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Assessment of ICT Utilization in Disaster Risk Reduction Management in the 4th District of Camarines Sur

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Abstract— On a global scale, the application of information and communication technology (ICT) in disaster risk reduction management has proven to be critical for success. The purpose of this study is to determine the extent to which disaster-prone municipalities in Camarines Sur are utilizing information and communications technology (ICT) for disaster risk reduction and management (DRRM).The research was conducted in disaster-prone municipalities in Camarines Sur because of their proclivity to be impacted by natural disasters. The researcher conducted key informant interviews with the DRRM officers in local government units (LGUs) and used qualitative methods to analyze the data gathered. The findings indicated that some LGUs in Camarines Sur have adequate ICT resources for DRRM, while other LGUs do not have adequate ICT resources for DRRM, and the level of ICT application to DRRM corresponds to the availability of ICT resources in the LGUs. Moreover, it was found that there were a number of challenges that prevented the effective utilization of ICT in DRRM. The study recommends that LGUs allocate funds and resources to the improvement of ICT infrastructure and the utilization of ICT in disaster risk reduction efforts. On a continuous basis, LGUs should train their employees on the latest information and communication technologies, as well as their applications in disaster risk reduction.

Index Terms— Information and Communication Technology (ICT), Disaster Risk Reduction Management, Local Government Unit (LGU), Camarines Sur

I. INTRODUCTION

On a global scale, the application of information and communication technology (ICT) in disaster risk reduction management has proven to be critical for disaster mitigation, preparedness, response and recovery. The ICT's application in disaster risk reduction management (DRRM) has provided an expedient advantage in connecting networks across different geographical areas because it facilitates fast flow of information. The ICT is also an essential tool for cooperation, coordination as well as collaboration among different sectors since it provides opportunities in improving the DRRM in building resilient communities (Apikul, 2010).

Philippine DRRM Context

The Philippines has a high vulnerability to natural hazards which are attributed to the nation's geographic position in Southeast Asia [2]. Natural disasters such as typhoons, earthquakes, floods, volcanic eruptions, landslides, and fires affect the country [3]. Disaster has a tremendous effect to our country and our community. In 2013 alone, about 12.9 million people were affected by Typhoon Haiyan, leaving 1.9 million people homeless, 281,091 houses destroyed, 575,378 people in evacuation centers, 2.5 million people in need of food and 4,460 people dead [4].

The National Disaster Risk Reduction and Management Plan (NDRRMP) serves the need of RA No. 10121 of 2010, which establishes the legal framework for disaster-related policies, plans, and programs. The National Disaster Risk Reduction and Management Council's structure corresponds to the four thematic areas covered by the NDRRMP: (1) disaster prevention and mitigation; (2) disaster preparedness; (3) disaster response; and (4) disaster rehabilitation and recovery [5]. The NDRRMP is in line with the National Disaster Risk Reduction and Management Framework (NDRRMF), which envisions a country of "safer, adaptive, and disaster resilient Filipino communities toward sustainable development"[5].

Information Communication Technology in DRRM

In disaster management, information and communication technologies (ICTs) are used in two ways. The first set of uses is linked to knowing the risks, which includes being aware of the risk and having access to essential information about risk in order to minimize them as quickly as possible. The second area of application focuses on how to best manage risks and disasters by incorporating ICT technologies into mitigation programs and projects [1]. In the twenty-first century, the use of ICT for disaster risk management is a must for efficiency and timely disaster risk management as well as medium of information and communication for better disaster response [7]. At international forums such as the World Summit on the Information Society, the role of ICT for DRR is recognized (WSIS). The use of ICT for humanitarian assistance during disaster relief, as well as forecasting and monitoring the impact of disasters, is particularly mentioned in the WSIS Plan of Action [1].

Local Government Units (LGUs) in DRRM

LGUs play an important role in community-based disaster risk reduction management by developing necessary policies,

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plans, and legal instruments, providing financial and technical resources, coordinating and linking activities, and building community capacity for early warning, preparedness, relief, rescue, shelter management, first aid, and damage assessment [6]. LGUs can utilize the use of ICT to reinforce their emergency preparedness and response capabilities.

Objectives of the study

The aim of the study is to determine the extent to which the 4th District of Camarines Sur is utilizing information and communications technology (ICT) for disaster risk reduction and management (DRRM). The study has the following specific objectives:

1. Identify ICT resources and areas of DRRM where ICT is utilized;
2. Determine the level and challenges of ICT application in DRRM;
3. Assess the effectiveness of ICT in DRRM;
4. Propose an ICT utilization plan for the 4th district of Camarines Sur.

The study focuses on the use of ICT in disaster risk reduction and management in the 4th District of Camarines Sur in order to improve DRRM and contribute to the development of a sustainable and resilient community. It will serve as a reference for local government units regarding the critical role of ICT in disaster risk reduction and management. Similarly, serve as a foundation for the development of policies and their implementation in disaster risk reduction and management.

II. METHODOLOGY

Objectives of the study

The Philippines is one of the countries in Asia Pacific that is susceptible to all types of disasters, the most common of which are tropical cyclones, which bring heavy rains, strong winds, landslides, and flooding. Additionally, it is vulnerable to volcanic eruptions, earthquakes, and tsunamis. The province of Camarines Sur belongs to the 5th region of the country. The study focuses on the 4th district of the province. The district is composed of the municipalities of Caramoan, Garchitorena, Goa, Lagonoy, Presentacion, Sagay, San Jose, Siruma, Tigaon, and Tinambac. Based on the Geohazard mapping conducted by the Mines and Geosciences Bureau (MGB) in risk reduction and development planning, the 4th district of Camarines Sur is susceptible to the impact of natural catastrophic events like earthquakes, tsunami, floods and landslides.

The respondents of this study are from the DRRM office of the Local Government Units of the Fourth (4th) district of Camarines Sur. With a total of 53 respondents, composed of Local DRRM Officers, Local DRRM Assistants, Local DRRM Researchers, Technical Staff, Responders/Rescuers, and Admin Officers. Their responsibilities include planning and implementing mitigation, response, and recovery during the occurrence of natural disasters. As well as provide information and awareness to communities on how to respond and recover during natural calamities.

Research Design

The research is primarily descriptive in nature, with data being gathered through questionnaires and unstructured interviews. In order to determine the extent to which ICT is being used in the 4th district of Camarines Sur, the researchers distributed questionnaires to the respondents, who were composed of DRRM officers and staff from each municipality in the district. The officers from the DRRM were subjected to an unstructured interview.

Data Interpretation and Analysis

The data were analyzed using percentages, and the effectiveness of ICT on DRRM was determined using a weighted-mean on a 5-point scale, with five (5) indicating extremely effective treatment and one (1) indicating ineffective treatment. The 5-point scale was used to determine the effectiveness as well as the rate of utilization of ICT in the DDRM offices in the surveyed municipalities. The percentages were used on types of ICT tools, areas of ICT utilization and ICT use challenges wherein it represents the proportion of respondents who have selected that particular answer.

III. RESULTS AND DICSUSSION

The research study employed the use of questionnaires as the primary instrument of data collection. Fifty-three (53) respondents from the Municipal Disaster Risk Reduction and Management Offices (MDRRMOs) of the ten (10) municipalities of Partido were administered with the devised questionnaire. All of the respondents are under contract of services and most are permanently hired by the local government units in their MDRRMOs.

Demographics of MDRRMO Staff Respondents

The demographics of the respondents represents the type of workforce that are present in the Municipal Disaster Risk Reduction and Management Offices (MDRRMOs). This information includes the gender and age of the respondents, the employment status and number of years of service in the office.

Table 1. Gender of Disaster Risk Reduction Management Staff Respondents

Option	Number of Respondents	Percentage
Male	35	66.04%
Female	16	33.96%
Total	53	100%

Table 1 shows that male are over-represented compared to females which indicates that the percentage of females in the

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organization is low which is probably because of the nature of the job that involves a lot of field work and physical ability especially during disaster rescue operations. Moreover, female staff mostly are tasked to manage the office while the male staff are more involved in handling the rescue operations.

Table 2. Age of Disaster Risk Reduction Management Staff Respondents

Option	Number of Respondents	Percentage
Under 25	5	9.4%
25-29	11	20.8%
30-39	21	39.6%
40-49	12	22.6%
50-59	3	5.7%
Above 60	1	1.9%
Total	53	100%

Table 2 shows that around 40% of respondents are around 30-39 years old, followed by 40-49 years old (22.6%) and 25-29 years old (20.8%). The data shows a high diversity of respondents present in the DRRMO. The line of work of the staff in MDRRMO is physically demanding thus the office opts to hire staff that can sustain the work.

Table 3. Employment Status of Disaster Risk Reduction Management Staff Respondents

Option	Number of Respondents	Percentage
Permanent	17	32.1%
Temporary	6	11.3%
Contract of Service	30	56.6%
Part-time	0	0%
Total	53	100%

Table 3 shows that the majority (56.6%) of the respondents are under Contract of Service, while only 17 (32.1%) out of 53 are permanent employees and 6 (11.3%) are temporary employees.

Table 4. Years of service in Disaster Risk Reduction Management

Option	Number of Respondents	Percentage
8 years and above	2	3.77%
4-7 years	18	33.96%
1-3 Years	28	52.83%
Less than 1 year	5	9.43%
Total	53	100%

According to Table 4, the majority of respondents (52.83%) have at least 1-3 years of experience in DRRM, 18 respondents (33.9%) have at least 4-7 years of experience, 5 respondents have less than a year of experience in DRRM, and only 2 respondents have more than 8 years of experience in the field. Most of the respondents who are working for the MDRRMO between 1-3 to years are still undergoing training and capacity building to further strengthen their knowledge and capabilities.

ICT Resources in MDRRM Office of the 4th District of Camarines Sur

The use of information and communication technology resources play a significant role in disaster risk reduction management. The use of these resources provided ease of communications between the responders and the community especially during disasters, that is why all municipalities in the 4th district of Camarines Sur utilizes different ICT tools. These tools are being utilized in the different areas in DRRM. The data in Tables 5 and 6 summarizes the results on the use of ICT in DRRM and ICT resources present in the DRRM Offices in the 4th district of Camarines Sur.

Table 5. Use of ICT for Disaster Risk Reduction Management

Option	Number of Respondents	Percentage
Yes	53	100%
No	0	0
Total	53	100%

As shown in Table 5, all respondents (100%) used ICT for disaster risk reduction management, implying that the use of ICT is a necessary component of Municipal DRRM activities both in the office and in the field.

Table 6. Types of ICT tools used for Disaster Risk Reduction Management

Options	Number of Respondents	Percentage
Computer	53	100%
Graphical Information System (GIS)	17	32.6%
Satellite Imaging	4	7.7%
Internet	53	100%
Remote Sensor	1	1.9%
Digital Camera	24	46.2%
Telephone	13	25%
GPS	26	50%
Mobile Phones	48	92.3%
Ham Radio Comms	44	84.6%
Satellite Radio Comms	28	53.8%

Table 6 presents the types of ICT tools utilized for disaster risk reduction management. According to the responses the most common ICT tools that are used by the Municipal DRRM offices are the computers and internet connection

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(100%), mobile phones (92.3%) and Ham Radio Communications (84.3%) while the use of remote sensors and satellite imaging were not commonly utilized. However, according to current research the utilization of all these aforementioned ICT tools are all essential in enhancing the capacity of the MDRRMOs in managing disasters.

ICT Resource Utilization in Different Areas of DRRM

There are different areas wherein ICT resources are utilized in disaster risk management. According to UN ESCAP & APCICT (undated), ICT can be applied to risk assessment, evaluation, assessment, visualization, mitigation, prevention, preparedness, response, relief and recovery. From the risk evaluation to the post-disaster recovery the use of ICT is very critical hence the Tables 7 and 8 shows percentage of ICT utilization in different areas of DRRM as well as its rate of utilization in the 4th district of Camarines Sur.

Table 7. Specific areas where LGU applies ICT in Disaster Risk Reduction Management

Areas in DRRM	Number of Respondents	Percentage
Raising awareness to the community	8	15.1%
Issuing disaster alerts and warnings	9	17%
Monitoring weather events	9	17%
Supporting emergency response through communication	7	13.2%
Search and rescue operation	7	13.2%
Data storage and record keeping	8	15.1%
Identifying high risk areas	6	11.3%
Supporting decision-making	3	5.7%
Helps DRRM Planning	10	18.9%
Providing Platform for collaboration	5	9.4%
All of the above	41	77.4%
Others	0	0%

Table 7 shows that the majority of the respondents applied ICT in DRRM on all the areas specified in the survey. Whilst using ICT in DRRM Planning, issuing disaster alerts and warnings, monitoring weather events as well as raising awareness to the community were identified as the areas wherein ICT is more utilized. However, it is under-utilized in terms of providing a platform for collaboration and in supporting the decision making process.

Table 8. Rate the utilization of ICT in Disaster Risk Reduction Management

Rate of Utilization	Number of Respondents	Percentage
20%	0	0%
40%	3	5.7%
60%	12	22.6%
80%	38	71.7%
100%	0	0%

According to Table 8, the majority of respondents rate of ICT utilization in DRRM was approximately 80%. While some of the respondents (3) have indicated the rate of utilization at only 40%. It can be noted from this data that in the MDRRMOs, ICT tools and other resources are highly utilized. Further, the survey shows that the utilization of ICT tools is most common in DRRM planning.

Challenges and Effectiveness of ICT in DRRM

There are a lot of challenges that are faced by the MDRRMOs on use of ICT resources since the upscaling ICT resources as well as the manpower required budget allocation from the local government as well as a stronger policy implementation to enhance the equipment along with the skills of the MDRRMOs office staff. Further, the upskilling of staff and upscaling of resources could result in higher effectiveness of ICT in DRRM. Table 9 summarizes the challenges that are faced by the LGU in the use of ICT for Disaster Risk Reduction Management and Table 10 shows the rate of effectiveness of ICT in DRRM.

Table 9. Challenges faced by the MDRRMOs in the use of ICT for Disaster Risk Reduction Management

Option	Number of Respondents	Percentage
Lack of skills in using ICT tools	10	19.2%
Dependability and reliability to mobile network/internet connection	18	34.6%
Error in data entry	4	7.7%
Outdated tools and application	9	17.3%
All of the above	31	59.6%
Others	0	0%

Over half of respondents (59.6%) experienced all of the challenges identified in the survey on the use of ICT for DRRM, as illustrated in Table 9. And the respondents' primary challenge was the dependability and reliability of their internet connection.

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Table 10. Rate the effectiveness of ICT usage in Disaster Risk Management

Option	Number of Respondents	Percentage
5 – Extremely Effective	19	35.8%
4 – Very Effective	24	45.3%
3 – Effective	10	18.9%
2 – Fairly Effective	0	0%
1 – Not Effective	0	0%
Total	53	100%

According to Table 10, the majority (45.3 %) of respondents rated ICT use in DRRM as "Very Effective," while 19 of 53 respondents (35.8 %) rated ICT use in DRRM as "Extremely Effective."

IV. DISCUSSION OF FINDINGS

The Role of ICT in Disaster Preparedness, Response and Recovery in MDRRMOs in Partido

Information and communication technology (ICT) plays a critical role in disaster prevention, mitigation, response, and recovery. Government agencies and other humanitarian actors engaged in rescue operations and decision-making processes that require timely, predictable, and effective information, according to the International Telecommunication Union [9]. In 2013, the Philippines was hit by one of the strongest typhoons recorded, Typhoon Yolanda (Haiyan). While the death toll was high, it could have been much worse without the efforts of PAGASA, the Philippine meteorological agency. It issued warnings two days before Typhoon Haiyan struck, forcing approximately 750,000 residents to evacuate [13]. Moreover, after the devastating typhoon hit the Philippines, Google launched a Person Finder web application that allowed users to post messages and search for the status of family and friends affected by the disaster [15].

Another initiative from the Ateneo de Manila University is the launching of eBayanihan. eBayanihan is a mobile and web-based participatory disaster management system that allows citizens to contribute and receive disaster-related information. eBayanihan crowdsources information providing actionable responses to build disaster-resilient communities [17]. These ICT technologies have proven to deliver real-time information and reliability during disasters from mapping out landslide and flood prone areas, to disseminating weather alerts and updates through SMS.

The most common ICT tools that are used by the Municipal DRRM offices based on the conducted survey were the computers and internet connection, mobile phones and Ham Radio Communications (see table 6). These ICT tools are classified under communication tools. Computers were used by the MDRRMOs in record keeping, creating reports, and producing information from stored data in databases where data collected and stored are used to support DRRM planning and decision-making. The internet provides the means through which MDRRMOs get all the information about incoming disaster warning, preparedness, response and recovery details. The Internet is also utilized in social media and communication with stakeholders. Through social media, MDRRMOs was able to reach the community, distribuite electronic IEC materials, post announcements and videos pertaining to DRRM activities. Mobile phone technologies enables MDRRMOs to pass information to stakeholders, such as early warning messages, to be shared immediately and directly with people at risk in remote locations, reducing the time required for this critical information to reach them and thus providing longer lead times for them to act or prepare in advance of a disaster, potentially mitigating their impact [10]. While ham radios are used by MDRRMOs to communicate with a variety of stakeholders, such as coastal barangays which has limited access to mobile network, used during the immediate response phase of numerous types of natural disasters, delivering messages, information, and advice to affected communities especially during power outages and when internet and phone lines are down. Hence, there is a need to prioritize these coastal barangays to be provided with communication tools such as satellite and ham radios.

Over the last decade, there has been a shift in how people receive information. Rather than waiting for the evening news or the morning newspaper, many people now receive real-time news and weather updates via social media platforms such as Facebook, Twitter, and Instagram [14]. Social media applications have established themselves as a reliable communication channel, even when more traditional methods of communication fail. Their application to emergency management expands the domain's benefits [15]. As a result, social media has grown in prominence in the worlds of disaster preparation, recovery, and relief. MDRRMOs in the 4th district of Camarines Sur utilizes social media platforms as a communication tool in providing information to their stakeholders. Using social media groups and pages, they were able to spread information using various media such as text, infographics and videos.

ICT is utilized in the four (4) thematic areas of DRRM, namely, (1) Disaster Prevention and Mitigation; (2) Disaster Preparedness; (3) Disaster Response; and (4) Disaster Rehabilitation and Recovery (NDRRMC, 2011). In the 4th District of Camarines Sur, as shown in Table 7, ICT was utilized in these thematic areas of DRRM particularly in data collection & DRRM planning, monitoring weather events, issuing alerts, raising awareness to the community, support to emergency response and rescue operations, and provides platform for collaboration.

Challenges and Opportunities for the Effective Utilization of ICT Resources in the MDRRMOs of Partido

A frequently-mentioned issue in Philippine disaster

management is the lack of capacity of line agencies and local government units to undertake DRRM activities. Several reasons for this include a lack of manpower, a lack of technical knowledge and comprehension, a lack of financial resources, and a lack of technology such as a multi hazard early warning system. The LGUs lack the technical capacity and resources necessary to carry out their statutory responsibilities. According to the DILG-Bureau of Local Government Supervision's 2013 national table assessment on LGU compliance with RA No. 10121, only 23% of LGUs located in flood-prone areas are prepared for disasters in terms of awareness, institutional capacities, and coordination (Policy Brief, 2017). Utilization of advanced ICTs is frequently accompanied by significant investment. Access to other basic needs takes precedence in the majority of cases within the region's less developed economies. When resources are scarce, it is frequently the case that investments in ICTs are deemed less critical [11].

It is related to the MDRRMO's challenges in the 4th district of Camarines Sur, which include a lack of adequate budget for facility upscaling, particularly in the ICT resources. MDRRMOs budget comes from the 5% of the municipal budget. The majority of this budget is dedicated to disaster response and recovery during and after a natural disaster. Hence, ICT equipment in MDRRMOs are limited and mostly are out of date. Among the challenges faced by MDRRMOs due to limited budget resources is the lack of training on the latest tools and ICT equipment for DRRM. Moreover, the majority of the respondents as seen on Table 4 are still new to the field of DRRM which poses a greater need to provide staff with proper knowledge and training in both DRRM and application of ICT to DRRM. These trainings needed will provide for a better efficiency and effectiveness of the utilization of ICT equipment. Another challenge faced by the MDRRMOs is the dependability of ICT resources to mobile network and internet connection. Majority of the MDRRMOs have low internet bandwidth and have a need to upgrade their internet connection. But due to limited budget, offices rely on the LGUs network infrastructure.

With the aforementioned challenges, MDRRMOs' capacity to improve their ICT resources for effective utilization is constrained. Despite these obstacles, the MDRRMOs ensure that ICT is both effective and necessary for DRRM. However, opportunities for the effective utilization of ICT exist if the possible scenarios will be met: (a) ICT resources supplied by the government is based on the actual need of the LGU, (b) all the MDRRMOs staff are well-knowledge and well-trained on the use of ICT resources, (c) if the DRRM Plan and Contingency Plan is well-implemented. The following opportunities will allow MDRRMOs to prioritize upgrading of ICT resources which will help in various areas in DRRM such as raising awareness to the community, mapping disaster prone areas using GIS, identifying community needs before a natural disaster, help in DRRM planning and support in decision making.

Proposed ICT Utilization Plan for the 4th District

Based on the data obtained from the study the following ICT utilization plan is proposed for the 4th district of Camarines Sur. The ICT Utilization Plan will focused on four (4) components (3As2Us):

1. **Awareness** – Collaboration with external institutions, the academe, and stakeholder is essential to promote and improve awareness of policies and programs of MDRRMOs to the community. Leveraging on the collaboration between different institutions the MDRRMOs could produce programs and activities such as IEC materials development, radio programs, and social media awareness campaigns.
2. **Allocation** - Proper allocation of funds from the LGUs is vital to the improvement of the MDRRMOs. But since the budget of the MDRRMOs is limited to only 5% of the entire municipal budget, it is a challenge for the MDRRMOs to allocate budget on the improvement of ICT resources since most of the budget allocated are geared toward disaster recovery and rehabilitation. Therefore, there is really a need to conduct a study to effectively identify the priority based on the needs of the MDRRMO and its stakeholders when it comes to upgrading/upscaling ICT infrastructure. Moreover, it is recommended to seek sources of funds from external institutions, non-government organizations in upgrading ICT infrastructure.
3. **Adaption** - MDRRMOs have a well established DRRM Plan and Contingency Plan. However, due to the limited budget of the office, MDRRMOs struggle to effectively implement the plan. Hence there is a necessity to create a strategy to adapt and properly implement LGU DRRM Plan and Contingency Plan despite limited budget. Therefore a benchmark study could be conducted to other municipalities/districts/provinces by the MDRRMOs and to establish a baseline and create strategy to effectively implement the DRRM Plan and Contingency Plan of their municipality.
4. **Upskilling** - Consider providing training and workshops to MDRRMOs workforce in the field of DRR as well as ICT since most of the members are fairly new in the field. MDRRMOs could collaborate with non-government organizations like CODE-NGO, Red Cross to conduct training and workshops, for example basic life support, on their staff and stakeholders. Furthermore, MDRRMOs could partner with the academe in promoting awareness as well as upskilling their staff in the field of Information and Communication Technology.
5. **Upscaling** - Prioritize upgrading ICT equipment since it is essential in the 4 thematic areas of DRRM

and establishment of DRRM Command Center with fully equipped ICT. In order to maximize the limited budget of the MDRRMOs, a study could be conducted to identify the priorities and needs of the municipality in ICT. A partnership with the academe and Department of Information and Communication Technology (DICT) could be formed to assist in the upscaling of ICT infrastructure.

V. CONCLUSION AND RECOMMENDATION

Conclusion

The purpose of this paper is to provide a concise overview of the utilization of information communication technology in disaster risk reduction management in the 4th district of Camarines Sur. From the perspective of Municipal Disaster Risk Reduction and Management Offices (MDRRMOs), critical areas of ICT, such as raising community awareness, providing data for disaster risk reduction planning, monitoring weather events, and issuing alerts and warnings, are critical for effective disaster management. The more IT-enabled MDRRMOs are, the more IT resources are required. MDRRMOs struggle to manage ICT resources. Collaboration with the academe, information technology professionals, government and non-government organizations (NGOs) is critical. Additionally, developing a holistic ICT utilization plan is necessary such as the proposed 3as2Us, as is determining how to utilize ICT resources.

Recommendation

Noticing this dilemma in practice, the researchers believe that studying disaster risk reduction management and information communication technologies can help Municipal Disaster Risk Reduction and Management Offices (MDRRMOs) improve their ability to utilize ICT resources in disaster management effectively. Since local governments are on the front lines of disaster preparedness and response. Moreover, the presentation of the result of this study as well as the proposed ICT utilization plan is recommended.

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