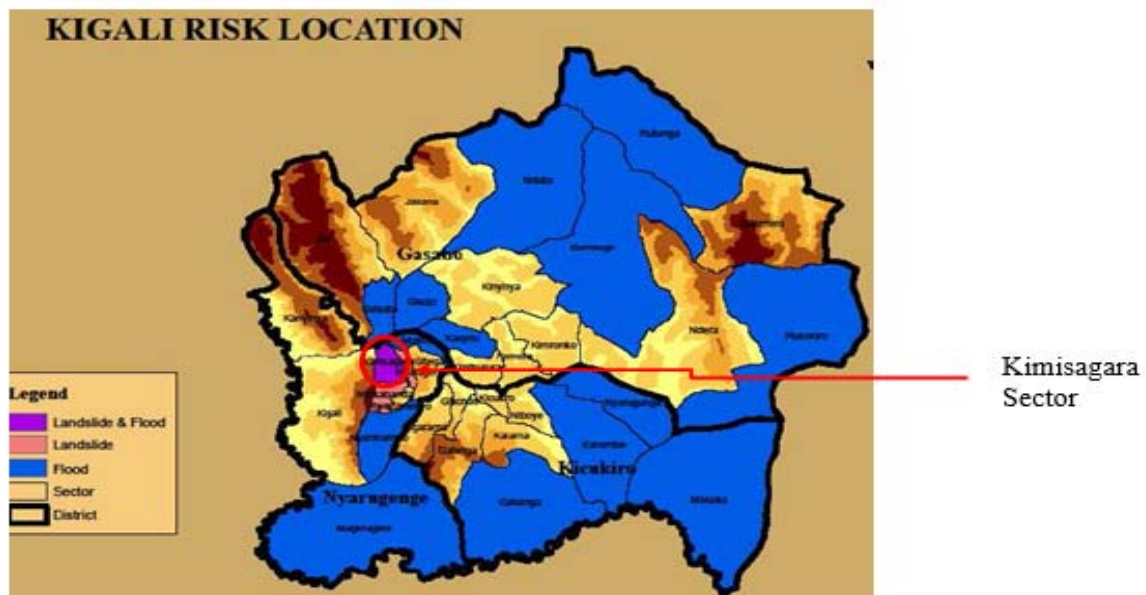


**Figure 4. 1: Kigali City risk location**

Source: (MIDIMAR, 2012)

## 3.2 Study design

A descriptive cross-sectional design was used. The study used both quantitative and qualitative approach to meet the objective. Quantitative data were collected in June 2016 from heads of households in high risk zone of Kimisagara sector. Qualitative data were obtained from different leaders in-charge of disaster management in different institutions responsible for disaster awareness and preparedness.

### 3.3 Study population

The target population in this study included the heads of households of Kimisagara sector aged from 21 years and above who live in high risk zones. This is because the major age in Rwanda is 21 years and above. In addition, key informants of this study were composed of six groups from different institutions such as disaster warning agencies including Meteo-Rwanda (in-charge of communication), advisory agencies such as MIDIMAR (in-charge of communication). At the District level, the interview was conduct with the In-charge of social protection, who is part of DDMC headed by the District Mayor. At the sector level, key informants included the In-charge of forests (Kanyamashyamba); he is also responsible for disaster management at the sector level and is part of SDMC headed by the Executive Secretary of the sector. At the cell level, two Executive Secretaries from Kamuhoza and Kimisagara Cells were interviewed.

### 3.4 Sample size and sampling strategies

The sample size of the current study consisted of 180 households residing in Kimisagara high risk zone. However, at the time of data collection, only 120 heads of households from high risk zone were available and accepted to be interviewed. In addition, six key informants from different administrative levels which are responsible for disaster management and preparedness were purposively selected and approached for interview.

### 3.5 Inclusion and exclusion criteria

**Inclusion criteria**

All heads households aged 21 years and above, living in high risk zones of Kimisagara sector and who were available at the time of data collection were included in the study.

**Exclusion criteria**

Heads of households younger than 21 years, living in high risk zones of Kimisagara sector were excluded from the study due to the minor age. This study also excluded heads of households who were absent during data collection period. Finally, heads of households who had stayed in Kimisagara for less than three months were not recruited by the current study.

## 3.6 Research instruments

The questionnaire (closed questions and open ended questions) were used to collect data from participants. This questionnaire has been adapted from another similar study entitled "SMS based disaster alert system in Developing countries: usability Analysis"(Mahmud et al., 2012). It is this questionnaire that helped to collect quantitative data for this study. This questionnaire collected data on the experience of disasters, reception of SMS for disaster preparedness,, awareness of disaster early warning system, knowledge of emergency service number and usability of SMS for disaster early warning and preparedness.

In addition, semi-structured interview guide was used to collect qualitative data from selected key informants. This interview guide collected data on the following topics: the existence of early warning system and its use of SMS, the categories of disasters the population is warned about, the recipients of the warning messages, the communication channels followed to send SMS, the challenges encountered in warning about the disasters, and the trustworthiness of received messages by the population. The interview guide was coined from literature.

## 3.7 Data analysis

Quantitative data were entered and analysed using SPSS software (version 21). Descriptive statistics using frequency tables were used to summarize data. Cross tabulation were used where necessary. Chi-square test was used and alpha set at 0.05 ($\alpha=0.05$).

Qualitative data were entered in Atlas.ti 5.2 for coding and analysis. Thematic analysis was performed to report qualitative data.

## 3.8 Ethical considerations

This study obtained an ethical clearance certificate from the University of Rwanda College of Medicine and Health Sciences Institutional Review Board. The study also was provided with an authorization to collect data from Nyarugenge District, Kigali City.

Before any data collection exercise, respondents were clearly informed about the purpose of the study and requested to provide a signed consent. Respondents were also granted of anonymity and confidentiality of their responses.

# CHAPTER IV: FINDINGS

## 4.0 Introduction

This chapter summarizes the study findings according to its objectives. First participants' sociodemographic characteristics are summarized. The following is the sequence of other study findings: participants awareness of disaster and emergency early warning system, experience of any disaster or emergency during their staying in Kimisagara sector, the knowledge of emergency service contact number; the ever reception of disaster or emergency alert SMS, usability of SMS for disaster and emergency early warning, and participants preferred communication channels about disaster and emergency warning.

## 4.1 Socio-demographic characteristics

This section presents the socio-demographic characteristics of the study participants. These characteristics include the participants' gender, age group, their duration of staying in Kimisagara sector, their household's size and education level. These findings are summarized in Table 4.1 by gender.

The study collected data from 120 participants, including 61 (50.8%) male and 59 (49.2%) female heads of households. With regards to their age, the mean age was $33.7 \pm 11.1$ years; and most participants were 21-30 years old (58.3%). Fifty-seven (47.5%) of the participants declared they have been residing in Kimisagara for three years or more. The mean household size was $4.2 \pm 2.2$ members, and 43 households (35.8%) had five and more members. Concerning the participants' education level, 68 (56.7%) heads of households had attained secondary education level; while there were only six (5.0%) with higher education level.

**Table 4. 1: Socio-demographic characteristics of participants**

| Characteristic | Gender | | | p* |
| --- | --- | --- | --- | --- |
| | Male, n(%) | Female, n(%) | Total, n(%) | |
| **Age groups in years (mean ± SD)** | **34.72±9.05** | **32.49±12.13** | **33.74±11.10** | |
| 21-30 | 31(50.8) | 39(66.1) | 70(58.3) | 0.107 |
| 31-40 | 16(26.2) | 9(15.3) | 25(20.8) | |
| 41-50 | 11(18.0) | 5(8.5) | 16(13.3) | |
| 51+ | 3(4.9) | 6(10.2) | 9(7.5) | |
| **Residence duration (in months) in Kimisagara Sector (mean ± SD)** | **81.33±107.03** | **67.22±88.89** | **74.39±98.38** | |
| <12 | 13(21.3) | 9(15.3) | 22(18.3) | 0.468 |
| 12-23 | 8(13.1) | (14(23.7) | 22(18.3) | |
| 24-35 | 10(16.4) | 9(15.3) | 19(15.8) | |
| 36+ | 30(49.2) | 27(45.8) | 57(47.5) | |
| **Household size (mean ± SD)** | **4.0±2.09** | **4.34±2.36** | **4.17±2.22** | |
| 1-2 | 16(26.2) | 11(18.6) | 27(22.5) | 0.608 |
| 3-4 | 24(39.3) | 26(44.1) | 27(22.5) | |
| 5+ | 21(34.4) | 22(37.3) | 43(35.8) | |
| **Education level** | | | | **0.327** |
| Primary or lower | 12(19.7) | 20(33.9) | 32(26.7) | |
| Vocational training | 8(13.1) | 6(10.2) | 14(11.7) | |
| Secondary | 37(60.7) | 31(52.5) | 68(56.7) | |
| Higher | 4(6.6) | 2(3.4) | 6(5.0) | |

* df: degrees of freedom

## 4.2 Experience of disaster

The first objective was to investigate about the ever-experience of disaster or emergency of the surveyed households of Kimisagara sector (Table 4.2). The findings revealed that 42 heads of households (35.0%) had experience of disasters. More importantly, the disaster experience was common among male heads of households (64.3%), p=0.031; those who were 21-30 years old (50.0%), who had three years and more of residence in Kimisagara sector (42.9%), among households which had 3-4 members (40.5%) and among heads of households who had attained secondary education (52.4%). Except the participants gender, the experience of disaster or emergency was not associated with other socio-demographic variables.

**Table 4. 2: Experience of disaster**

|  |  | Ever experience a disaster | | | |
|  |  | Yes | No | Total | p |
|---|---|---|---|---|---|
| Gender | Male | 27(64.3) | 34(43.6) | 61(50.8) | 0.031 |
|  | Female | 15(35.7) | 44(56.4) | 59(49.2) |  |
| Age group | 21-30 | 21(50.0) | 49(62.8) | 70(58.3) | 0.443 |
|  | 31-40 | 12(28.6) | 13(16.7) | 25(20.8) |  |
|  | 41-50 | 6(14.3) | 10(12.8) | 16(13.3) |  |
|  | 51+ | 3(7.1) | 6(7.7) | 9(7.5) |  |
| Duration (in months) of stay in Kimisagara Sector | <12 | 11(26.2) | 11(14.1) | 22(18.3) | 0.374 |
|  | 12-23 | 8(19.0) | 14(17.9) | 22(18.3) |  |
|  | 24-35 | 5(11.9) | 14(17.9) | 19(15.8) |  |
|  | 36+ | 18(42.9) | 39(50.0) | 57(47.5) |  |
| Household size | 1-2 | 14.13(33.3) | 13(16.7) | 27(22.5) | 0.079 |
|  | 3-4 | 17(40.5) | 33(42.3) | 50(41.7) |  |
|  | 5+ | 11(26.2) | 32(41.0) | 43(35.8) |  |
| Education level | Primary or lower | 12(28.6) | 20(25.6) | 32(26.7) | 0.362 |
|  | Vocational training | 4(9.5) | 10(12.8) | 14(11.7) |  |
|  | Secondary | 22(52.4) | 46(59.0) | 68(56.7) |  |
|  | Higher | 4(9.5) | 2(2.6) | 6(5.0) |  |

## 4.3 Reception of SMS alert about disaster

Also, this study collected data on the reception of SMS about disaster alert from the government authorities. The results are summarize in Table 4.3. It is indicated that 39 heads of households (32.5%) had ever received disaster early warning SMS. Of those who received SMS alert, there were 56.4% males (p=0.396), 56.4% heads of households aged 21-30 years (p=0.395), 38.5% who has resided for three years and above in Kimisagara Sector (p=0.208), 48.7% who had secondary education (0.643), and 43.6% whose households had 3-4 members (p=0.058).

**Table 4. 3: Ever reception of disaster alert SMS**

| | | Received SMS alert about the disaster | | | |
| | | Yes | No | Total | p |
|---|---|---|---|---|---|
| Gender | Male | 22(56.4) | 39(48.1) | 61(50.8) | 0.396 |
| | Female | 17(43.6) | 42(51.9) | 59(42.9) | |
| Age group | 21-30 | 22(56.4) | 48(59.3) | 70(58.3) | 0.395 |
| | 31-40 | 9(23.1) | 16(19.8) | 25(20.8) | |
| | 41-50 | 7(17.9) | 9(11.1) | 16(13.3) | |
| | 51+ | 1(2.6) | 8(9.9) | 9(7.5) | |
| Duration (in months) of stay in Kimisagara Sector | <12 | 11(28.2) | 11(13.6) | 22(18.3) | 0.208 |
| | 12-23 | 8(20.5) | 14(17.3) | 22(18.3) | |
| | 24-35 | 5(12.8) | 14(17.3) | 19(15.8) | |
| | 36+ | 15(38.5) | 42(51.9) | 57(47.5) | |
| Family size | 1-2 | 13(33.3) | 14(17.3) | 27(22.5) | 0.058 |
| | 3-4 | 17(43.6) | 33 (40.7) | 50(41.7) | |
| | 5+ | 9(23.1) | 34(42.0) | 43(35.8) | |
| Education level | Primary or lower | 13(33.3) | 19(23.5) | 32(26.7) | 0.643 |
| | Vocational training | 5(12.8) | 9(11.1) | 14(11.7) | |
| | Secondary | 19(48.7) | 49(60.5) | 68(56.7) | |
| | Higher | 2(5.1) | 4(4.9) | 6(5.0) | |

## 4.4 Awareness of disaster or emergency early warning system

The second objective was to assess the population's awareness of the existing disaster or emergency early warning system in Kimisagara sector. The distribution of such awareness is summarized in Table 4.4 by socio-demographic characteristics. The findings showed that 60 (50.0%) heads of households were aware of the existing warning system. Although these findings were not statistically different across the socio-demographic characteristics, the awareness of the disaster or emergency early warning was higher in males (58.3%), among participants who were 21-30 years old (51.7%), who had been residing in Kimisagara for three years and more (43.3%), and who had attained secondary education (51.7%).

**Table 4. 4: Participants' awareness of disaster warning system**

|  |  | Awareness | | | |
|---|---|---|---|---|---|
|  |  | Yes | No | Total | p |
| Gender | Male | 35(58.3) | 26(43.3) | 61(50.8) | 0.100 |
|  | Female | 25(41.7) | 34(56.7) | 59(49.2) |  |
| Age group | 21-30 | 31(51.7) | 39(65.0) | 70(58.3) | 0.496 |
|  | 31-40 | 14(23.3) | 11(18.3) | 25(20.8) |  |
|  | 41-50 | 10(16.7) | 6(10.0) | 16(13.3) |  |
|  | 51+ | 5(8.3) | 4(6.7) | 9(7.5) |  |
| Duration (in months) of stay in Kimisagara Sector | <12 | 14(23.3) | 8(13.3) | 22(18.3) | 0.511 |
|  | 12-23 | 10(16.7) | 12(20.0) | 22(18.3) |  |
|  | 24-35 | 10(16.7) | 9(15.0) | 19(15.8) |  |
|  | 36+ | 26(43.3) | 31(51.7) | 57(47.5) |  |
| Household size | 1-2 | 18(30.0) | 9(15.0) | 27(22.5) | 0.087 |
|  | 3-4 | 25(41.7) | 25(41.7) | 50(41.7) |  |
|  | 5+ | 17(28.3) | 26(43.3) | 43(35.8) |  |
| Education level | Primary or lower | 18(30.0) | 14(23.3) | 32(26.7) | 0.638 |
|  | Vocational training | 7(11.7) | 7(11.7) | 14(11.7) |  |
|  | Secondary | 31(51.7) | 37(61.7) | 68(56.7) |  |
|  | Higher | 4(6.7) | 2(3.3) | 6(5.0) |  |

## 4.5 Knowledge of emergency service number

The knowledge of emergency service contact number was also investigated by the current study (Table 4.5). The findings indicated that only 31 heads of households (25.8%) knew the emergency number to text government authority during disasters. This knowledge was most common among male (74.2%) compared to female (25.8%) heads of households (p=0.003) and those who have been residing in Kimisagara sector for three years and above, 54.8%, (p=0.037). although there were not significant difference in the distribution of the knowledge of the disaster and emergency service number, this knowledge was most frequent among heads of households who were 21-30 years old (54.8%), p=0.512; who had attained secondary education, 58.1%, p=0.952; and whose household size was 3-4 members (41.9%), p=0.075.

**Table 4. 5: Knowledge of emergency service number**

| | | Knowledge of emergency number | | | |
| --- | --- | --- | --- | --- | --- |
| | | Yes | No | Total | p |
| Gender | Male | 23(74.2) | 38(42.7) | 61(50.8) | 0.003 |
| | Female | 8(25.8) | 51(57.3) | 59(49.2) | |
| Age group | 21-30 | 17(54.8) | 53(59.6) | 70(58.3) | 0.512 |
| | 31-40 | 7(22.6) | 18(20.2) | 25(20.8) | |
| | 41-50 | 6(19.4) | 10(11.2) | 16(13.3) | |
| | 51+ | 1(3.2) | 8(9.0) | 9(7.5) | |
| Duration (in months) of stay in Kimisagara Sector | <12 | 9(29.0) | 13(14.6) | 22(18.3) | 0.037 |
| | 12-23 | 1(3.2) | 21(23.6) | 22(18.3) | |
| | 24-35 | 4(12.9) | 15(16.9) | 19(15.8) | |
| | 36+ | 17(54.8) | 40(44.9) | 57(47.5) | |
| Household size | 1-2 | 11(35.5) | 16(18.0) | 27(22.5) | 0.075 |
| | 3-4 | 13(41.9) | 37(41.6) | 50(41.7) | |
| | 5+ | 7(22.6) | 36(40.4) | 43(35.8) | |
| Education level | Primary or lower | 8(25.8) | 24(27.0) | 32(26.7) | 0.952 |
| | Vocational training | 3(9.7) | 11(12.4) | 14(11.7) | |
| | Secondary | 18(58.1) | 50(56.2) | 68(56.7) | |
| | Higher | 2(6.5) | 4(4.5) | 6(5.0) | |

## 4.6 Usability of SMS for disaster early warning

To assess the usability of SMS for disaster early warning, this study collected data on the mobile phone ownership, the pre-requisites for SMS use and the participants preferred communication channels.

### 4.6.1 Ownership of a mobile phone

Having a mobile phone is crucial for the use of SMS during early warning of the population about the disaster or any other emergency situation. Data on the ownership of a mobile phone among surveyed head of households are summarized in Table 4.6. The findings indicated that 115 (95.8%) heads of households had a mobile phone; five female heads of households declared not having a mobile phone at the time of data collection. the mobile phone ownership was higher among males (p=0.020), younger participants, 58.3%, (p=0.079); households of three years and above residence, 48.7% (p=0.055); and whose size was 3-4 members, 41.7% (p=1.00) and among heads of households who had secondary education, 58.3%, (p=0.078).

**Table 4. 6: Ownership of a mobile phone according to socio-demographic characteristics**

| | | Mobile phone ownership | | | |
| | | Yes | No | Total | p |
|---|---|---|---|---|---|
| Gender | Male | 61(53.0) | 0(0.0) | 61(50.8) | 0.020 |
| | Female | 54(47.0) | 5(100.0) | 59(49.2) | |
| Age group | | | | | |
| | 21-30 | 67(58.3) | 3(60.0) | 70(58.3) | 0.079 |
| | 31-40 | 25(21.7) | 0(0.0) | 25(20.8) | |
| | 41-50 | 16(13.9) | 0(0.0) | 16(13.3) | |
| | 51+ | 7(6.1) | 2(40.0) | 9(7.5) | |
| Duration of stay (in months) | | | | | |
| | <12 | 21(18.3) | 1(20.0) | 22(18.3) | 0.055 |
| | 12-23 | 22(19.1) | 0(0.0) | 22(18.3) | |
| | 24-35 | 16(13.9) | 3(60.0) | 19(15.8) | |
| | 36+ | 56(48.7) | 1(20.0) | 57(47.5) | |
| Household size | | | | | |
| | 1-2 | 26(22.6) | 1(20.0) | 27(22.5) | 1.00 |
| | 3-4 | 48(41.7) | 2(40.0) | | |
| | 5+ | 41(35.7) | 2(40.0) | 43(35.8) | |
| Education level | | | | | |
| | Primary or | 28(24.3) | 4(80.0) | 32(26.7) | 0.078 |

| | | | |
|---|---|---|---|
| lower | | | |
| Vocational | 14(12.2) | 0(0.0) | 14(11.7) |
| Secondary | 67(58.3) | 1(20.0) | 68(56.7) |
| Higher | 6(5.2) | 0(0.0) | 6(5.0) |

The usefulness and the limitations of mobile phones in crisis situations were demonstrated during the 2008 floods in Bihar India. Widespread mobile phone subscribership and 24-hour connectivity allowed large-scale SMS-based evacuation and rescue operations (Yap et al., 2011).

### 4.6.2 Pre-requisites for SMS use

Apart from owning a mobile phone, the study investigated about the individuals' frequency of mobile phone use, the ability to read SMS, the reading of Government's SMS, and the need for additional training in reading SMS. The findings on these variables are depicted in Table 4.7.

**Table 4. 7: Assessment of pre-requisites for SMS use among mobile phone owners**

| Variable | | Frequency | Percent |
|---|---|---|---|
| Frequency of mobile phone use per day | Almost every time | 86 | 74.8 |
| | Sometimes | 29 | 25.2 |
| | Total | 115 | 100.0 |
| Ability to read SMS | Yes | 110 | 95.7 |
| | No | 5 | 4.3 |
| | Total | 115 | 100.0 |
| Ever read SMS from Government authority | Almost every time | 9 | 7.8 |
| | Sometimes | 73 | 63.5 |
| | Just once | 33 | 28.7 |
| | Total | 115 | 100.0 |
| Need for additional training to read SMS | Yes | 43 | 37.4 |
| | No | 72 | 62.6 |
| | Total | 115 | 100.0 |

Table 4.7 indicates that of 115 heads of households who own a mobile phone 86 (74.8%) are using them phone almost every time. It is further indicated that among mobile phone users, 110 (95.7%) can read SMS; however, 43 (374% expressed the need for additional training to use/read SMS. The end-user's ability to read SMS is very important in disaster alert using SMS; otherwise this channel of warning using SMS may be impractical.

### 4.6.3 Preferences about communication channels involving disaster and emergency early warning

Assessing the study participants' preferences was also part of this study. If the population is to be early warned about the disaster or any other emergency, it is worthy to use the communication way that best suits them. It is against this background that the preferred channels were assessed. The findings are displayed in Table 4.8.

**Table 4. 8: Preferred communication channels about disaster alert**

|  |  | **Frequency** | **Percent** |
|---|---|---|---|
| **Communication channels** | TV | 19 | 15.8 |
|  | Radio | 30 | 25.0 |
|  | SMS | 68 | 56.7 |
|  | Others | 3 | 2.5 |
|  | Total | 120 | 100.0 |

Data from Table 4.8 indicated that SMS use was most preferred (56.7%) to other communication channels by the study participants. In addition to SMS, one out four participants (25.0%) want to be alerted about disasters using radio broadcasting, while 15.8% would like to be warned using TV messages. The participants' preferences by socio-demographic characteristics are shown in Table 4.9.

**Table 4. 9: Participants' preferred channels about disaster warning**

|  |  | **Preferred channel** | | | | |
|---|---|---|---|---|---|---|
|  |  | **SMS** | **Others** | **Total** | **$\chi2$; df; p** | |
| Gender | Male | 36(52.9) | 25(48.1) | 61(50.8) | 0.279; 0.597 | 1; |
|  | Female | 32(47.1) | 27(51.9) | 59(49.2) | | |
| Age group | 21-30 | 43(63.2) | 27(51.9) | 70(58.3) | 5.583; 0.134 | 3; |
|  | 31-40 | 16(23.5) | 9(17.3) | 25(20.8) | | |
|  | 41-50 | 6(8.8) | 10(19.2) | 16(13.3) | | |
|  | 51+ | 3(4.4) | 6(11.5) | 9(7.5) | | |
| Duration of staying in | <12 | 13(19.1) | 9(17.3) | 22(18.3) | 0.238; 0.971 | 3; |

| Kimisagara Sector (in months) | | | | | | |
|---|---|---|---|---|---|---|
| | 12-23 | 13(19.1) | 9(17.3) | 22(18.3) | | |
| | 24-35 | 10(14.7) | 9(17.3) | 19(15.8) | | |
| | 36+ | 32(47.1) | 25(48.1) | 57(47.5) | | |
| Household size | 1-2 | 16(23.5) | 11(21.2) | 27(22.5) | 0.096; 0.953 | 2; |
| | 3-4 | 28 (41.2) | 22(42.3) | 50(41.7) | | |
| | 5+ | 24(35.3) | 19(38.5) | 43(35.8) | | |
| Education level | Primary or lower | 14(20.6) | 18(34.6) | 32(26.7) | 8.569; 0.036 | 3; |
| | Vocational training | 6(8.8) | 8(15.4) | 14(11.7) | | |
| | secondary | 42(61.8) | 26(50.0) | 68(56.7) | | |
| | Higher | 6(8.8) | 0(0.0) | 6(5.0) | | |

According to data in Table 4.9, SMS was significantly preferred by heads of households who had attained secondary education (61.8%), p=0.036. although significant differences were not notices among the categories of the remaining socio-demographic variables, SMS was preferred by most males (52.9%), youngest (21-30 year- old) participants (63.2%), those whose residence lasted for three years and above (47.1%), and had a household size of 3-4 members (41.2%).

## 4.7 Qualitative data analysis

### 4.7.1 Theme 1: Existence of early warning system and use of SMS and other media

Key informants were asked about the existence of disaster early warning system. Some key informants including MIDIMAR, and Meteo-Rwanda agreed there is a warning system using SMS, twitter and Facebook in place. Others stated that they do not dot use SMS but other means including mobilization, mass communication during public work (umuganda) and through elected committees. On key informant declared that there is no warning system about disasters.

**4.7.2 Theme 2: Categories of disasters the population is warned of and recipients of warning messages**

The emerging disasters for which an alert is given include all categories of disasters such as heavy rains, weather changes, hot seasons, land slide, floods, and fire.

With regard to receivers of the warning messages, all people, concerned and unconcerned, are alerted irrespective of where they reside. Specific recipients of such messages include MIDIMAR, other government institutions including districts and sectors, private sector such as farmers.

**4.7.3 Theme 3: Communication channels followed and encountered challenges**

The key informants revealed that the disaster warning messages enter the MIDIMAR's system, where they are channelled to responsible staff who resend the messages to appropriate recipients. In addition, TV and radio are used to send messages to concerned people. Such messages may also be conveyed through administrative committees, public gatherings and other meetings. According to collected data, the activity of sending disaster warning messages brings together different partnerships including Meteo-Rwanda, MIDIMAR, MINAGRI, National Police and District Level.

Concerning the challenges, keys informants said the message do not reach all concerned people. Disaster related knowledge was also said to be a challenge. Limited response to disaster and appropriate interventions was another challenges to key informants. Also it not known how the disaster warning messages are received by end-users and how the messages contents are implemented at local level.

One key informant stressed that some messages go against the end-users interests as follows:

> *"Ntabwo babyumva neza ijana ku ijana kuko bibangamira inyungu zabo"*.

Abiding by the warning messages is specific to houses' renters while owners to not care about the content of such messages.

> *"Abakodesha nibo bawumvira ariko ba nyiri amazu ntibabireba"*.

Another informant said that the population does have a low meteorological understanding; that only educated people understand as follows:

"*Imyumvire ijyanye níkirere iracyari hasi... ariko mbere ntibabyumvaga; abajijutse barabyumva*".

### 4.7.4 Theme 4: Possibility to send SMS directly to end-users

Key informant were also asked about the possibility of sending SMS directly to end-users. It was said that this has been possible for some farmers who requested so. It was also revealed that another wide category of the population received warning messages through their leaders. However, some informant wished to see messages being sent without intermediate recipients:

"*Ibyiza ubutumwa bwagezwa ku babugenewe ntaho buciye (Direct)*".

On the other hand, on key informant stressed the need to send verified messages and sees inappropriate to send these messages without passing through intermediate levels:

"*Ntabwo byakunda kuko twirinda gutanga amakuru atabaye verified ngo " adahungabanya abaturage,...*"

Another informant said that the process of sending warning message is to be well discussed and agreed upon as follows: "*Ni ibyo kwigwaho*".

Finally, one key informant declared that the usual ways to communicate disaster related information are not sufficient and they need to be supplemented with others:

"*Uburyo bwo kugezwaho amakuru ajyanye n'ibiza ntibuhagije*".

Another informant stressed the importance of timely communication about disasters in order to preserve the population's health:

"*Ndasaba ko ibijyanye n'ibiza abaturage n'ubuyobozi bajya babimenyeshwa kare mu rwego rwo kurengera ubuzima bw'abantu*".

# CHAPTER V: DISCUSSION OF FINDINGS

## 5.1 Experience of disasters

The experience of disasters is common among high risk zone population. This study found that 35% of the surveyed households had experienced disasters in the day preceding data collection. This testifies that the experience of disasters in Kimisagara sector is real. In other study, the lifetime self-reported prevalence of natural disasters in this sample was 22% (Briere & Elliott, 2000). The experience of disaster call for early warning systems for the population alert and preparedness.

## 5.2 Awareness of existing early warning system and knowledge of service number

Warning the population about disasters is a key action for their preparedness. The need for for an early warning and disaster detection system is obvious and repeatedly mentioned by researchers (Zaboli, Seyedin, & Malmoon, 2013). Risk communication in disasters aims to prevent and mitigate harm from disasters, prepare the population before a disaster, disseminate information during disasters and aid subsequent recovery (Bradley et al., 2014). For example, the population should have been warned about the 26 December 2004 tsunami (Schmidt, 2005). This can be achieved using different ways of communication including the use of SMS (Zhang et al., 2014). The study found that only 32.5% of surveyed households had ever received an SMS warning about disasters. This proportion suggest the need for the remaining people to be warned about the disaster.

The population's awareness of the existing warning system was also investigated. The study revealed that only 50% of the surveyed participants were aware of the existing warning system. This shows the need for more efforts to sensitize people about the existing early warning systems in Kimisagara Sector of the Kigali City.

## 5.3 Usability of SMS in disaster communication

Using SMS for sending information has the effect of informing the public (Ho, Chung, Chen, & Lee, 2010). SMS text is an effective technology to use in disaster relief operations (Meyer, 2013) and has huge impact in the communication system of modern civilization (Mahmud et al., 2012) . There is no doubt SMS has the ability to save lives in an emergency (Gomez,

2008). Assessing the usability of SMS in disaster communication was done to ensure the early warning system can work effectively to save lives of people residing in high-risk zone of Kimisagara sector. To this end, ownership of a mobile phone is a requirement. The study revealed that around 96% of the households own a mobile phone. This proportion is far higher to the national proportion of households that own a mobile phone (63.6%) in 2014 (National Institute of Statistics of Rwanda, 2014). However, the proportion of mobile phones owners in Kimisagara is close to that of the whole Kigali city in 2014 (90.0%) (National Institute of Statistics of Rwanda, 2014) as Kimisagara is located in the Kigali City

Owning a mobile phone is not enough alone in warning the population about disasters. It requires the owners to be literate and have high skills to use the mobile phones involving the reading abilities. This study found that the proportion of participants who knew to read SMS was 95.7%. Nationwide the literacy rate was 86.2% in 2014 for people aged 15-24 years (National Institute of Statistics of Rwanda, 2014). The literacy rate was higher in Kimisagara that the national average (68%) in 2012 (National Institute of Statistics of Rwanda & Rwanda Ministry of Finance and Economic Planning, 2014). Training has been a requirement for effective SMS use (Gomez, 2008).

Data from this study show that SMS is preferred (56.7%) to other means of communication about disasters in Kimisagara sector. These include radiobroadcasting, and TV. The literature suggests several ways of communication during disaster warning and management but only the use of SMS has the highest speed (Zhang et al., 2014).

## CHAPTER VI: CONCLUSION AND RECOMMENDATIONS

This section provides the conclusion, recommendations and further studies in line with the findings of the current study.

### 6.1 Conclusion

The main objective of this study was to assess the usability of SMS for disaster or emergency early warning system for the population's preparedness and adaptaion in high risk zones of Kimisagara Sector, Nyarugenge District, in the City of Kigali.

About the experience of disasters, this study revealed that 35% of the surveyed households had ever experienced disasters during their stay in Kimisagara sector. The study also revealed that 39 households (32.5%) had ever received SMS warning them about disaster preparedness.

Another objective of the study was to assess the population's awareness of the existing disaster or emergency early warning system in Kimisagara sector. This study showed that one out of two heads of households (50%) were aware of the existing disaster warning system in Kimisagara Sector.

The knowledge of emergency service number to call or text was also assessed as another objective of the study. It was indicated that only one out of four heads of households (25.8%) knew the emergency service number, and this knowledge was most common among male heads of households.

Finally, this study was to assess the usability of SMS technology for disaster early warning and population preparedness. The findings revealed that nearly 96% of the heads of households declared owning a mobile phone, with the highest proportion of owners among males (p=0.020) and those had stayed in Kimisagara for three years and more (p=0.055). In addition, of the mobile phone owners, 74.8% declared using the phone almost every time and their ability to read SMS was high (95.7%). However, a non-negligible proportion of the surveyed heads of households (37.4%) indicated need for more training about SMS use. Lastly, the study indicated the participants preferred ways of receiving the disaster warning

and preparedness messages. It was indicated that SMS was most preferred 56.7%) to other ways including radio or TV broadcast.

## 6.2 Recommendations

This study recommends that SMS be sent directly to end-users for disaster awareness and preparedness. This would require to compile a database of mobile phone numbers to receive these messages. This study also recommends that the population's awareness of the existing disaster early warning system be raised using appropriate means, as a few of them know what number to call or text in case of a disaster.

## 6.3 Further studies

It is needed to extent the study to a larger population in order achieve generalizable findings to all populations residing in different high-risk zones. Also, there is a need to investigate about the trustworthiness of the disaster warning message by end-users. There is a need to know what happens in-between the sending and the reception of the warning messages and how long it take for the message to reach the end-users.

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**APPENDICES**

**APPENDIX1: ETHICAL CLEARANCE FROM INSTITUTIONAL REVIEW BOARD**

**UNIVERSITY OF RWANDA**    **COLLEGE OF MEDICINE AND HEALTH SCIENCES**

CMHS INSTITUTIONAL REVIEW BOARD (IRB)

Kigali, 9th June/2016

**UWAMAHORO Clementine**
**School of Public Health, CMHS, UR.**

Approval Notice: No 253 /CMHS IRB/2016

Your Project title *"Usability of short Message Service Based Alert Warning System in Increasing Disaster Awareness and Emergency Preparedness. Case Study: Kimisagara Sector, Nyarugenge District"* has been evaluated by CMHS Institutional Review Board.

| Name of Members | Institute | Yes | Absent | Withdrawn from the proceeding |
|---|---|---|---|---|
| Prof Kato J. Njunwa | UR-CMHS | | X | |
| Prof Jean Bosco Gahutu | UR-CMHS | X | | |
| Dr Brenda Asiimwe-Kateera | UR-CMHS | X | | |
| Prof Ntaganira Joseph | UR-CMHS | | X | |
| Dr Tumusiime K. David | UR-CMHS | X | | |
| Dr Kayonga N. Egide | UR-CMHS | | X | |
| Mr Kanyoni Maurice | UR-CMHS | X | | |
| Prof Munyanshongore Cyprien | UR-CMHS | X | | |
| Mrs Ruzindana Landrine | Kicukiro district | | X | |
| Dr Gishoma Darius | UR-CMHS | X | | |
| Dr Donatilla Mukamana | UR-CMHS | X | | |
| Prof Kyamanywa Patrick | UR-CMHS | | X | |
| Prof Condo Umutesi Jeannine | UR-CMHS | | X | |
| Dr Nyirazinyoye Laetitia | UR-CMHS | | X | |
| Dr Nkeramihigo Emmanuel | UR-CMHS | | X | |
| Sr Maliboli Marie Josee | CHUK | X | | |
| Dr Mudenge Charles | Centre Psycho-Social | X | | |

*Header above table: "Involved in the decision" with subcolumns "Yes" and "No ( Reason)" where "No ( Reason)" covers "Absent" and "Withdrawn from the proceeding".*

After reviewing your protocol during the IRB meeting of where quorum was met and revisions made on the advice of the CMHS IRB submitted on 8th June2016, **Approval letter has been granted to your study.**

Please note that approval of the protocol and consent form is valid for **12 months**.
You are responsible for fulfilling the following requirements:

1. Changes, amendments, and addenda to the protocol or consent form must be submitted to the committee for review and approval, prior to activation of the changes.
2. Only approved consent forms are to be used in the enrolment of participants.
3. All consent forms signed by subjects should be retained on file. The IRB may conduct audits of all study records, and consent documentation may be part of such audits.
4. A continuing review application must be submitted to the IRB in a timely fashion and before expiry of this approval
5. Failure to submit a continuing review application will result in termination of the study
6. Notify the IRB committee once the study is finished

Sincerely,

Date of Approval: The 9th June 2016
Expiration date: The 9th June 2017

Professor Kato J. NJUNWA
**Chairperson Institutional Review Board,**
**College of Medicine and Health Sciences, UR**

Cc:
- Principal College of Medicine and Health Sciences, UR
- University Director of Research and Postgraduate studies, UR

**APPENDIX 2: DATA COLLECTION AUTHORIZATION**

REPUBLIC OF RWANDA

Kigali, 20....06./2016
Réf n°....2894.../01.01/08

**KIGALI CITY
NYARUGENGE DISTRICT**

**TO: UWAMAHORO Clementine**

TEL:0789804173,

RE: Acceptence for permission to conduct Research in Nyarugenge District

This comes to inform you that you have been accepted to conduct Research in Nyarugenge District as requested in your application Letter. You will be working in **NYARUGENGE district especially in KIMISAGARA Sector** about "**Usability of Short Message Service Based Alert Warning System in Increasing Disaster Awareness and Emergency Preparedness**".

You will be expected to have Maximum co-operation with the Employees as requested to. We hope that it will benefit you and our organization.

Yours sincerely.

**MUTWARA KAHIGA EZRA**
**Executive secretary of Kimisagara District**

*B.p 1092Kigali*   E mail : nyarugengedistrict@ minaloc.gov.rw,   website :www.nyarugenge.gov.rw

**APPENDIX 3: CONSENT FORM**

I, Clementine UWAMAHORO a student in the Master's program of Health Informatics, at University of Rwanda College of Medicine and Health Sciences,  I am conducting a research entitled "**usability of short message service based alert warning system in increasing disaster awareness and emergency preparedness.**" in Kimisagara Sector of the city of Kigali, Rwanda". This research is one of the requirements we have to fulfil in order to obtain the Master's degree in Health Informatics, Regarding this research we have to conduct, and you will answer some questions, all the responses will be kept strictly confidential.

**Participation:** Participation is based on the willingness of individual, and everyone has the right to agree, disagree to participate or withdraw from this study and that will not affect his/her right.

**Payment:** Participation is free of charge, and no payment will be done to participants

**Confidentiality**

Data provided by the participants will be kept confidential and the name of participant will not be mentioned anywhere

**Risk**

The risk to participate in this study is minimum.

**Acceptance to participate**

Acceptance to participate in this research will be approved by signature of participant.

If you accept to participate, please only sign in the space below.

Signature………………………………………..

**APPENDIX 4: CONSENT FORM (KINYARWANDA VERSION)**

**KWEMERA KUGIRA URUHARE MU BUSHAKASHATSI**

Nitwa Uwamahoro Clementine, ndi Umunyeshuli wa Kaminuza y'u Rwanda mu Gashami k'Ikoranabuhanga mu Buzima, ndakora ubushakashatsi ku ikoreshwa ry' ubutumwa bugufi bugamije gukangurira abantu kwitegura ibiza mu murenge wa Kimisagara, Umujyi wa Kigali. Ubu bushakashatsi ni kimwe mu bisabwa kugira ngo mbone impamyabummenyi yok u rwego rwa Master mu bijyanye n'ikoranabuhanga mu by'ubuzima. Muri ubu bushakashatsi, turakubaza ibibazo; kandi ibisubizo byabyo bizabikwa mu ibanga rikomeye.

**Kugira uruhare mu bushakashatsi**

Kugira uruhare mu bushakashatsi bituruka ku bushake bwa buri muntu. Buri muntu ashobora kwemera, kwanga cyangwa kuva mu bushakashatsi kandi nta ngaruka bizamugiraho.

**Ikiguzi**

Nta kiguzi gisabwa kugira ngo umuntu yinjire mu bushakashatsi kandi nta kwishyura abemeye kugira uruhare mu bushakashatsi kuzabaho.

**Ingaruka**

Nta ngarukuka ubu bushakashatsi buzagira ku bantu bazemera kubugiramo uruhare

**Kwemera**

Kwemera kugira uruhare muri ubu bushakashatsi bigaragazwa no gushyira umukono kuri iyi nyandiko. Niba wemeye, shyira umukono wawe ahabigenewe

Umukono …………………………………………..

**APPENDIX 5: SURVEY QUESTIONS FOR HEADS OF HOUSEHOLDS**

Date of survey…/……………………./……………………

Start Time:

Contact number of enumerator …………………………..

*Instructions: Please tick in appropriate answer box*

| Section I: This section covers the information related to demographic data | | | |
|---|---|---|---|

| Gender of respondent | | Age | Duration in zone(months) | Size of the family |
|---|---|---|---|---|
| M | F | | | |

Head of the family

| Father | Mother | Others/specify……………….. |
|---|---|---|
| | | |

Level of education of the head of family

| None | Incomplete Primary | Primary | Vocational training | Incomplete secondary | Secondary | University |
|---|---|---|---|---|---|---|
| | | | | | | |

| Section II: This section is composed of the questions related to the source of information, related to short message usage. |
|---|

1. Do you have a mobile phone? (If yes, go to question no 3)

a. Yes

b. No

2. Do any of your family members have mobile phone?

a. Yes

b. No

3. How frequent do you use mobile phone?

a. Almost every time

b. Sometimes

c. Just the once

4. Can you read SMS?

a. Yes

b. No

If the answer of the question is 'no' then stop the question and go to question no **6**

5. Do you read the SMS sent by government?

a. Almost daily

b. Sometimes

c. Just once

6. Do you need additional training to read SMS?

a. Yes

b. No

7. Have you ever experienced of disaster?

a. Yes

b. No

8. Do you know the emergency number to text government authority during disaster?

a .Yes

b. No

9. Did you receive any SMS alert from government during disaster?

a. Yes

b. No

10. In which media, you would like to get alert?

a. TV

 b. Radio

c. Alarm

d.SMS

e. Others

11. How much would you rate the concept behind SMS based disaster alert system?

a. Very good

b. Good

c. Neither Good nor bad.

12. Do you know if any form of local warning exists in your area?

**1. Yes**

**2. No**

**KWEMERA KUGIRA URUHARE MU BUSHAKASHATSI**

Jyewe, Uwamahoro Clementine, Umunyeshuli wa Kaminuza y'u Rwanda mu Gashami k'Ikoranabuhanga mu Buzima, ndakora ubushakashatsi ku ikoreshwa ryúbutumwa bugufi bugamije gukangurira abantu kwitegura Ibiza mu murenge wa Kimisagara, Umujyi wa Kigali. Ubu bushakashatsi ni kimwe mu bisabwa kugira ngo mbone impamyabummenyi yok u rwego rwa Master mu bijyanye n'ikoranabuhanga mu by'ubuzima. Muri ubu bushakashatsi, turakubaza ibibazo; kandi ibisubizo byabyo bizabikwa mu ibanga rikomeye.

**Kugira uruhare mu bushakashatsi**

Kugira uruhare mu bushakashatsi bituruka ku bushake bwa buri muntu. Buri muntu ashobora kwemera, kwanga cyangwa kuva mu bushakashatsi kandi nta ngaruka bizamugiraho.

**Ikiguzi**

Nta kiguzi gisabwa kugira ngo umuntu yinjire mu bushakashatsi kandi nta kwishyura abemeye kugira uruhare mu bushakashatsi kuzabaho.

**Ingaruka**

Nta ngarukuka ubu bushakashatsi buzagira ku bantu bazemera kubugiramo uruhare

**Kwemera**

Kwemera kugira uruhare muri ubu bushakashatsi bigaragazwa no gushyira umukono kuri iyi nyandiko. Niba wemeye, shyira umukono wawe ahabigenewe

Umukono …………………………………………..

**APPENDIX 6: SURVEY QUESTIONS FOR HEADS OF HOUSEHOLDS (KINYARWANDA VERSION)**

**UMUGEREKA WA MBERE: IBIBAZO BIGENEWE UHAGARARIYE UMURYANGO**

Itariki: …………………/………………………/……………………

Nomero iranga ukusanya amakuru: ……………………..

**Amabwiriza:** Shyira akamenyetso ka v ku gisubizo uhisemo

**Igice cya mbere: Umwirondoro w' usubiza**

1. Igitsina:

   1. Gabo
   2. Gore

2. Imyaka yúsubiza: …………………

3. Igihe (mu mezi) amaze atuye mu murenge wa Kimisagara: ………………..

4. Umubare w'abagize umuryango we: ………………………

5. Icyo akora mu muryango:

   1. Umugabo nyirurugo
   2. Umugore nyirurugo
   3. Undi mwanya. Wuvuge…………………………..

6. Amashuli yize:

   1. Ntayo
   2. Ntiyarangije amashuri abanza
   3. Yarangije amashuli abanza
   4. Amashuli yímyuga
   5. Ntiyarangije amashuli yisumbuye
   6. Yarangije amashuli yisumbuye
   7. Kaminuza

**Igice cya kabiri: aho amakuru aturuka**

7. waba utunze telephone igendanwa?

1. Yego -→ Jya ku kibazo cya 9

2. Oya

8. Haba hari umuntu utunze telefoni igendanwa mu muryango wanyu?

1. Yego

2. Oya

9. Ukoresha telefoni igendwa incuro zingahe?

1. Buri gihe

2. Rimwe na rimwe

3. Rimwe

10. Ubasha gusoma ubutumwa bufufi (SMS)?

1. Yego

2. Oya --→ Jya ku bibazo cya 12

11. Waba usoma ubutumwa bwoherejwe na Guverinoma/ Leta?

1. Buri munsi

2. Rimwe na rimwe

3. Gake cyane

12. Waba ukeneye amahugurwa y'inyongera kugira ngo usome ubutumwa bugufi?

1. Yego

2. Oya

13. Waba warigeze uhura n'ikiza cyangwa íngaruka zacyo?

1. Yes

2. No

14. Waba uzi nomero ya telefoni wahamagara  kugira ngo umenyeshe inzego za Leta ibijyanye n'ikiza?

   1. Yego

   2. Oya

15. Waba warigeze wakira ubutumwa bugufi buturutse mu nzego za Leta mu gihe cy'ikiza?

   1. Yego

   2. Oya

16. Ni uwuhe muyoboro wifuza ko wanyuzwaho ubutumwa bukuburira ku bijyanye n'ikiza?

   1. TV

   2. Radio

   3. Impuruza

   4. Ubutumwa bugufi

   5. Undi muyoboro. Wuvuge …………………………

17. Ni gute ubona uburyo bwo kuburira abantu ku bijyanye n'ibiza hakoreshejwe ubutumwa bugufi?

   1. Bwiza cyane

   2. Bwiza

   3. Nta gisubizo

18. Waba uzi  niba hari uburyo bukoreshwa n'inzego z'ibanze mu kuburira abantu mu gace utuyemo?

   1. Yego

   2. Oya

**APPENDIX 7: REQUEST TO COLLECT DATA IN KIMISAGARA SECTOR**

Uwamahoro Clementine                                              Kigali, 09/06/2016
University of Rwanda College of Medicine and Health Sciences
School of Public Health
Health Informatics Program
Telephone: 0789804173
Email: shadia@khi.ac.rw

The Mayor of Nyarugenge District

**RE: Request for data collection authorization**

Dear Madam,

I am a student in the program of Health Informatics, School of Public Health, College of Medicine and Health Sciences, University of Rwanda.

I am conducting a research study entitled "**Usability of Short Message Service Based Alert Warning System in Increasing Disaster Awareness and Emergency Preparedness. Case study of Kimisagara Sector Nyarugenge District**". The aim of this study is to assess the usability of SMS in increasing the population's awareness, preparedness and adaptation to disasters in Rwanda, especially in Kimisagara Sector of Nyarugenge District. This study is one of the requirements for completing the study program.

The current letter serves to request for authorization to collect study data in Kimisagara sector as the study targeted area.

Looking forward to your favourable consideration and acceptance of the current request.

Sincerely,

**Uwamahoro Clementine**

**APPENDIX8 6: INTERVIEW GUIDE FOR DIFFERENT LEADERS**

     i.     Do you have an early warning system about the disaster?
    ii.     Does the early warning system use SMS?
   iii.     What category of disaster the population is warned about?
   iv.     Who are the receiver of SMS warning about disaster? Only direct users?
    v.     What is the communication channel followed to send SMS?
   vi.     Are there any challenges in sending the early warming messages to users? If yes, what are the challenges
  vii.     Do the SMS receivers take into consideration the content of warning SMS?
 viii.     Is it possible to send warning SMS directly to beneficiaries without transiting to a third party?
   ix.     Do you have any additional information about the use of early disaster warning system messages?

Thank you

**APPENDIX 9: INTERVIEW GUIDE FOR DIFFERENT LEADERS (KINYARWANDA VERSION)**

**IBIBAZO BIGENEWE ABAYOBOZI KU NZEGO ZITANDUKANYE**

i. Mwaba mufite uburyo mukoresha mu gukangurira abantu kwirinda Ibiza?

ii. Abaturage bajya bakangurirwa kwirinda ibiza hakoreshejwe ubutumwa bufufi?

iii. Ubutumwa boherezwa bujyanye n'ibihe biza?

iv. Ni bande mwoherereza ubwo butumwa? Ababugenewe? Abatabugenewe?

v. Ubwo butumwa bunyuzwa mu zihe nzira? Bunyuzwa kuri bande mbere yo kugera kubo bugenewe?

vi. Haba hari imbogamizi mu gutanga ubwo butumwa? Ni izihe?

vii. Abagenewe ubwo butumwa babwakira gute? Baba bumvira inama zo kwirinda mubagira?

viii. Birashoboka ko ubutumwa bwoherezwa abo bugenewe nta zindi nzira bunyuzemo? Mubona byakorwa gute?

ix. Hari ikindi mwifuza kutubwira kijyanye no kuburira abantu ibijyanye n'ibiza?

Murakoze.