

“CRISIS MANAGEMENT: CASE STUDY OF NYIRAGONGO VOLCANO ERUPTION 2021 IN DEMOCRATIC REPUBLIC OF CONGO”

Research Paper

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Abstract

The current research explored various aspects that have shaped the crisis management of Nyiragongo volcano eruption 2021 in Democratic Republic of Congo (DRC). To do that, a survey was conducted to 5000 people from Goma city including Nyiragongo. Eleven aspects were addressed in this survey: Facts about Nyiragongo volcano environment and activity; preparedness and early warning system; contingency planning (emergency planning); security and political context; socio-economic realities; health situation and COVID-19; shelter, water, sanitation, and hygiene; communication; access and accessibility; community and national engagement; and international support. Although there is emergency planning for eventual volcano eruption in DRC; this research revealed that existing realities in the country made it so difficult to adapt it and implement it in the field. Armed conflicts, poverty, malnutrition, COVID-19; all these complex facts have contributed in the volcano crisis management 2021 in DRC. Therefore, this paper will be an important tool in developing an effective preparedness & response planning for potential volcano eruption. It will suggest also, an evidence-based source in volcano crisis management for tomorrow's workforce in DRC and worldwide.

Keywords: volcano eruption, Nyiragongo 2021, crisis management, aspects, preparedness, response.

1 Introduction

Mount Nyiragongo, active volcano in the Virunga Mountains of east-central Africa. It lies in the volcano region of Virunga National Park, near the border with Rwanda, 12 miles (19 km) north of Goma. Nyiragongo rises 11,385 feet (3,470 metres) high and has a main crater 1.3 miles (2 km) wide and 820 feet (250 metres) deep containing a liquid lava pool. Some older craters on the mountain are noted for their plant life (Rafferty, 2021). It was discovered in 1894 by the German explorer Count G. A. von Götzen (Sahama, Meyer, 1958, p.1).

Mount Nyiragongo erupted on 22 May 2021 at 19:00 local time near the city of Goma, (province of North Kivu) in the east of the Democratic Republic of Congo (DRC). Two lava streams emerged from the volcano at a height of 1,800 meters. One stream flowed east in the direction of Rwanda, while the other headed towards Goma, stopping 300 meters from Goma International Airport. 32 people died as a direct result of the eruption (either burned by the lava or asphyxiated by fumes), including three children (UNICEF, 2021). The official declaration of the volcanic eruption was released by the Military Governor of the Province of North Kivu and the volcanological Observatory of Goma who

have been coordinating the crisis response (ACT Alliance, 2021). Increased volcanic activity earlier this year suggested an eruption was possible, but the Goma Volcano Observatory's functions were hampered by funding cuts (Salazar, 2021).

450,000 people were displaced and evacuated after the Nyiragongo volcano erupts. The majority (over 80%) returned to their localities or neighbourhoods of origin. 4,051 households are currently living in collective centers and temporary sites. (IFRC, 2021). 3 health centres and 7 schools (five primary and two secondary schools) are destroyed. Other health and education services are affected due to the interruption of basic services like destruction of access roads, disruption of electricity and supply to markets (ACT Alliance, 2021). The volcano eruption damaged a critical water pipeline in Goma, cutting off access to potable water for 500,000 people (USAID, 2021).

According to a satellite image from 9 October 2021, the lava flows remain active and continue to fill the summit crater's lava lake. The lava returned to the crater 11 days ago and started to form the new lava lake (Martin, 2021). Celestin Kasereka Mahinda, the scientific director of the Goma Volcanology Observatory, said: "Today Nyiragongo found a way to breathe, which is a good sign," and he said also that "Fear would have persisted if the volcanic chimney remained blocked" from 18th September 2021, four months after the major eruption (Africanews, 2021).

As stated by the "Plan Urbain de Référence, Plans Particuliers d'Aménagement, Goma, 2021" which refers to the Urban Plan for Goma that was published in July 2021; the population of Goma is estimated around **1.039.966** and they are living at risk of volcano hazards. So, to prevent life losses, casualties, major damages, and global impacts on economies and services; it is vital to conduct researches on these phenomena and prepare for appropriate interventions.

Based on literature review, there are some studies on Nyiragongo volcano eruption that took place on 1977 and 2002. Relatively little has been written about volcano crisis management and the organizational aspects related to the response. Therefore, it is crucial to explore the current process of crisis management of 2021 Nyiragongo volcano eruption and attempts to find an answer to the following questions: What are the aspects that have shaped the crisis management of Nyiragongo volcano eruption 2021 in DRC? And how can DRC be better prepared for potential Nyiragongo volcano eruption? For now, there are some reports, articles, assessments that have been published on the event; but no academic research has been conducted on Nyiragongo volcano eruption of 2021.

2 Literature Review

Volcanic crisis management is a framework whereby scientists, emergency managers (civil protection), and communities work together to develop and implement a set of preparedness and response measures aimed toward the mitigation of the effects of an eruption. (Sigurdsson et al, 2015, p.1188). Additionally, we recognize that crisis management broadly captures organizational leaders' actions and communication that attempt to reduce the likelihood of a crisis, work to minimize harm from a crisis, and endeavour to re-establish order following a crisis (Bundy et al, 2016, p.1661-1692). While indicative of changes occurring in the volcanic edifice, they do not always lead to eruptions and may be unreliable as indicators of when an eruption may occur. They thus present a challenging environment for effective response, emergency management planning, and decision management (Doyle et al, 2014, p.62-72). This, together with the high social and economic cost of evacuation, makes volcanic crisis management extremely complex in areas of high risk (Marrero et al, 2012, p.33). A general methodology for management of eruptive crises is not available nor possible due to the great variety of situations deriving from differences in physical settings and, mainly, in social, cultural, economic, and political conditions. However, some basic components of the management plan can be identified, together with some steps necessary for its successful implementation. These steps result from the careful analysis of recent volcanic crises and the reasons for the success or failure of their management (Sigurdsson et al, 2015, p.1200).

There are probably millions of volcanoes that have been active during the whole lifespan of the earth. During the past 10,000 years, there are about 1500 volcanoes on land that are known to have been

active, while the even larger number of submarine volcanoes is unknown (Volcano Discovery, 2021). The Holocene is the most recent geological epoch spanning from about 11700 years ago to the present day (Peppoloni, Di Capua, 2012). Hereafter, few statistics from Smithsonian Institution's Global Volcano Program database of 15 October 2021:

- Volcanoes erupting now: 48
- Volcanoes that erupted during 2021: 69
- Volcanoes that erupted during 2020: 68
- Volcanoes with confirmed historical eruptions: 560
- Volcanoes with confirmed Holocene eruptions: 866
- Volcanoes thought to have Holocene eruptions: 1,357

Nyiragongo is known for its devastating eruptions. In 1977 some 2,000 people were killed, and in 2002 Goma was largely destroyed by lava, leaving more than 100,000 people homeless and creating a refugee crisis (Rafferty, 2021). In 2002, the UN reported 147 deaths (of whom 60-100 died in an explosion of the Goma central petrol station on 21 January) (Wunderman, 2002).

Following the eruption of the Nyiragongo volcano on 22 May 2021, Congolese authorities ordered the evacuation of 10 of Goma's 18 neighbourhoods. On 06 June 2021, IOM counted more than 400,000 displaced people internally as well as to Rwanda, including 160,000 people who have already returned. Certain businesses and services such as banks are closed and certain markets partially or totally interrupted, which particularly affects the informal sector on which many very poor and poor households depend. The volcano eruption damaged a critical water pipeline in Goma, cutting off access to potable water for 500,000 people (USAID, 2021). There are also reported cases of disturbance of public order including an increase in looting, crime, and many cases of family separation (UNICEF, 2021).

Livelihood activities have also been impacted due to the disruption in agricultural activities, farming, fishing, and other commercial activities resulting in a shortage of basic food stuffs. In addition, the families that have fled are completely reliant on government and humanitarian aid agencies for basics needs like food, water, and shelter (ACT Alliance, 2021).

The DRC Prime Minister, together with 12 ministers, met on 24 May 2021 with the Humanitarian Coordinator and the Humanitarian Country Team (HCT). The Government activated its contingency plan which highlighted the following priorities: shelter, opening the Rutshuru-Goma Road, tracing children and opening the Goma airport. Humanitarian actors have provided assistance areas of displacement, but this remains largely insufficient in view of the needs in WASH, shelter and food security in particular (OCHA, 2021).

High acute food insecurity in the DRC is estimated at 27.3 million (or 1 in 3 people), including nearly seven million people grappling with emergency levels of acute hunger. (*Integrated Phase Classification 4 (IPC4) analysis*, 2021). Between conflict, poverty, malnutrition and frequent disease outbreaks, humanitarian needs in the Democratic Republic of the Congo (DRC) are among the highest in the world. Such is their scale that the 2021 UN's Humanitarian Response Plan for the DRC requires more than €1.5 billion to meet the needs of vulnerable people. (*European Civil Protection and Humanitarian Aid Operations*, 2021).

The volcanic eruption comes at a time of acute ancillary humanitarian need in North Kivu and Ituri. A State of Siege was declared by the Government to be in force in the two provinces since early May. Some 44 per cent of the 5.04 million IDPs in DRC are currently located in North Kivu. 3.2 million people are already in dire need of food assistance in a province that has the highest protection incidences (5,856) in the country (OCHA, 2021).

In spite of sustained interest in exploring volcanoes from different perspectives, there are few studies that have examined aspects of volcano crisis management in DRC. Previous studies were focusing mainly on the activity of the volcano and damaged noticed on the ground such as: geological setting, lava flow, devastated infrastructure, and few others on the response, emergency planning and the impact of volcano eruption on the Congolese society. Crisis management has become an important

challenge for DRC authorities, considering the growing complexity of chronic and recent emergencies. Therefore, we have selected this topic of research in order to address undebated issues related to crisis management of Nyragongo volcano eruption 2021 and try to identify its constraints. Then, based on these findings, draw attention on recommendations for operational preparedness and response framework before a crisis emerges.

3 Methodological Research

The approach used in this research is based on exploratory sequential design and it combined qualitative and quantitative methods. To meet the objectives of this research, that aimed to identify aspects of Nyragongo crisis management 2021; a case study and survey are main tools to collect and analyse data. The first stage meant to explore past studies through literature review. At a second stage, a survey has been conducted over a questionnaire to 5000 people from Goma including Nyragongo territory. At third stage, the results of the questionnaire were statically analysed. The survey was carried out during three months from August to October 2021.

3.1 Area of research

The target area of this research is Goma. City of Goma, situated on the northern shore of Lake Kivu about 12 miles (19 km) south of Nyragongo (Nyragongo Volcano before the Eruption, 2001). Goma is the administrative capital of North Kivu province and a major urban centre in the Great Lakes Region. The city serves as an important economic and transportation hub that links eastern Congo to the broader East African sub-region. Goma shares a border with the Rwandan city of Gisenyi, and thousands of people cross each day. The city of Goma is divided into two communes, the Commune of Goma to the south and Commune of Karisimbi to the north. It has 18 neighbourhoods, and each has its own chief. Neighbourhoods' chiefs (chefs de quartier) are important partners for local-level response efforts in resource-poor neighbourhoods, and are well placed to provide access and information. (Peyton, Gercama, Bedford, 2019).

3.2 Population and sample

5000 is the number of targeted populations in our survey and it is also considered as the minimum sample size in a survey for academic research in DRC. To reach a wide range and variety of people including persons involved the Nyragongo volcano crisis response 2021; we have divided our survey in two categories: 1) population of Goma 2) actors involved in the response. Hence, each category got 2500 questionnaires. To reach our target, we got in touch with different stakeholders and entities living in the 18 neighbourhoods of Goma. Among these entities: National institutions, UN Agencies, National and International NGOs, United Nations Organization Stabilization Mission in the Democratic Republic of the Congo (MONUSCO) and donors operating in Goma.

3.3 Questionnaire

The draft survey questionnaire was subjected to testing for 30 volunteers through focus group discussions. In respect of COVID-19 prevention's measures, the testing was conducted for two separated groups of 15 adults from different backgrounds. The questionnaire was tested in French as it's the most common used language jointly with 4 other national languages. As a result of the testing, several items were modified accordingly.

The final questionnaire contained 12 sections: 1) personal information 2) facts about Nyragongo volcano environment and activity; 3) preparedness and early warning system; 4) contingency planning (emergency planning); 5) security and political context; 6) socio-economic realities; 7) health situation and COVID-19; 8) shelter, water, sanitation, and hygiene; 9) communication; 10) access and accessibility; 11) community and national engagement; and 12) international support. Each section has

4 questions with multichoice answers, except for section (1) related to personal information that has 8 questions.

3.4 Data collection

Two briefings were conducted to 30 volunteers prior to the study and immediately before the survey was launched. Interviewers were walked through each question from the questionnaire. They were also given instructions to have the consent of each individual before starting the interview and ensure accurate data collection. The written materials were provided prior to the beginning of the survey. Households, individuals and entities were selected at random bases from Goma area.

A combination of one-to-one interview, emailing and phone calls were used for data collection. The people interviewed were given the option to choose the way of completing the interview, whether directly in person, or by phone or via email. Most of the households have chosen one-to-one interviews and some others phone calls. In the other hand, people who worked for the volcano response have opted for emailing by keeping the anonymous profile.

3.5 Data analysis

Prior to data analysis, the primary data was gathered from different sources paper: survey, emails, and phone calls. Then it was compiled to an electronic file by using Microsoft Excel. During that exercise, we noticed that some values have been entered and did not make any sense for the questionnaire. Responses that appear to be entered in error have been flagged, reviewed more closely, and fortunately the correct response was available and replaced accordingly.

The summary statistics were analysed and presented by using Microsoft PowerBI. To ensure that the results were understandable to all participants of the survey and diverse readers, the preliminary summary statistics were outlined in tables and figures.

3.6 Research limitations

Due to the lack of previous academic researches on Crisis management of Nyiragongo volcano eruption 2021, it was difficult to find relevant information on this topic. The current research was conducted from August till October 2021, during that period preventing measures against COVID-19 were still in place. Hence, we couldn't make a focus group discussion for more than 20 people in same place; then we opted for other possible means like one-to-one interviews, emailing and phone calls. As some parallel roads were affected by volcano eruption, and people were moving to safer locations; it was difficult to have access directly to persons of concerns in some districts. Despite briefings and instructions given to interviewers, some questionnaires were filled in incorrectly in the beginning of the survey. Having observed this problem, we gave more detailed instructions to them and then they returned again to responders to fill the gaps; which was a time consuming.

4 Results

This research aimed at exploring the multiple aspects that have formed the crisis management of Nyiragongo volcano eruption 2021 in DRC, by studying the following features: 1) facts about Nyiragongo volcano environment and activity; 2) preparedness and early warning system; 3) contingency planning (emergency planning); 4) security and political context; 5) socio-economic realities; 6) health situation and COVID-19; 7) shelter, water, sanitation, and hygiene; 8) communication; 9) access and accessibility; 10) community and national engagement; and 11) international support. It aimed also to suggest avenues of solutions that can lead to better management for such crisis. To reach this goal, a survey was conducted in Goma town for 5000 people by using one-to-one interview to 3225 participants, emailing to 1175 participants and phone calls to 600 participants. 99% of the responders prefers to keep anonymous profile and only 1% have given their names. The main findings of this survey are summarized in the following illustrations:

1) Personal Information

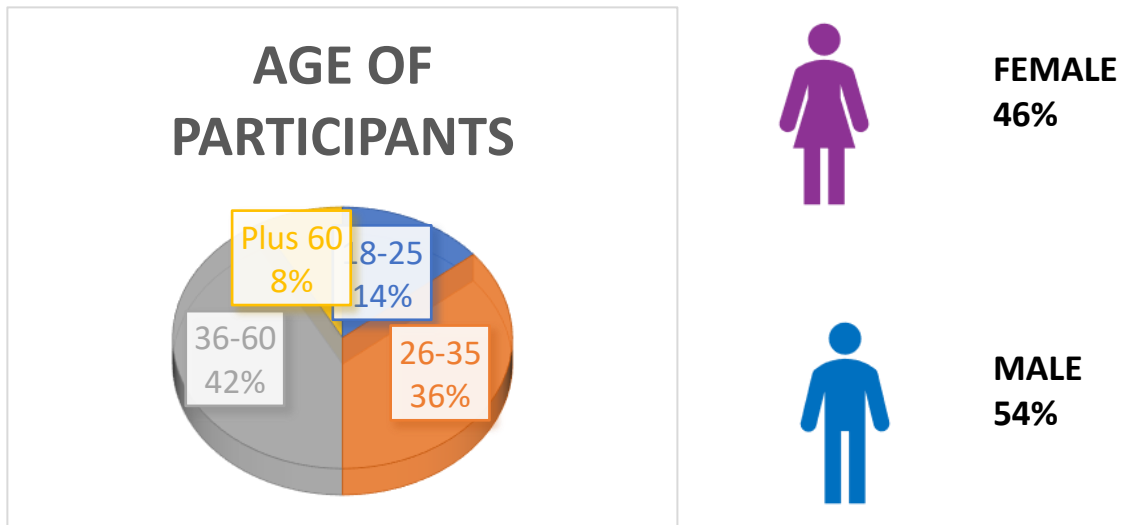


Figure 4. Response to questions about age and gender of participants

2) Preparedness and early warning system

Questions	Answers	In numbers	In percentage
1 Were you prepared for potential eruption of the Nyiragongo volcano?	Yes	11	0%
	No	4989	100%
2 Did you receive any training on what to do in case volcano eruption?	Yes	7	0%
	No	4993	100%
3 Were you alerted on time about the eruption of Nyiragongo volcano in order to protect yourself?	Yes	68	1%
	No	4932	99%
4 In your opinion, was there any monitoring of the Nyiragongo volcano before its eruption in May 2021, by L’Observatoire Volcanologique de Goma (OVG) or another institution?	Yes	13	0%
	No	3339	67%
	I don’t know	1648	33%

Table 1. Response to four questions about preparedness and early warning system.

3) Facts about Nyiragongo volcano environment and activity

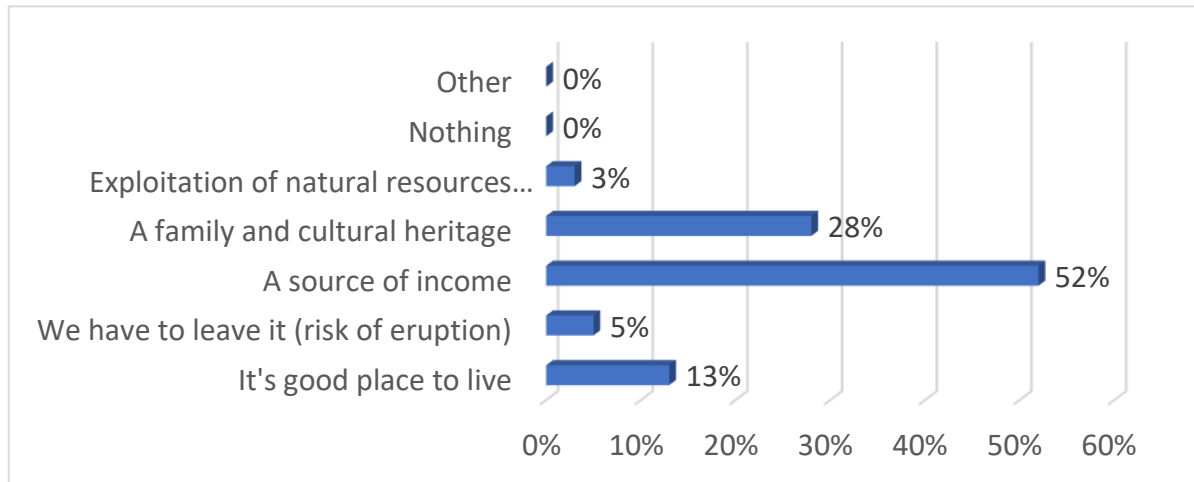


Figure 5. Response to question: What does the natural environment around the Nyiragongo volcano represent for you?

4) Contingency planning

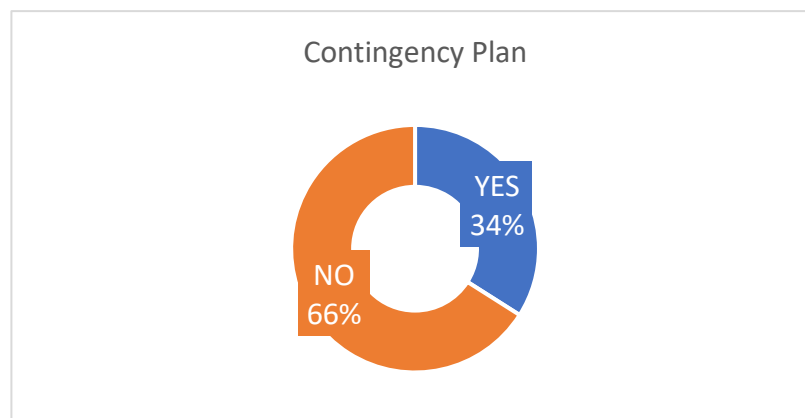


Figure 6. Response to question: Did you know that there is a National Contingency Plan in anticipation of volcanic eruptions in the DRC (2018-2022) for North Kivu in the DRC? (Emergency Plan)

5) Security and political context

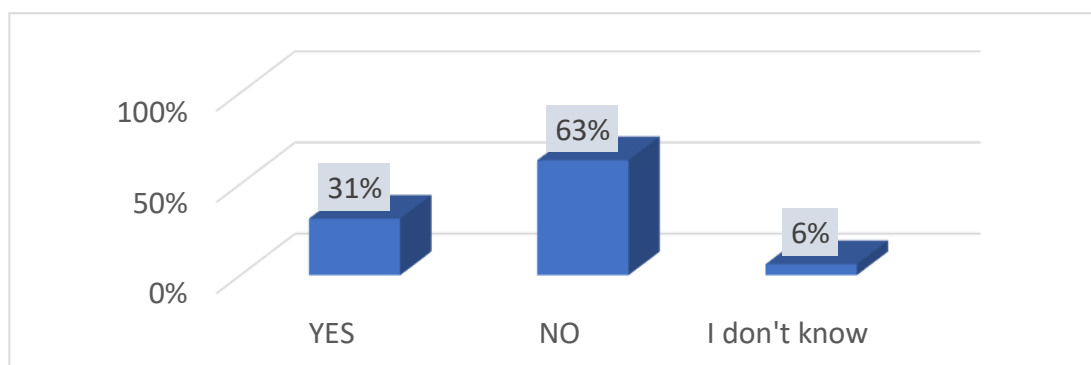


Figure 7. Response to question: Did you feel protected during and after the eruption of the Nyiragongo volcano?

6) Health situation and COVID-19

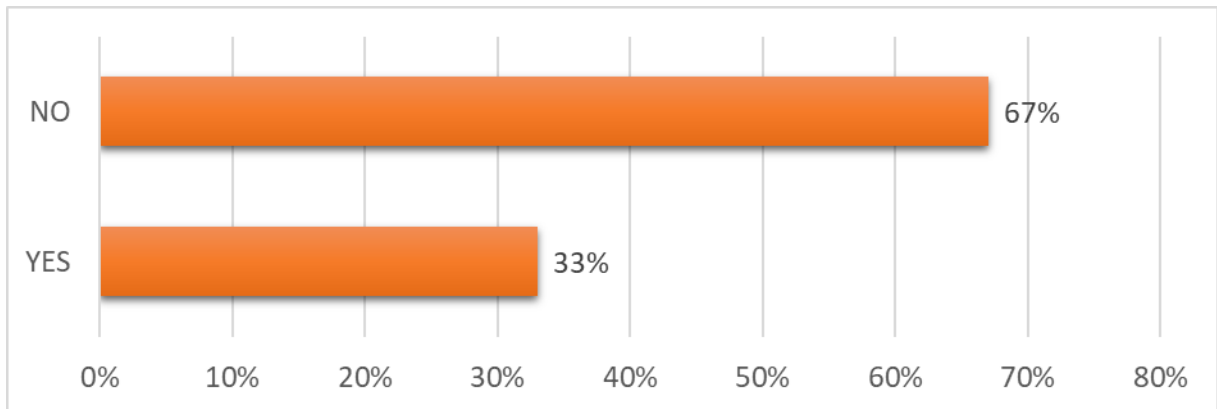


Figure 8. Response to question: Were you avoiding health services because of COVID-19?

7) Communication

Answers		In numbers	In percentage
1	Radio	27	1%
2	TV	104	2%
3	Earthquakes	54	1%
4	Red sky	1220	24%
5	Social networks	1492	30%
6	Lava flow	2080	42%
7	Publication of the Volcanological Center of Goma	23	0%
8	Other	0	0%

Table 2. Response to question: How were you informed about the eruption of the Nyiragongo volcano in May 2021?

5 Discussion & Conclusion

There are several aspects that have shaped Crisis Management of Nyiragongo Volcano Eruption 2021 in DRC. However, the main concern was that the “Observatoire Volcanologique de Goma (OVG)” that refers to Goma Volcano Observatory, wasn’t operational at time of eruptions due to lack of funding. As a result, OVG couldn’t provide early warnings of eruptions. So, the population of Goma didn’t have access to timely information and there has been exceptional uncertainty throughout about the progress of the still continuing eruption. Therefore, continuous support should be given to OVG, and more attention should be directed to volcano’s studies.

Contingency planning was previously developed for potential volcano eruptions; however, it wasn’t updated with accurate data related to new realities such as COVID-19 and conflicts. As Goma city is about 19 km far from the volcano, most income activities are around that area and was impacted by

volcano eruptions; especially those who rely on farming, tourism and other informal jobs. Meanwhile, insufficient priority was dedicated to reduce the economic and financial impacts of the eruption.

A multi-disciplinary team in national or local level should be put in place with sufficient delegated authority to coordinate and reinforce crisis management of such phenomenon. This team must include experts from different areas and communities' representatives together with NGOs and local institutions. Existing services in various sectors were already weakened by several episodes of Ebola, insecurity, displacement, malnutrition and COVID-19. And these services were exposed directly to assist people during volcano eruption without adequate materials or prior trainings to handle such situation. For that reason, it is highly recommended to strengthen the capacity of local services and promote preparedness and readiness actions for better response.

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