REPUBLIC OF RWANDA

POST DISASTER NEEDS ASSESSMENT AND RECOVERY PLAN

MAY 2021 RUBAVU DISTRICT SEISMIC DISASTERS

July 2021

Suggested citation

Post Disaster Needs Assessment and Recovery Plan for Rubavu District seismic disasters (2021), Government of Rwanda, July 2021.

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In collaboration with:

WB, UNDP and TROCAIRE which represented respectively Development Partners, UN Agencies and NGOs.

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CONTENT

ACKNOWLEDGEMENTS

On 22nd May 2021, Nyiragongo volcano erupted and earthquakes followed forcing around 21,000 people to cross to Rwanda for refuge. These damaged houses, various infrastructures in Rubavu District (roads, schools, hotels, shops, hospital, water supply system, etc), affected local communities, interrupted businesses and affected environment. However, rapid response interventions were deployed under the coordination of the Government of Rwanda with the participation of Rwanda Red Cross, Caritas Rwanda, Nyundo Diocese, UNHCR, etc.

In the aftermath of these events, from 7th to 12th June 2021, the Post Disaster Needs Assessment (PDNA) and Recovery Plan (RP) have been conducted to determine and quantify damages and losses associated to the disastrous situation with a view to have reference and options for building back better and ensure resilience.

The PDNA and RP document was produced by a multisector team composed of MININFRA, MoH, MINICOM, MINALOC, MoE, MINEDUC, MINECOFIN, MINEMA, RMB, RTDA, RHA, WASAC, REG, REMA, PSF, RRC, UR, INES and RUBAVU DISTRICT as well as WB, UNDP and TROCAIRE which represented respectively Development Partners, UN Agencies and NGOs.

Our sincere gratitude and appreciation are extended to all institutions and partners that supported all response efforts after the volcanic eruption and earthquakes. And special thanks are drawn-out to the team that developed the present Post Disaster Needs Assessment and Recovery Plan.

We look forward to collective efforts and commitments from all concerned institutions and partners to enable the effective implementation of the recovery plan to reduce shocks/impact to the affected communities and continue building a resilient nation.


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ABBREVIATIONS AND ACRONYMS

CS: Centre Scolaire
DRC: Democratic Republic of Congo
DRM: Disaster Risk Management
ES: Ecole Secondaire
Frw: Rwandan Francs
GS: Groupe Scolaire
GVO: Goma Volcano Observatory
Ha: Hectare
HHs: Households
HRZ: High Risk Zones
INES: Institut des Sciences Appliquées de Ruhengeri
LKMP: Lake Kivu Monitoring Programme
MINALOC: Ministry of Local Government
MINECOFIN: Ministry of Finance and Economic Planning
MINEDUC: Ministry of Education
MINEMA: Ministry in Charge of Emergency Management
MINICOM: Ministry of Trade and Industry
MININFRA: Ministry of Infrastructure
MoE: Ministry of Environment
MoH: Ministry of Health
NFIs: Non-Food Items
PDNA: Post Disaster Needs Assessment
PSF: Private Sector Federation
REG: Rwanda Energy Group
REMA: Rwanda Environment Management Authority
RHA: Rwanda Housing Authority
RLMUA: Rwanda Land Management and Use Authority
RMB: Rwanda Mines and Petroleum and Gas Board
RP: Recovery Plan
RRC: Rwanda Red Cross
RSA: Rwanda
RTDA: Rwanda Transport Development Agency
UR: University of Rwanda
WASAC: Water and Sanitation Corporation

LIST OF TABLES

EXECUTIVE SUMMARY

In the aftermath of Nyiragongo eruption and earthquakes that affected Rubavu District, the Government of Rwanda conducted the Post Disaster Needs Assessment to value physical damages and economic losses as well as costs of meeting recovery needs.

The exercise assessed emergency response activities provided by various government and partners institutions. Those include provision of relief (food and nonfood items) to both displaced Congolese and affected local communities, provision of emergency health services, evacuation of essential services and people exposed to high risks; initial rehabilitation of essential infrastructure (access roads, water supply); ensure security and public order; continuous risk monitoring and provide information to the public for safety. The cost of response interventions was considered as an encountered loss since without the disaster incident these expenses could not have been engaged.

The risk information available played a key role in the development of Post Disaster Needs Assessment (PDNA). The risk monitoring and surveillance highlighted the background on the hazard, exposure, vulnerability to volcanic eruption, seismic activities, interventions with associated cost and recommendations to build resilience.

Earthquakes decreased significantly after 10 days to normal seismic activities. However, the rifting activities can generate earthquakes from active faults. Existing scientific data are not indicating any possibility of eruption beneath the lake and/or through the fissures. Lake Kivu/Gas outburst is less likely to happen due to the water volume and the permanent stratification stability of the lake. Recorded air quality data in Rubavu comparing pre and post eruption indicated normal trend. However, ash fall from eruption were observed shortly after the eruption and did not pose any significant side effects.

Basing on the above, the following risks have been identified:

- Collapse of public facilities located in the created and aggravated faulting cracks (e.g. Gisenyi hospital, 7 schools, business center and occupied residential houses) associated with possible human losses and injuries if the country faces heavy seismic activities or another volcanic eruption;
- Water born diseases' outbreaks resulting from underground settings such as roads, water pipes, other waste facilities damaged;
- Increase of vulnerability of residential houses and facilities in Rugerero Sector, Rwaza Cell deeply affected due to their position and location vis-à-vis Mont Rubavu made of granite;
- Low level of preparedness due to limited scientific knowledge and tools for monitoring and surveillance of future volcanic/seismic associated risks as well as their impact.

The multisector team determined the impact and the cost of the post volcanic eruption and earthquakes effects on various sectors especially housing, transport and water supply and treatment infrastructure, education, health, trade and business, environment, human and social impact and determined needs for recovery and resilience.

The total estimated cost of effects of volcanic eruption and earthquakes (damages and losses including cost of response provided) is 36,650,606,036 Frw while the recovery needs would cost 91,430,692,055 Frw. Note that recovery needs consider both needs for recovery and requirement for resilience to future similar events.

The recovery plan provides urgent interventions, required investments and also an implementation framework to ensure effective coordination and harmonization.

The effects and needs per sector are summarized in the table below.

Table 1: Summary sector effects and needs

Sector	**Effects (Frw)**	%	**Recovery needs (Frw)**	%
Social protection (assistance)	457,355,400	1.25	605,300,000	0.66
Transport	1,779,559,165	4.86	19,745,000,000	21.60
Water	127,257,217	0.35	15,820,000,000	17.30
Risk management	13,651,500	0.04	2,131,610,785	2.33
Environment	23,161,900,000	63.20	39,840,000	0.04
Health	45,696,072	0.12	1,961,508,670	2.15
Education	39,830,682	0.11	-	
Housing infrastructure	10,547,750,000	28.78	47,101,023,600	51.52
Trade	477,606,000	1.30	4,026,409,000	4.40
Grand total	**36,650,606,036**	**100**	**91,430,692,055**	**100**

As a way forward, the team proposed:

1. Temporary rehabilitation and gradual relocation of damaged houses, public facilities particularly those located in the identified red zone of cracks;
2. Quick repair of water supply systems in Rubavu City and surrounding areas;
3. Assessing and control of potential water borne diseases and other human health effects related to volcanic eruption and earthquakes;
4. Conduct an extensive study to determine the extent of cracks, fissures and related risks;
5. Build the Country's capacity so as to increase our level of monitoring and preparedness as well as resilience to volcanic eruption and seismic activities;
6. Mobilization of resources for recovery and resilience.

1. INTRODUCTION

Rwanda is prone to a variety of natural and man-made disasters. These disasters cause physical, socio-economic and environmental damages and losses. The major disasters that cause huge impacts in Rwanda include mainly hydro-meteorological disasters. However, Rwanda is also prone to hazard, exposure and vulnerability to volcanic eruption and seismic activities.

The development of PDNA and Recovery plan is in accordance with the Government of Rwanda's vision to build a disaster resilient nation and safer communities. Therefore, the effective implementation of the recovery plan will ensure assistance to affected people, reconstruction and build back better of the affected areas, as well as building the national capacity for preparedness and resilience to future natural disasters.

1.1. OBJECTIVES OF THE PDNA AND RECOVERY PLAN

The general objective of conducting a post disaster needs assessment in Rubavu was to determine and quantify damages and losses associated to the volcanic eruption and earthquakes with a view to have reference and options for building back better and ensuring resilience.

Specific objectives include:

- Assessing and costing damages and losses;
- Costing recovery needs;
- Prioritizing and proposing areas of focus in recovery and reconstruction;
- Producing a fund mobilization tool for the building better plan**.**

1.2. EXPECTED RESULTS:

- PDNA for housing, infrastructure (roads, water supply systems, health facilities, schools, administration) and environment sectors detailing the effects, the impact and loss in monetary terms consolidated;
- Recovery plan with detailed requirements and prioritization.

1.3. METHODOLOGY

While developing the PDNA and the recovery plan, the following methodologies were used:

- Use of primary data collected by Rubavu District staff and some technical institutions;
- The multisector team collected additional data and information to complement primary data;
- Analysis of damages and losses;
- Discussions and exchange between various sectors and the District to improve and adjust to the situation;

- Damages and losses determination: Damages are the physical impact suffered due to the disaster event. They are determined by either the cost of damages, the replacement cost and the value of future missed use. Loss is the cost suffered by not benefiting or using the affected element in the past or the expenses that were triggered by the incident that wouldn't be there without the impact;
- Costing was done through combining different methods but especially:

  Comparative: Replacement costs of a given element were compared with a similar element recently built (Ex: Hospital, health center, schools, …);

  Calculation: Wherever possible required interventions were calculated using unit prices observable on the market;

  Estimation: Estimation based on the value and the actual value of the element was used.

However, some budgets will require more analysis to establish needs, details on specifications to consider the proposed budget as final (E.g., geosciences studies).

2. FINDINGS

2.1. HOUSING

Housing considered private and public buildings destroyed or partially damaged, Gisenyi hospital, six schools most affected by faulting cracks and destroyed/damaged houses from different Sectors of Rubavu District.

While damages were estimated at 10,547,750,000 Frw, recovery needs that consider resilience and building back better accounts for 47,101,023,600 Frw. Below table provides details on damages on housing infrastructure.

Table 2: Damages - housing infrastructures

S/N	Building category	Grand total
1	Damages on residential houses	5,702,850,000
2	Damages on health facilities	1,356,750,000
3	Damages on schools' facilities (classrooms rooms, dormitory, offices, kitchen and toilets)	1,998,150,000
4	Damages on government buildings	266,250,000
5	Damages on private/commercial	1,220,000,000
6	Damages for churches	3,750,000
Total		**10,547,750,000**

The cost of recovery needs shall cover reconstruction and rehabilitation of houses; relocation of houses from high risk or affected zones; reconstruction of health and education infrastructure, capacity building and training of communities in safer housing construction; temporary shelter provision, household equipment and updating the hazard and risk maps and standards related to seismic risks resilience.

The table below highlights summary recovery needs for the housing sector.

Table 3: Recovery needs in housing infrastructures

S/N	Interventions	Qty	Unit Cost	Total Cost (Frw)
1	Relocation and construct resilient houses by using treated timber for 303 affected families (located on fault line zone and other HRZ)	303	7,578,900	2,296,406,700
	Relocation and construct IDP model village for 303 affected families (located on fault line zone and other HRZ)	303	40,000,000	12,120,000,000
2	Construction of resilient houses in treated timber of Category (cat) 1&2 for 1,331 families located in Rwaza Cell, Rugerero Sector.	1,331	6,774,900	9,017,391,900
	Option of relocation and construction of resilient houses in treated timber of Cat 1,2,3&4 for 1,841 families located in Rwaza Cell, Rugerero Sector	1,841	7,578,900	13,952,754,900
3	Urbanization of site in Rwaza Cell, Rugerero Sector (providing and installation of main infrastructure: Roads, Water, electricity etc.)	1	12,000,000,000	12,000,000,000
4	Relocation and construction of Gisenyi Hospital	1	20,000,000,000	20,000,000,000
5	Relocation and construction of 4 Public and Government aided schools (Relocation of developments from the fault line: ES. GISENYI, CS GACUBA II C, GS MUHATO, CS RUBONA)	4	900,000,000	3,600,000,000
6	Repairing and retrofitting of 20 Public schools	20	150,000	3,000,000
7	Repair of light and medium damages for Gisenyi District Hospital (Retrofitting of chirurgical building and ARV, Relocation of oxygen plant, Relocation of hospitalization house for prisoners, Relocation of mortuary house, Relocation of generator houses)	1	175,375,000	175,375,000
8	Repair of light and medium damages for Byahi Health Center, Gacuba Health Center, Gacuba Health Post, Murara Health Center, Nyarubande Health Post	5	1,770,000	8,850,000
Total				**47,101,023,600**

2.2. WATER INFRASTRUCTURE AND SUPPLY

Water infrastructure was hit in transmission, distribution and service pipelines that resulted into leakages and losses estimated at 127,257,217 Frw (43,183,208 Frw incurred during quick fix and estimated loss of 84,074,009 Frw).

Damages were as follows:

1) **Water transmission**

   - Gihira - Murakazaneza
   - Gihira - Rwaza
   - Rwaza - City of Rubavu
   - Murakazaneza - Mbugangali area

2) **Water distribution**

   - Supply to the city: 63% damaged & 34 leaks
   - Supply to Mbugangali area: 52%damaged & 23 leaks
   - Supply to Rugerero area 23% damaged & 16 leaks
   - Supply to Nyamyumba area 10% damaged & 12 leaks

3) **Service water pipelines to customers**

   78% affected & 187 leaks, especially in Mbugangali

The required recovery cost and for resilience to seismic shocks is estimated at **15,820,000,000 Frw** and should cover:

- Repair of damaged water pipelines
- Rehabilitation of the damaged and old water pipelines using adaptive/resilient materials
- Alternatives:
  - Interconnection for water pipelines from Gihira Water Treatment Plant (WTP);
  - Mobile water treatment plant.

2.3. TRANSPORT INFRASTRUCTURE

Roads especially urban roads in Rubavu City were highly affected by the cracks resulting from earthquakes. The incurred damages and losses are estimated at 1,779,559,165 Frw (190,059,165 incurred during quick fix and 1,589,500,000 as estimated loss).

The identified effects are the following:

- Junction NR 2 – Gisenyi Hospital around the monument;
- The connection coming from Musanze to Gisenyi Hospital;
- The extension of the ramp to Gisenyi Hospital near the former access to the hospital (Nengo Cell);
- Rubavu Urban Road, Gisenyi Sector, Nengo Cell. At the junction connecting the road from Nyirinkwaya Clinical (or Catholic Church) and the road going to Gisenyi Hospital;
- Rubavu Urban Road, Gisenyi Sector, Nengo Cell. Near Rubavu market and Kobil station;
- Rubavu Urban Road, Gisenyi sector. At junction near Rujende Bus station;

- Rubavu Urban Road. Road coming from ADEPR to Rubavu Bus Station and Petite; Barriere (ADEPR Rubavu). About 1,9 km from Petite Barrière;
- At Buhuru Center Umuganda Stadium Urban Road, at 0+250 of the new and ongoing road;
- Rubavu Urban road - at Petite Barrière - Karundo Center Road, PK 2+300 new and ongoing road;
- Road Marine at PK 4+300 (New Road and ongoing road);
- Mbugangari roads: around 3Km were affected in different sections.

The required recovery cost for roads and bridges to make them resilient to seismic shocks is estimated at 19,745,000,000 Frw.

- Repair works of 12 damaged road sections;
- Alternative roads;
- Bypass road from Rugerero – Magengo (13km) – Short term solution;
- Upgrading & rehabilitation of NR (Rubavu-Busasamana-Kabuhanga (32km) – Long term solution;
- Rehabilitation and upgrade of Brasserie- Nkora – 21 km (DR22 & 31) – Long term solution.

The Rubavu Airport was also affected. The feasibility study for required repair and upgrade was estimated at 350,000,000 Frw

2.4. TRADE AND BUSINESS

The flow of businesses in Rubavu City was affected by earthquakes due direct physical effects and resulting panic. The total effects are estimated at 501,606,000 Frw and needs for recovery at 4,926,409,000 Frw. The two tables below provide details:

Table 4: Damages and losses for the trade and business sector

S/N	Sector affected / damages and losses	Cost (Frw)
1	Damaged perishable products for export	440,000
2	Transporters (Bicycles & RIFFAN)	19,373,000
3	Lost earnings from disrupted informal export trade and Casual laborers	49,000,000
4	Non-payment for small scale traders who supplied in Goma/DRC	113,750,000
5	Damaged goods in Warehouses and cost of relocation of stocks in warehouses	229,335,000
6	Local markets, abattoirs and butchery	41,908,000
7	Hotels and Guest houses services	47,800,000
Total		**501,606,000**

Table 5: Recovery and resilience needs for trade and business sector

S/N	Needs	Quantity	Cost (Frw)
1	Construction of Cold room	1	1,500,000,000
2	Awareness creation on DRM, Insurance and recovery funds	-	10,000,000

3	Establish business recovery/emergency fund in collaboration with PSF	-	716,409,000
4	Relocation of three private schools (ESFB, IP Gisenyi and College Baptiste) located in fault lines	3	2,700,000,000
			4,026,409,000

2.5. HEALTH AND SANITATION

The health sector is among the most hit sectors as the main facility that provides health services in Rubavu. Gisenyi District Hospital was severely damaged and it made health services' delivery flow halt. The total effects were estimated at 45,696,072 Frw while the recovery needs are estimated at 1,961,508,670 Frw.

The main losses recorded were Health services provided to displaced Congolese and Cost for patients and medical staff transferred to other health facilities.

Key recovery needs identified include:

- The relocation of Gisenyi District Hospital;
- Upgrading Kabali health center in Rubavu to serve as back up;
- Psycho-social support for affected people;
- Regular water and air quality testing and surveillance;
- Hygiene and sanitation behavior change campaigns;
- Provision of hygienic, bed and kitchen kits to affected vulnerable households.

The table below summarizes effects and needs for the health and sanitation sector

Table 6: Summary of effects and recovery needs

S/N	Sector effects	Description	Total effects (Frw)	Recovery needs (Frw)
1	Damages on Gisenyi hospital premises		Counted in housing	Counted in housing
2	Kabali backup Health Center	- Buildings, materials and advanced services with specialists.	-	1,500,000,000
3	Hygiene campaigns.	- Hygiene campaigns - Hygiene items to affected HHs (2,654)	-	310,327,050
4	Risk assessments	- Water & air quality, - Health & waste management	-	50,172,500
5	Psycho-social support	- Trainings and counselling exercises.	-	101,009,120
6	Unplanned expenses	- Assistance to displaced Congolese	45,696,072	-

		- Patients and medical staff transfer to other health facilities. - Covid-19 tests		
	TOTAL		**45,696,072**	**1,961,508,670**

2.6. ENVIRONMENT

The total effects were estimated at 23,161,900,000 Frw. The damage suffered by the sector included damages to the land covered by the lava, the surface affected by the cracks (8 km long with a width ranging between 40 and 60 meters) and crops on 5 hectares destroyed by the lava. The total affected area is 365 hectares. The table below highlights the summarized effects of environment sector.

Table 7: Effects on environment sector

S/N	Item	Quantity	Cost (Frw)
1	Land covered by lava	5ha	125,000,000
2	Damaged crops	20,000 kg (2,250 kgs of beans and 17,750 kg of potatoes	6,900,000
3	Cracked land in fault zone	40 ha	7,000,000,000
4	Shaked land in Rugerero	320.6 ha	16,030,000,000
Total			**23,161,900,000**

The total recovery needs are estimated at over 39,840,000 Frw including the required demarcation of the high-risk zones, updating Rubavu District Land Use and Master Plans and planting the trees around the cracked areas while studies to determine appropriate measures are underway. The table below shows the needs description.

Table 8: Recovery and resilience needs for the environment sector

S/N	Item	Quantities	Cost (Frw)
1	Demarcation of high-risk zone	Benchmarks (328) including manpower and surveying	9,840,000
2	Updating Rubavu District Land Use and Master Plans	2 months joint workshop	30,000,000
Total			**39,840,000**

2.7. EDUCATION

Education infrastructure was deeply affected by the earthquake, resulting in heavy disruption of education service provision. Six (6) schools were mostly hit and 4 totally closed as they are crossed by a widening crack. The total effects on education infrastructure are estimated at 1,998,150,000 Frw. Damages include cracked classrooms, dormitories, kitchens, latrines and fences. The continuous expenses (losses) on relocated students are estimated at 39,830,682 Frw calculated for two (2) months and needs for recovery, mostly relocation, are 8,896,303,000 Frw.

Table 9: Effects and needs for the education sector

S/N	Sector effects	Quantities	Total effects (Frw)	Sector recovery needs	Cost of recovery needs (Frw)
1	Awareness Campaign	- 60 radios - announcement - 30 days awareness by Executive cell secretary	13,697,400	Relocation and reconstruction of six schools	(8,896,303,000[1])
2	Transport (Food and Students) for 2 months	- For 60 days (2months) - 178 students to access labs	10,050,000	-	
3	Provision of hygienic items	- 6 water tanks & - 6 hand washing facilities	16,083,282	-	
	Total		**39,830,682**		**(8,896,303,000)**

2.8. RISK MANAGEMENT

Losses for the risk management takes into consideration cost that was used for risk monitoring (geologists for volcanic eruption and seismic activity and environmentalists for air quality) by experts from RMB, REMA, MINEMA and other agencies and counts 33,444,000 Frw. The following table provides the related information.

Table 10: Summary losses related to risk monitoring

S/N	Item	Quantities	Cost (Frw)
1	Facilitation of risk assessment teams made of geologists for volcanic eruption and seismic activity and environmentalists for air quality	Logistic facilitation for REMA/LKMP RMB, and RHA and MINEMA	6,240,000
2	Facilitate risk assessment teams made of geologists for volcanic eruption and seismic activity and environmentalists for air quality	Logistic facilitation for REMA/Air quality unit staff and equipment	7,411,500
3	Cost for facilitation of other interventions teams	Logistic facilitation for institutions that participated in PDNA and recovery development as well as other response interventions	19,792,500
Total			**33,444,000**

To ensure resilience, risk management technical institutions will need to conduct comprehensive geo-scientific investigation and assessment, study on Lake Kivu to strengthen its monitoring including but not limited to the gas partial pressure measurement, regular

[1] The amount is captured under housing infrastructure

technical, inter-sectoral, and regional collaboration forum. At least two scientific focal points should be appointed to collaborate with OVG. More recommendations include the revision of Rwanda urban and building code to guide adaptation/resilience in Kivu Belt/ western province near the rift border faults, acquire Risk surveillance/Monitoring equipment and deploy a dedicated technical team for continuous monitoring. The listed interventions for resilience will require 2,131,610,785 Frw as highlighted in the table below.

Table 11: Proposed recovery and resilience interventions

S/N	Item	Quantities	Cost (Frw)
1	Geo-scientific investigation and assessment	One study covering geological, geophysical, geotechnical, geochemical and geodesy aspects	500,000,000
2	Study on Lake Kivu to strengthen its monitoring including but not limited to gas partial pressure measurement	1 comprehensive study	500,000,000
3	Operation cost for the Joint Technical Teams and concerned 5 Districts	4 quarterly joint assessments and consultation meetings	60,000,000
4	Facilitate country representative in GVO	2 staff for one year	64,160,000
6	Revision of Rwanda Urban and Building code to guide adaptation/resilience in Kivu Belt/ western province near the rift border faults	-5 Consultation meetings -3 Validation workshops -4 Field assessments -Consultancy firm hiring	150,000,000
7	Acquire Risk surveillance/Monitoring equipment	-Equipment: 685,450,785 -Technical trainings: 60,000,000 -Expertise and installation: 100,000,000	845,450,785
8	Update National Volcanic eruption and Earthquake Contingency Plan	2 workshops and 1 validation meeting	12,000,000
Total			**2,131,610,785**

2.9. HUMAN IMPACT, LIVELIHOOD AND SOCIAL ASSISTANCE

The earthquake has caused no death and minor injury of one person. This was due to community awareness and education (to evacuate from buildings and houses) and keep applying safety measures. However, due to the effect on the business continuity to damages and losses on houses and to the panic provoked by the sustained tremors, 4,349 families were in need to social assistance especially food, non-food items and emergency shelter to name a few. Similar assistance was provided to the population displaced from DRC.

The budget used for the provision of humanitarian assistance was estimated at 457,355,400 Frw while needs for resilience are 605,300,000 Frw. The table below provides details for effects and needs for recovery and resilience

Table 12: Social assistance effects and recovery needs

SOCIAL ASSISTANCE EFFECTS AND RECOVERY NEEDS		
	Item	**Cost (Frw)**
DAMAGES AND LOSSES	Cost of food items	124,808,200
	Cost of NFIs	99,312,000
	Emergency expenditures	30,183,600
	Assistance to DRC displaced population Refugees	128,701,600
	Renting (Emergency phase)	53,850,000
	Facilitate emergency operations	20,500,000
	TOTAL	**457,355,400**
RECOVERY AND RESILIENCE NEEDS	NFIs	532,400,000
	Renting (Post emergency phase)	60,300,000
	Operations	12,600,000
	TOTAL	**605,300,000**

2.10. PDNA AND RECOVERY NEEDS

The Post disaster need assessment (PDNA) estimated the total effects of the May 2021 seismic incidents in Rubavu District at 36,650,606,036 Frw with the affected land accounting for 63%, housing 29%, transport and water supply and treatment infrastructure 5%. The recovery needs for all sectors are estimated at 91,430,692,055 Frw with 51.5% for housing sector and 38.9% for transport and water infrastructure. Below is the recapitulation of effects and needs for all sectors.

Table 13: Effects and needs for all sectors

Sector	**Effects (Frw)**	**%**	**Recovery needs (Frw)**	**%**
Social assistance	457,355,400	1.25	605,300,000	0.66
Transport	1,779,559,165	4.86	19,745,000,000	21.60
Water	127,257,217	0.35	15,820,000,000	17.30
Risk management	13,651,500	0.04	2,131,610,785	2.33
Environment	23,161,900,000	63.20	39,840,000	0.04
Health	45,696,072	0.12	1,961,508,670	2.15
Education	39,830,682	0.11	-	-
Housing	10,547,750,000	28.78	47,101,023,600	51.52
Trade	477,606,000	1.30	4,026,409,000	4.40
All sectors	**36,650,606,036**	**100.00**	**91,430,692,055**	**100**

2.11. PRIORITY INTERVENTIONS

Though all the interventions listed above are very important to ensure full recovery and resilience for the district and the country in general, however some interventions have to be considered as imperatives for safety and for sector business continuity in short and mid-term. The following table provides the lists of interventions selected as priorities across all sectors

Table 14: Top priority across sectors

S/N	Sector	Intervention	Cost (Frw)
1.	Housing	1. Relocate and construct resilient houses by using treated timber[2] for 303 affected families (located on fault line zone and other HRZ)	2,296,406,700
		2. Construction of resilient houses in treated timber of Cat 1&2 for 1,331 families located in Rwaza Cell, Rugerero Sector.	9,017,391,900
		3. Relocation and construction of Gisenyi Hospital	20,000,000,000
		4. Relocation and construction of 4 Public and Government aided schools (Relocation of schools from the fault line: ES. GISENYI, CS GACUBA II C, GS MUHATO, CS RUBONA)	3,600,000,000
		5. Repair of light and medium damages for Gisenyi District Hospital (Retrofitting of Chirulgie and ARV., Relocation of Oxygen Plant, Relocation of Hospitalization House for prisoners, Relocation of Mortuary House, Relocation of Generator houses)	175,375,000
		6. Repair of light and medium damages for Byahi Health Center, Gacuba Health Center, Gacuba Health Post, Murara Health Center, Nyarubande Health Post	8,850,000
2.	Transport infrastructure	7. Repair works of 12 damaged road sections	190,059,165
3.	Water infrastructure	8. Repair of damaged water pipelines	800,000,000
4.	Risk monitoring	9. Geo-scientific Investigation (detailed geological, geophysical, geotechnical, geochemical, geodesy), and assessment	500,000,000
		10. Study on Lake Kivu to strengthen its monitoring including but not limited to the gas partial pressure measurement	500,000,000
		11. Deployment of two (2) scientific focal points to work closely with OVG	64,160,000
		12. Acquire Risk surveillance/Monitoring equipment	845,450,785
5.	Environment	13. Physical demarcation of red/High risk zone	9,840,000
		14. Revision of Rubavu secondary City Land use and Master Plan to consider geo-hazards features.	30,000,000
6.		15. Construction of Cold room	1,500,000,000

[2] Using the IDP model village would cost 12,120,000,000 Frw for the 303 and over 53 billion for the 1,331 families in Rugerero.

	Trade and Industry	16. Establish business recovery/emergency fund	716,409,000
		17. Relocation of three private schools (ESFB, IP Gisenyi and College Baptiste) located in fault lines	2,700,000,000
7.	Health and Sanitation	18. Upgrading Kabali Health Center	1,500,000,000
		19. Water borne diseases risk assessments	50,172,500
			Total: 44,504,115,050

ANNEXES OF SECTOR DETAILED PDNA REPORTS AND RECOVERY PLAN

ANNEX 1: HOUSING INFRASTRUCTURE

1. Pre and post disaster context

The District of Rubavu lies on the shores of Lake Kivu in the western region of Rwanda close to the Albertine rift valley surrounding the Volcano ranges.
Its geographic location and related features such as Lake Kivu helps the District to be a business and tourism hub (especially through cross border trade with DRC).

However, most of the housing infrastructure in Rubavu District are constructed without considering earthquake impact, leading to be more vulnerable to tremors. Few hours after Nyiragongo eruptions, series of earthquakes were felt and affected mostly Rubavu District.

2. Damages on housing

The damages for buildings occurred in form of complete building/houses collapse, failure of main building structures, and collapse or development of cracks in walls. In total 2,990 houses/buildings were affected in Gisenyi, Rubavu, Rugerero, Nyamyumba and Cyanzarwe Sectors of Rubavu. The breakdown is described in the table below:

Table 1: Description of damages recorded on housing infrastructure

S/N	Building Category	Severe	Medium	Light	Total
1	Residential	1,920	587	147	2,654
2	Private/Commercial	20	55	209	284
3	Schools (classrooms rooms, dormitory, offices, Kitchen and toilets)	7	0	21	28
4	Churches	0	3	0	3
5	Health facilities	1	0	5	6
6	Government Buildings	0	2	13	15
Total		**1,948**	**647**	**395**	**2,990**

The following map shows 3 high risk fault line zones created by seismic activities

The following table in continuation with the above, provides cost estimate of the damages recorded to the housing infrastructure.

Table 2: Estimated cost for houses/buildings damages

S/N	Building Category	Severe	Medium	Light	Grand total
		Sub-total	Sub-total	Sub-total	
1	Residential	4,800,000,000	880,800,000	22,050,000	5,702,850,000
2	Private /Commercial	714,000,000	192,500,000	313,500,000	1,220,000,000
3	Schools (classrooms rooms, dormitory, offices, kitchen and toilets)	1,932,000,000	0	66,150,000	1,998,150,000
4	Churches	0	3,750,000	0	3,750,000
5	Health facilities	1,350,000,000	0	6,750,000	1,356,750,000
6	Government Buildings	0	250,000,000	16,250,000	266,250,000
Total		**8,796,000,000**	**1,327,050,000**	**424,700,000**	**10,547,750,000**

3. Housing infrastructure recovery needs

a) Status

Recovery related activities done from May 22, 2021 up to date

- Assessment of 2,990 affected buildings in 5 Sectors;
- Renting houses for severely affected households;
- Gisenyi Referral Hospital has returned back operational.

b) Issues and challenges

- Families affected started to rehabilitate their houses without technical guidance;
- Lack of financial support for reconstruction/rehabilitation, plot acquisition for vulnerable people whose houses were damaged;

4. Principle, options and proposed solutions for housing recovery

All buildings should be located in safe places and structurally stable enough to resist earthquakes.

Options for recovery:

a) Measures

- New buildings should consider earthquakes as per Rwanda Building Code 2019
- Repair/retrofitting of damaged buildings: Before any repair/retrofitting, assessment should be directed by a qualified structural engineer. The priority repairs should be to the main structural elements before embarking on any non- structural repairs (cracked walls, falling plaster from walls and ceilings, rebuilding of parapets etc.).
- No new building shall be allowed to be constructed in a fault line buffer zone except recreational facilities and light structures.

b) **Recovery objective:** Bring back a vibrant city with safe and sustainable housing infrastructure.

c) Actions: **Repairs, retrofitting and relocation**

The majority of affected buildings need repair/retrofitting for building back better the structural strength lost during earthquakes and/or upgrade the seismic resistance so that they become stronger and safer for future earthquakes.

Some of severely affected buildings will be relocated to safe planned residential areas for sustainable solution. In addition, all affected buildings in high-risk zones (close to the fault line, steep slopes, landslides, marshland) will also be relocated.

Below short-, medium- and long-term solutions are proposed for affected buildings in 6 categories: residential, private/commercial, schools, churches, health facilities and Government buildings (offices and stadium).

Table 3: Needs for recovery

S/N	Building Category	Repair /Retrofitting	Re-construction	Relocation
1	Residential	734	1,617	303
2	Private/commercial	264	15	5
3	Schools	21	0	7
4	Churches	3	0	0
5	Health facilities	5	0	1
6	Government buildings	14	0	1
Total		**1,041**	**1,632**	**317**

(i) Residential houses

Shelter in a safer resettlement creates a sustainable physical foundation to socio-economic development. Below are proposed short, mid and long term proposed solutions for residential houses.

Short term:

All lightly affected residential buildings and medium affected non-storied residential buildings should be repaired in three-months. Among them there are 1,796 buildings whose owners are in social category 1 & 2 who will need support from the Government.

Before carrying out repairs, the building owner should consult a qualified builder and follow local authority advice whether it is practical and safe to repair. To ensure a certain level of resilience has also to be done under the supervision on District One Stop Center.

Midterm:

Medium affected storied buildings shall be repaired/retrofitted following the findings of extensive geological study determining the buffer of the fault line zone and other measures for consideration in the red zones prone to earthquakes. Retrofitting/strengthening will be mandatory for storied residential buildings. The building owner should have approval from local authority. It is also very important to consult qualified structural engineer to carry out a detailed structural assessment of the damaged building with particular attention to vulnerable elements of the structure.

Appendix B details the guide to repairs and retrofitting of affected buildings.

Long term:

- Severely affected houses out of high-risk zones (106) will be reconstructed following guidelines that will be set by competent authority. The design of housing typologies and construction techniques that can be adopted will be developed and disseminated to the public so that people with financial capacity can be able to build houses that are strong and safe from earthquakes.
- The Government through unconventional approach will assist lower income and vulnerable people (Category 1 and 2) for self-construction in their own plots out of high-risk zones. After assessment by DIDIMAC, people in category 3 will also be considered to be assisted to have shelter.
- 317 households in high-risk zones shall be resettled to Muhira site in Muhira Cell, Rugerero Sector in Rubavu District. Geological and Geotechnical investigations is highly required to know the underground conditions to develop sustainable, livable and safe residential neighborhoods. Below is the proposed site plan

Site plan of proposed resettlement

Proposed Apartments to Accommodate Affected households

(ii) Health facilities

❖ **Gisenyi District Hospital**

Short term

- The hospital has returned to full operation after tremors that have shaken Rubavu District and other areas. Repairs for light damages are required for quality medical service delivery.

Medium term

- Retrofitting/strengthening severely affected buildings: Chirurgie and ARV.
- Relocation: Oxygen plant will be relocated within the boundary of the hospital behind laboratory block. To be installed in short period, it will be built with Strawtec Panels. Hospitalization house for prisoners and mortuary house will also be relocated within the boundary and built with prefabricated elements (Containers, Strawtec Panels or Precast Concrete). Generator houses will be relocated behind the Power House.

Long term

- As the hospital is proposed to be developed to the highest standard to provide health services for not only nationals but also tourists and expatriates in Africa, it is highly recommended to relocate all facilities to the safe zone, approximately 5 km from existing facilities.

❖ **Byahi Health Center**

All buildings were found in good condition except a laundry building that has light damages that require repair and retrofitting.

❖ **Gacuba Health Center**

The Health Centre continues to be used until a further decision may be taken based on a comprehensive geological study of the area.

❖ **Gacuba Health Post**

The building needs a small repair but can continue to be used.

❖ **Murara Health Center**

The administration bloc needs to be repaired before the raining season

❖ **Nyarubande Health Post**

The building is still under the guarantee period, the building needs a small repair

❖ **Schools**

In total 28 Schools affected; 7 schools located within fault line zone that need to be relocated in safe zone and 21 partially damaged. Among 28 schools affected, 10 are public schools, 3 are private and 15 are Government aided schools. Before carrying out repairs, the school's owner should consult the District Authorities through One Stop Center for advice whether it is practical and safe to carry out the repair. It is advised that the school's owner should in all cases consult a qualified structural engineer before carrying out any repair.

Table 4: List of affected schools

Sector	S/N	Name of schools	Status
GISENYI	1	ES. GISENYI	Public
	2	CS GACUBA II C	Gov aided
	3	IP GISENYI	Private
	4	ESBF	Private
	5	COLLEGE BAPTISTE	Private
	6	CS UBUMWE	Gov aided
	7	GS MUHATO	Gov aided
	8	GS UMUBANO I	Public
	9	GS GISENYI	Gov aided
	10	CS KIVUMU	Gov aided
	11	CS UMUBANO III	Gov aided
RUBAVU	12	GS KANEMBWE I	Gov aided
	13	CS ISANGANO	Public
	14	CS BUHAZA	Public
	15	GS RUBAVU I	Gov aided
NYUNDO	16	GS MUKONDO	Public
	17	CS KAMUGARURA	Public
	18	CS KIGARAMA	Public
BUSASAMANA	19	GS RWAMGEGA	Gov aided
	20	GS BUSASAMANA II	Gov aided
	21	CS KINOGO	Public
	22	CS MUNANRA	Public
NYAMYUMBA	23	GS RAMBO	Public
	24	GS BUSORO	Gov aided
	25	CS KINIGI	Gov aided
	26	CS RUBONA	Gov aided
	27	GS BURUSHYA	Gov aided
RUGERERO	28	CS KIROJI	Gov aided

Table 5: List of school to be relocated

S/N	Name of schools	Status	Items damaged
1	ES. GISENYI	Public	Located in fault line zone
2	CS GACUBA II C	Gov aided	Located in fault line zone
3	GS MUHATO	Gov aided	Located in fault line zone
4	CS RUBONA	Gov aided	Located in fault line zone
5	IP GISENYI	Private	Located in fault line zone
6	ESBF	Private	Located in fault line zone
7	COLLEGE BAPTISTE	Private	Located in fault line zone

❖ **Commercial buildings**

After exhaustive investigation of the fault line buffer and following volcanic eruption sequence, relocation will be done into phases so that some infrastructures may have return on respective investment.

Before carrying out repairs, the building owner should consult Local Authorities for advice whether it is practical and safe to carry out the repair. It is advised that the building owner should in all cases consult a qualified structural engineer before carrying out any repairs. It is also equally important to recall the services of a qualified builder when carrying out repairs.

❖ **Government Buildings**

a) Umuganda Stadium

The fault line passes through the stadium, changing rooms block was highly affected. It requires a thorough structural audit so that it can be retrofitted for a medium-term use.

b) Regional Police Headquarters

An administration building was affected at medium category. The structural audit is required to check its resistance to earthquake.

As priority, there is a need for relocation of all infrastructure located close to the fault line zone (Gisenyi District Hospital, Rubavu Stadium, 7 schools and 317 building infrastructure).

5. Actions for resilience

- Review of Rwanda Urban Planning and Building Code: MININFRA, RHA, MOE, RLMUA, MINEMA;
- Capacity Building
  - Study tour to countries with construction technologies that resist to earthquakes of high intensity; China, Japan, Italy etc. Stakeholders: MININFRA, MINEMA, RHA, UR, RMB
  - Training of professionals and technicians in construction sector: MININFRA, RMB
- Development of housing typologies with construction technology that are resistant to earthquakes.
- Upgrading the national risk Atlas of Rwanda to take into consideration earthquake magnitude;
- Review of Rubavu District Detailed Urban Master Plan considering earthquake prone areas: MININFRA, RHA, MOE, RLMUA, MINEMA
- The buffer zone that will be left after relocation of all existing developments alongside the fault line, should be developed for higher income generating projects such as recreational facilities.

6. Implementation framework for housing recovery

S/N	Intervention	Quantities	Unit Cost (Frw)	Cost (Frw)	Priority	Timeframe	Responsible	Duration (Months)
1	Relocation and construction of houses for 303 affected families (located on fault line zone and other HRZ) **Option 1:** resilient houses by using treated timber	303	7,578,900	2,296,406,700	High	Long-term	**Lead:** MINEMA **Stakeholders:** RHA, MINALOC, MININFRA, Rubavu District	12
	Option 2: Relocation and construct IDP model village for affected hhs	303	40,000,000	12,120,000,000	High	Long-term	**Lead:** RHA **Stakeholders:** MINEMA, MINALOC, MININFRA, Rubavu District	12
2	Construction of resilient houses in treated timber for families located in Rwaza Cell, Rugerero Sector. o **Option 1:** Cat 1&2 (1,331 HH) o Option 2: Cat	1,331	6,774,900	9,017,391,900	High	Long-term	**Lead:** Rubavu District/MINEMA **Stakeholders:** RHA, MINALOC, MININFRA	6
	o 1,2,3&4 (1841 HH)	1,841	7,578,900	13,952,754,900	High	Long-term	**Lead:** Rubavu District/MINEMA **Stakeholders:** RHA, MINALOC, MININFRA	6
3	Urbanization of site in Rwaza Cell, Rugerero Sector (providing, installation and construction of main infrastructure: roads, water, electricity etc.)	1	12,000,000,000	12,000,000,000	High	Long-term	**Lead:** RHA **Stakeholders:** MINEMA, MINALOC, MININFRA, Rubavu District	36

4	Relocation and construction of Gisenyi Hospital	1	20,000,000,000	20,000,000,000	High	Mid-term	**Lead:** RHA **Stakeholders:** MINEMA, MoH, MININFRA, MINECOFIN, Rubavu District	36
5	Relocation and construction of 4 Public and Gov aided schools (Relocation of developments in the fault line: ES. GISENYI, CS GACUBA II C, GS MUHATO, CS RUBONA)	4	900,000,000	3,600,000,000	High	Long-term	**Lead:** MINEDUC **Stakeholders:** RHA, MINEDUC, MININFRA, Rubavu District	36
6	Repairing and retrofitting of 20 Public schools	20	150,000	3,000,000	Medium	Short-term	**Lead:** MINEDUC **Stakeholders:** RHA, MINEDUC, MINENFRA, Rubavu District	1
7	Repair of light and medium damages for Gisenyi District Hospital (Retrofitting of Chirurgie and ARV., Relocation of Oxygen Plant, Relocation of Hospitalization House for prisoners, Relocation of Mortuary House, Relocation of Generator houses)	1	175,375,000	175,375,000	High	Short-term	**Lead:** RHA **Stakeholders:** MoH, MININFRA, Rubavu District	3
8	Repair of light and medium damages for Byahi Health Center, Gacuba Health Center, Gacuba Health Post, Murara Health Center, Nyarubande Health Post	5	1,770,000	8,850,000	High	Short-term	**Lead:** RHA **Stakeholders:** MoH, MININFRA, Rubavu District	4
Total						**47,101,023,600**		

ANNEX 2: TRANSPORT, WATER AND ELECTRICITY INFRASTRUCTURE

1. Introduction

The infrastructure sector was mostly hit by earthquakes which followed the volcanic eruption of Nyiragongo.

Water was hit in transmission, distribution and service pipelines that resulted into leakages and losses estimated at 127,257,217 Frw. The required recovery cost for resilience to seismic shocks is estimated at 15,820,000,000 Frw. Electricity lost about 42,500,000 Frw due to less consumption. The electricity network in Rubavu town was upgraded and meets required standards. The transport (roads and bridges) incurred damages and losses estimated at 1,779,559,165 Frw, and about 20,543,440 Frw was incurred while facilitating transportation of the DRC refugees in terms of hiring of vehicles and fuel consumed. The required recovery cost for roads and bridges to make them resilient to seismic shocks is estimated at 19,745,000,000 Frw.

The Rubavu Airdrome was also highly affected at terminal building and runaway structures. This requires 350,000,000 Frw for feasibility studies, which will determine cost of the loss/ damages and required upgrading cost.

2. Pre and post disaster context

a) Water infrastructure:

Rubavu District/WASAC serves 15,000 m^3 per day in the city and suburbs using 430 km water network length and 8,500 m^3 of storage (5 tanks). It serves 10,535 clients. The supply was sustainable and enough water was served, the pipes used in supply are: PVC pipes, HDPE Pipes and Steel Galvanized pipes.

- **What happened on 22nd May 2021:** The Gihira water treatment plant was not affected but the water network was highly affected due to the earthquakes and types/nature of pipes used.
- **Affected water pipelines:**
    - Transmission water pipelines were affected by 27% and 4 big leaks have been recorded;
    - Distribution water pipelines were affected by 67% and 102 leaks have been recorded;
    - Service water pipelines were affected by 78% and 187 leaks have been recorded.

There are 4 cases of affected transmission lines that were damaged and caused a one-day cut off water in the whole city and after repair of those four big leaks, water has been restored in the city but some parts were not connected due to the distribution water lines which have been damaged.

b) Electricity:

Rubavu electricity network is made of 3 Hydro Power Plants that are generating 5.7MW (Gisenyi HPP 1.7MW, Gihira HPP 1.8MW and Keya HPP, 2.2 MW) all connected to the

National Grid. The network is served by 2 Substations with 2 Power transformers (5MVA and 10MVA) and 14 in house cabins. The Electricity network covers 24 km of High Voltage (HV) lines of 220kV Line, 215 km of Medium Voltage (MV) of 30kV and 784km Low Voltage lines (LV) of 400V with 224 distribution transformers. The total clients served with electricity is 71,500.

Electricity infrastructures were not affected, only the customers were consuming thus affecting the sales and projected losses is estimated at 42,500,000 Frw.

c) Transport (roads and bridges):

The road network in Rubavu District comprises a total of 155.76km. This figure is composed of 77.9Km of national roads (42.6km paved and 35.3km unpaved) and 77.86km of urban roads (31.99km paved and 45.87km unpaved). Before the earthquakes hit the District, the roads and bridges were in good condition and periodically maintained.

The earthquakes damaged the roads which resulted in the traffic being cut off. The following main roads were severely damaged and were not practical.

- Road coming from ADEPR to Rubavu Bus Station and Petite Barriere (ADEPR Rubavu/About 1,9 km from Petite Barrière)
- Junction NR 2 – Gisenyi Hospital around the monument on NR 2 between the two petrol stations (GEMECA and Gas Oil).
- An immediate but temporary restoration of traffic on the junction NR 2 – Gisenyi Hospital was done.
- A full assessment was conducted by RTDA and Rubavu District and a total of 12 spots have been identified so far.

The airdrome was not functioning, waiting for upgrading and extension of the runaway and rehabilitation of the terminal building.

3. Damages and losses incurred by Infrastructure Sector

a) Losses in water

Table 1: Summary of losses for Water

Sector	Component	Cost (Frw)	Estimated loss (Frw)	Total loss
Infrastructure	Water	43,183,208	84,074,009	127,257,217

Transmission water pipelines

- Water pipelines PVC DN 315 from Gihira WTP to Murakaza neza Water Tanks (10%)
- Water pipelines PVC DN 315 from Gihira WTP to Rwaza Water Tanks (10%)
- Water pipelines PVC DN 400 from Rwaza WTP to the City of Rubavu (20%)
- Water pipelines PVC DN 400 and PVC DN 200 from Murakaza neza tanks to Mbugangali area (20%)

Distribution water pipelines

Water pipelines which supply water to the city were damaged on 63% and 34 leaks have been recoded.

- Water pipelines which supply water to Mbugangali area were damaged on 52%. This resulted into 23 leaks which have been recoded.
- Water pipeline which supplies water to Rugerero area was damaged on 23% and 16 leaks have been recoded
- Water pipeline which supplies water to Nyamyumba area was damaged at 10% and 12 leaks have been recoded.

Service water pipelines

- Service water pipelines are the pipes which connect the customers to WASAC water line.
- Service water pipelines were affected at 78% and 187 leaks were recorded, repaired and continuous fixing of the damaged pipes done, especially in Mbugangali.

The Total cost for all damaged water pipelines is 43,183,208Frw.

Water production:

- Water lost from main tanks: 8,500 m3
- Water lost from Rwaza and Murakaza neza tanks: 4,300 m3
- Water lost from network after earthquakes: 39,804 m3
- Water used in network cleaning after repair: 27,004 m3

Total Cost for all the water lost is: 84,074,009 Frw

b) Losses encountered in transport

Table 2: Summary of losses for Transport

Sector	Component	Cost incurred on quick response (Frw)	Estimated loss (Frw)	Total loss (Frw)
Infrastructure	Roads and Bridges	190,059,165	1,589,500,000	1,779,559,165

Damaged roads and bridges:

- Junction NR 2 – Gisenyi Hospital around the monument;
- On the connection coming from Musanze to Gisenyi Hospital;
- In the extension of the ramp to Gisenyi Hospital near the former access to the hospital (Nengo cell)
- Rubavu Urban Road, Gisenyi sector, Nengo cell. At the junction connecting the road from Nyirinkwaya Clinical (or Catholic Church) and the road going to Gisenyi Hospital;
- Rubavu Urban Road, Gisenyi sector, Nengo cell. Near Rubavu market and Kobil station;
- Rubavu Urban Road, Gisenyi sector. At junction near Rujende Bus station;

- Rubavu Urban Road. Road coming from ADEPR to Rubavu Bus Station and Petite Barriere (ADEPR Rubavu). About 1,9 km from Petite Barrière;
- At Buhuru Center Umuganda Stadium Urban Road, at 0+250 of the new and ongoing roads;
- Rubavu Urban road - at Petite Barrière - Karundo Center Road, PK 2+300 new and ongoing road;
- On the connection coming from Musanze to Gisenyi Hospital;
- Road Marine at PK 4+300 (New road and ongoing road);
- Mbugangari roads: around 3Km were affected in different sections.

The total loss calculated due to 12 damaged road sections on national and urban roads is 1,779,559,165 Frw. The cost includes hiring contractors, supervision consultants, materials and equipment to be used for repair works.

c) Losses for electricity

Table 3: Summary of losses for electricity

Sector	Component	Cost incurred on quick response (Frw)	Estimated loss (Frw)	Total loss (Frw)
Infrastructure	Electricity	-	42,500,000	42,500,000

REG recently upgraded the electricity network in Rubavu town which led it to sustain seismic shocks.

4. Recovery needs and interventions in water, transport and electricity

(i) Interventions

a) Water

- Repair of damaged water pipelines
- Rehabilitation of the damaged and old water pipelines using adaptive/resilient materials
- Alternatives:
  - Interconnection for water pipelines from Gihira WTP
  - Mobile water treatment plant

b) Roads and bridges

The immediate recovery of transport infrastructure (roads and bridges) aims at allowing movements and connection of different places, fully resuming services and avoiding total destruction and related impacts.

- Repair works of 12 damaged road sections
- Alternative roads
  - Bypass road from Rugerero-Magengo (13km) – short term
  - Upgrading & rehabilitation of NR (Rubavu-Busasamana-Kabuhanga (32km) – Long term
  - Rehabilitation and upgrade of Brasserie- Nkora – 21 km (DR22 & 31) – Long term

c) Electricity

Rubavu electricity network was recently upgraded and meets the N-1 criteria that imply that even if one source is affected, there would be continuous supply to the area. All REG electricity network was inspected after the incident of 22 May 2021 i.e. lines, substations and power plants and found that all are in good conditions and none is found to be at risk as the network was recently upgraded.

(ii) Summary recovery needs

Recovery Needs for Infrastructure Sector

a. Water

Table 4: Summary of recovery needs for water

Sector	Component	Available Budget (Frw)	Needed budget for immediate recovery	Total budget (Frw)
Infrastructure	Water	-	15,820,000,000	15,820,000,000

b. Transport

Table 5: Summary of recovery needs for transport

Sector	Component	Available Budget (Frw)	Needed budget for immediate recovery
Infrastructure	Roads and Bridges	10,700,000,000	19,395,000,000
	Feasibility study for Rubavu Airdrome	-	350,000,000
Total		**10,700,000,000**	**19,745,000,000**

d) Implementation framework

Table 6: Infrastructure sector recovery implementation framework

S/N	Intervention	Cost (Frw)	Priority	Timeframe	Responsible	Duration (Months)
1	Repair works of 12 damaged road sections	190,059,165	High	Short term	**Lead:** RTDA **Stakeholder:** MININFRA	3
2	Alternative road 1: Bypass Road from Rugerero-Magengo (13km)	10,700,000,000	High	Medium term	**Lead:** RTDA **Stakeholder:** MININFRA	12
3	Alternative road 2: Upgrading and rehabilitation of the	11,200,000,000	Medium	Medium term	**Lead:** RTDA **Stakeholder:** MININFRA	24

	national road (Rubavu-4 Busasamana-Kabuhanga (32km)					
4	Alternative road 3: Upgrading and rehabilitation of the Brasserie – Nkora road (21 KM)	8,195,000,000	Medium	Medium term	**Lead:** RTDA **Stakeholder:** MININFRA	
5	Feasibility study for Rubavu airdrome	350,000,000	High	Short term	**Lead:** RAC **Stakeholders:** MININFRA, RCAA	3
6	Repair of damaged water pipelines	800,000,000	High	Short term	**Lead:** WASAC **Stakeholder:** MININFRA	4
7	Rehabilitation of the damaged and old water pipelines	5,100,000,000	Medium	Medium term	**Lead:** WASAC **Stakeholder:** MININFRA,	8
8	Interconnection for water pipeline from Gihira WTP	800,000,000	Medium	Medium	**Lead:** WASAC **Stakeholder:** MININFRA	8
9	Acquisition of 2 Mobile water treatment plants	9,120,000,000	Low	Medium term	**Lead:** WASAC **Stakeholder:** MININFRA	18
10	Capacity Building on volcanic and seismic effects management	50,000,000	High	Short term	**Lead:** MINEMA **Stakeholders:** MININFRA, MINECOFIN, RTDA, WASAC, REG & Rubavu District, Institution of Engineers	3

ANNEX 3: TRADE AND BUSINESSES

1. Introduction

Trade sector is among the basic income generator to the population of Rubavu District as it's a tourist zone and border with DRC. The flow of businesses in Rubavu city was affected by earthquakes. The total effects have been estimated at 477,606,000 Frw and the needs for recovery at 4,026,409,000 Frw.

Prior to Nyiragongo eruption and earthquakes that followed, the trade sector in Rubavu District was vulnerable due to Covid-19 effects. This is defined by the fact that before Covid-19, about over 50,000 individuals have been crossing the border daily.

The main recorded damages and losses included cross border business disruptions that affected incomes, closure of businesses, perishable and rotting goods, etc. The losses were incurred in a maximum of four days when the businesses were completely closed or temporarily interrupted. The identified recovery need consists of the construction of an advanced cold room and initiation of a recovery fund.

2. Pre-and post-disaster context

The trade sector in Rubavu District may be categorized under three main activities namely; cross border trade, domestic trade and trade in services. Cross border trade is comprised of small-scale businesses that contribute greatly to the economy and to individual households and trade on large scale involving import, export and re-exports. Domestic trade includes wholesale and retail shops of various products (shops, markets, pharmacies and hardware shops, etc). Finally, services trade includes: medical, banking, telecommunication, transport, education, leisure activities, hospitality (hotels, guest houses, motels and restaurants) and tourism related services.

Prior to Nyiragongo eruption and earthquakes that followed, the trade sector in Rubavu District was vulnerable and most hit by Covid-19 effects. This is defined by the fact that before Covid-19, about over 50,000 individuals crossed the border daily while the earthquake hit when cross border frequency was declined to about 5000 daily. Most of these small-scale cross border traders are women (over 70%). The cross-border traders were grouped into associations and cooperatives based on product clusters (e.g., vegetables, fruits, eggs, milk, etc.). The cooperatives/associations helped to sustain the cross-border trade whereby the members and goods were aggregated and transported across the border. Subsequently, over 12 associations with different value chains later formed ONE platform called "Rubavu Cross border traders" with a current membership of about 5,800 members. The Cross-border trade was carried out using the four main crossing points; Petite Barrière, La Corniche, Kabuhanga and Nyamyumba.
The domestic business made up of both wholesale and retail business total up to 15,344 in all the 12 sectors of the District, with Gisenyi taking a big percentage of 43.7% (6,700).

The disaster of 22nd May 2021 which involved volcanic eruptions of Nyiragongo accompanied by a series of earthquakes in the surrounding areas up to Rubavu District. The immediate

disruption in the context of trade was the mass movement of people from the Goma area (which is the main market for exports) crossing into Rubavu District and other nearby areas considered safer. Subsequently, the earthquakes in Rubavu and warning announcements by the officials also made people close their businesses, for most of the businesses, the disruption was for a period ranging from about one to three days while for others, like public warehouses, the impact took a bit longer.

3. Damages and losses

The main recorded damages and losses include:

- Damaged perishable products for export;
- Loss of daily income of Cross border trade Transporters – Bicycles association (Velo of people with disability) and transporters of tricycles (RIFFAN);
- Lost earnings from disrupted informal export trade;
- Loss of incomes for Casual laborers and man powers;
- Non-payment for small scale traders who supplied in Goma/DRC because of their Congolese counterparts claiming being affected by erupting lavas and being displaced;
- Damaged goods in warehouses;
- Cost for loading and offloading in relocations of goods in cracked warehouses;
- Damaged goods in warehouses;
- Loss of daily earnings for wholesalers and retailers in local markets;
- Loss for Abattoirs and butchery with the felt price;
- Losses from Hotels and Guest houses' rooms affected by earthquakes.

The impact of the disaster was felt across all the three categories of the trade sector. While it is not easy to quantify the actual value of the damages and losses in trade with certainty due to the nature of business in Rubavu District and the limited time, the table below presents a snapshot of the estimated cost of damaged goods and losses incurred by each trade subsector;

The damages and losses are calculated basing on four (4) days that the market of Gisenyi was closed, the four (4) days that the movement on border were disturbed due to panic, a one (1) day of the closure of the border and the days of off services for rooms in hotels and guest houses. The table below provides estimates costs of damages and losses for trade and businesses.

4. **Damages and losses for trade and businesses for trade and businesses sector**.

Table 1: Summary damages and losses

S/N	Affected service (damages and losses)	Quantity	Cost (Frw)
1	Damaged perishable products (various vegetables and fruits, eggs and milk) for export	Various products	440,000
2	Loss of income per day for associations of Transporters Rubavu-Goma (using Bicycles & tricycle/Riffan)	136 bicycles and 15 tricycles	19,373,000

3	Lost earnings from disrupted informal export trade and Casual laborers	4946 persons	49,000,000
4	Non-payment for small scale traders (chicken that were exported and other goods) because of their Congolese counterparts claiming being affected by erupting lavas and being displaced	2500 chicken and other various goods	113,750,000
5	Damaged Goods in warehouses (3) 20 containers out of 33 of building glasses totally broken and cost of relocation of goods in 5 warehouses with cracks.	3 containers of glasses and 5 warehouses	229,335,000
6	Losses of earnings for wholesalers and retailers, man powers, casual workers in Local markets and abattoirs and butchery where the price of meat tumbled due to the closure of the border.	680 traders and 3 abattoirs and butchery	41,908,000
7	Loss of earnings from Hotels and Guest houses' rooms affected with cracks	11 hotels and 37 guest houses affected	47,800,000
	Total		**477,606,000**

5. Recovery needs and interventions for building disaster risk resilience

As the earthquakes decreased and borders operate normally, the affected services have been slowly recovering from the disaster shock.

The recovery needs and interventions for building disaster resilience will center on both the immediate priority interventions as well as the medium/long term initiatives.
These will, among others, include:

- Construction of the multi service cold room;
- Creation of the recovery funds, this fund will be jointly mobilized by government and private sector members;
- Creation of risk awareness and advocacy programs on issues of resilience in the face of such volcanic eruptions and earthquakes among the business community and potential investors. Also, there is a high likelihood of developing a negative business perception for potential future investment especially in immovable properties in Rubavu District due to this disaster incident and the proximity of the active Virunga volcanic mountains of Nyiragongo and Nyamuragira. This will require proactive and sustained advocacy activities and promotion to ensure favorable attitudes and perceptions by prospective investors in the area.
- Relocation of three private schools (ESFB, IP Gisenyi and College Baptiste) located in fault lines
- Upscale insurance policies aimed at covering risks arising from earthquakes and volcanic eruptions

The recovery needs for the construction of a cold room is calculated basing on its facilities at high capacity and quality with standards while the establishment of recovery funds is calculated basing on losses and resuming business with insurance while the relocation of schools is calculated basing on the price of disaster resilient room and the principle of building back better.

The table below shows the cost calculations of proposed interventions:

Table 2: Needs for trade recovery and resilience

S/N	Needs	Quantity	Cost (Frw)	Priority (High, Medium, low)
1	Construction of Cold room	1	1,500,000,000	High
2	Awareness creation on DRM, Insurance and recovery funds	-	10,000,000	Medium
3	Establish business recovery/emergency fund in collaboration with PSF	-	716,409,000	High
4	Relocation of three private schools (ESFB, IP Gisenyi and College Baptiste) located in fault lines	3	2,700,000,000	High
			4,026,409,000	

The following are some principles for recovery:

(a)To ensure all businesses take insurance policies covering disaster related risks,

(b)The export shall be on contract basis,

(c) All traders to operate in registered cooperatives

6. Implementation framework

The implementation of the interventions will be guided by the priority ratings of the proposed interventions and will be multipronged with the concerted efforts of various players in PPP framework. The following tables provides details of the proposed implementation plan

Table 3: Implementation framework for trade and business sector

S/N	Intervention	Priority Ranking	Responsible	Outcome of recovery action	Cost (Frw)	Timeline	Duration (months)
1	Construction of multi services cold rooms	High	**Lead;** MINICOM **Stakeholders;** MINICOFIN Development Partner, PSF and District	Building safety and resilience for perishable products traded with required standards	1,500,000,000	Mid	12
2	Establish business recovery/emergency fund in collaboration with PSF	High	**Lead:** PSF, MINEMA **stakeholders**: MINICOM	Compensation of damages and losses	716,409,000	Short	3
3	Awareness creation and capacity building on disaster risk management and insurance policy	Medium	**Lead:** MINEMA, **Stakeholders:** MINICOM, PSF, District	Sensitized and mobilized PSF for changed attitude and perception	10,000,000	Short	3
4.	Relocation of three private schools (ESFB, IP Gisenyi and College Baptiste) located in fault lines	High	**Lead: MINEDUC Stakeholders:** MINECOFIN, District and School Owners	Building disaster resilient schools	2,700,000,000	Mid	12

ANNEX 4: HEALTH AND SANITATION

1. Introduction

Gisenyi District Hospital was severely damaged and it made health services' delivery flow halt. The total effects are estimated at over 45,696,072 Frw while the recovery need is estimated at 1,961,508,670 Frw. The main losses recorded were health services provided to displaced Congolese and cost for patients and medical staff transferred to other health facilities.

Key recovery needs identified include upgrading one health center in Rubavu to serve as back up during frequent emergencies, psycho-social support for affected people; regular water and air quality testing and surveillance, rehabilitation and construction of damaged latrines; hygiene and sanitation behavior change campaigns as well as provision of hygienic, bed and kitchen kits to affected vulnerable households.

1. Summary of damages, losses, and needs

The losses calculated comprise of unplanned expenses encountered in Assistance to displaced Congolese, patients and medical staff transfer to other health facilities. The total estimated cost for damages and losses is 45,696,072 Frw. The recovery needs would cost 1,961,508,670 Frw as described below:

Table1: Summary damages, losses and needs for health sector

S/N	Sector effects	**Quantities**	**Needs (Frw)**
1.	Kabali backup Health Center	- Buildings, materials and advanced services with specialists.	1,500,000,000
2.	Hygiene campaigns.	- 2 Hygiene campaigns, - Hygiene items to affected HHs (2,654)	143,143,750
3.	Risk assessments	- Water & air quality, - Health and waste management	50,172,500
4.	Psycho-social support	- Four (4) trainings and counselling exercises.	101,009,120
5.	Provision of Hygienic, Bed and Kitchen sets	- 2,654 HHs identified	167,183,300
TOTAL			**1,961,508,670**

2. Pre and post disaster context

Before Nyiragongo Volcano eruption and earthquakes that followed, health service delivery in Rubavu District was stable and the population mainly in Rubavu City and suburbs enjoyed adequate services from Gisenyi Hospital as well as polyclinics and pharmacies in the City. In general, the population appreciate health services delivery at the level of 71,8% (RGB **CRC2020**.)

On evening of 22nd May, 2021, Nyiragongo volcano located in the DRC erupted. The eruption was followed by repetitive earthquakes with the highest of 5.3 magnitude as recorded by Rwanda Mines, Petroleum and Gas Board (RMB). Gisenyi District Hospital that mainly provides health services in Gisenyi is crossed by the crack that widened and damaged different facilities, both private and public. This made health services' delivery flow cut off for days.

3. Identification of damages and losses

When the earthquakes hit, Gisenyi District Hospital almost stopped working, 17 pharmacies and 11 polyclinics were affected and this increased risks mainly; Covid-19, communicable and non-communicable diseases' contamination increase as preventive measures were highly violated. Overcrowding in schools, health facilities and provisional transit centers set for displaced Congolese also increased risks.

Covid-19 vaccination campaign stopped and quality of health care services and patients' privacy affected as the hospital was forced to make two patients share the same bed. WASH infrastructures got affected and this increased the risk fecal matters leaked and mixed up with water due to earthquakes. Waste disposals (open defecation and Gisenyi landfill) and ashes from volcanic eruption would also lead to the poor hygiene diseases and different cancer types.

Besides increased risks, there are also recorded damages and losses related to unplanned expenses (Covid-19 tests for displaced Congolese, transport for patients and medical staff and other health care services) and physical damages. The table below provides details on damages and losses.

Table 2: Details damages and losses

S/N	Affected services/Loss	Comment	Cost (Frw)
1	Cost of COVID-19 test for displaced Congolese.	Sampled displaced Congolese in provisional camps and those who continued their travel to other regions.	20,000,000
2	Other health services to displaced Congolese.	Per diem, transport for staff and materials.	2,841,014
3	Cost for patients' transfer to other health facilities without paying for earlier services.	Patients who were hospitalized got transferred without payment.	2,608,698
4	Temporary repairs for damaged items	minor repairs were made for halted services to resume	1,533,760
5	Facilitation for medical staff who shifted to other health facilities.	Medical staff who were assigned to relocate to other health facilities.	15,880,000
6	Cost for awareness campaigns conducted.	Sono-Mobile was hired for more than 10 days	2,400,000
7	Mobile Toilets for 2 days	Mobile toilets were hired to for first days when other toilets were not yet ready.	432,600
Total:			**45,696,072**

4. Health sector recovery needs.

Health recovery needs identified to address the sector issues are estimated at **1,983,023,122 Frw.** Main identified interventions include: upgrade Kabali health Center to serve as backup in case of Emergency; psycho-social support for affected people; regular water and air quality testing and surveillance at different points; Rehabilitation and Construction of damaged latrines to vulnerable families; promote hygiene and sanitation behavior change campaigns in community; provision of hygienic kit to vulnerable households as well as monitoring and enhancing health service delivery.

a) Health sector recovery objectives, principle and options.

Objectives:

- Ensure health services flow is not interrupted;
- Increase the understanding of health safety measures through awareness campaigns;
- Conduct scientific studies for decision making and protection of people;
- Assist traumatized individuals.

Principles for recovery:

- All interventions should respect Health and WASH standards and other safety measures (20L of Water per 1 Person and 20 People sharing 1 stance of latrines, aeration, fire assembly points, emergency exits, potable water, …);
- Community engagement should be considered in all interventions;
- Daily monitoring and surveillance for outbreaks related to the poor WASH services.

Options for recovery:

- Reconstructing WASH infrastructure for resilient health;
- Relocation of health facilities from high risk areas to safer place,
- Set an operational adequate early warning system;
- Enhance hygiene practices among population

The table below highlights detailed needs for the health sector

Table 3: Recovery needs for health sector

S/N	Intervention	Cost (Frw)	Priority	Timeframe	Responsible	Duration (Months)
1.	Psycho-social support (Training, identification and counselling exercises.)	101,009,120	High	Short term	**Lead:** MoH **Stakeholders:** Rubavu District and partners	12
2.	5 Water Quality testing and surveillance exercises.	18,090,600	High	Short term	**Lead:** MoH **Stakeholders:** WASAC and Rubavu District	5
3.	2 hygiene and sanitation campaigns. (Water filters and cleaning tablets)	143,143,750	High	Short term	**Lead:** MoH **Stakeholders:** Rubavu District and Stakeholders	12
4.	5 monitoring of Air Quality and Health Impact exercises	17,080,500	High	Short term	**Lead:** REMA **Stakeholders:** RMB and MoH	5
5.	Provision of hygienic, bed and kitchen kits to 2,654 HHs	143,183,300	High	Short term	**Lead:** MINEMA **Stakeholders:** Rubavu, partners	3
6.	Deworming for affected schools (10, 000 students)	9,000,000	High	Short term	**Lead:** MoH **Stakeholders:** MINEDUC, Rubavu District	2
7.	Provision water treatment products to Schools	15,000,000	High	Short term	**Lead:** MoH **Stakeholders:** WASAC and Rubavu District	3
8.	One Health, WASH and waste management risk assessment in Rubavu	5,001,400	High	Short Term	**Lead:** MoH **Stakeholders:** MINEMA, WASAC and Rubavu District	1
9.	Inspection of health safety measures in Private and Public Buildings	10,000,000	High	Short Term	**Lead:** MoH **Stakeholders:** RHA, MINEMA and Rubavu District.	5
10.	Upgrade of Kabali health Center as backup (Cost referred to the upgrade of Bigogwe HC)	1,500,000,000	High	Long term	**Lead:** MoH **Stakeholders:** MINECOFIN, MININFRA and Rubavu District	12
TOTAL COST: 961,508,670 Frw						

5. Summary of recovery recommendations

The measures proposed are to enable Rubavu District recover from losses and impacts, including reconstructing destroyed and damaged health assets by building them back better, and to promote enhanced hygiene practices to reduce vulnerability and risk.

The interventions for health sector recovery are to cover a period calculated in months for immediate response and in years (one, two or three years) for mid-term and long-term interventions.

The recommended measures are:

- Urgency of temporary rehabilitation and relocation of Gisenyi DH;
- Upgrading Kabali health center that may serve as back up during emergencies;
- Enhancing risk management through risk assessments and information sharing;
- Promoting hygiene practices among Rubavu District population.

6. Details of activities under proposed interventions

Promote hygiene and sanitation behavior change campaigns in community:

- Distribution of water filters and water cleaning tablets;
- Establishment and functionality of community hygiene clubs;
- Media and social media;
- Household water treatment campaigns.

Psycho-social support for affected people:

- Training orientation (Red Cross volunteers and community health workers and 3 staff from Gisenyi DH);
- Identification exercise for affected individuals, Home visits and counseling.

Provision of hygienic kit to 2654 families:

- 2 jerry cans, 1 bucket, 5 soaps, MHM kit, Tooth paste and brushes (3)

Rehabilitation and construction of damaged latrines to vulnerable families:

- Latrines for 2654 families:

Provision of non-food items

- Bet kit: (2 Blankets, 2 mats, 2 tents): 27,000, Kitchen set: 5 plates, 5 spoons, 5 cups, 2 saucepans

Conduct health, WASH and waste management risk assessment.

- Dumping site effects;
- Water quality monitoring and sanitation assessment.

ANNEX 5: RISK MANAGEMENT AND ENVIRONMENT SECTORS

1. Introduction

Risk information plays key role in the development of Post Disaster Needs Assessment (PDNA). This section of Risk Monitoring and Environment will present the background on the hazard, exposure, vulnerability to volcanic eruption, seismic activities, interventions with associated cost and recommendations to build resilience. The current status of the risk is reactivated fissure, seismicity, possibility of Lake Kivu gas outburst and air pollution.

The Nyiragongo re-eruption will depend on the refilling of the magma chamber and its drained lava Lake. Post eruption earthquakes are apparently decreasing based on the recorded data to the normal seismic activities. However, the rifting activities can generate earthquakes from active faults. Existing scientific data are not indicating any possibility of eruption beneath the lake and/or through the fissures. Lake Kivu/Gas outburst is less likely to happened due to the water volume and the permanent stratification stability of the lake. Recorded air quality data in Rubavu comparing pre and post eruption indicated normal trend. However, ash fall from eruption were observed shortly after the eruption and did not pose any significant side effects.
The interventions and recommendations are proposed in the table below:

Table 1: Recommendations for risk resilience

Short-term Interventions
o Physical demarcation of red/high risk zone to fault lines; o Revision of Rubavu District Land use and Master Plan to consider geo-hazards features; o Strengthening regional collaboration on Nyiragongo volcanic eruption including appointing two scientific focal points to work closely with OVG; o Establish the Intersectoral collaboration between MINEMA, RMB, REMA, UR and other higher learning institution, research centers, RSA, MoH, MoE, RLMUA, RWB, Meteo-Rwanda, RSB, Security organs, Rubavu, Rutsiro, Karongi, Nyamasheke, and Rusizi Districts).
Mid- and long-term interventions
o Geo-scientific Investigation (detailed geological, geophysical, geotechnical, geochemical, geodesy), and assessment; o Study on Lake Kivu to strengthen its monitoring including but not limited to the gas partial pressure measurement; o Establishment of a dedicated research entity on geology and geohazard; o Establish regional bilateral Lake Kivu Monitoring committee; o Acquire Risk surveillance/Monitoring equipment, and capacity building; o Updating National earthquakes and Volcanic eruption contingency plans;
Recommendations

o Direct measures to relocate affected properties along the reacted fissure zones; o Conduct a geoscientific investigation and details assessment in affected areas and beyond (along the rift valley in Rwanda); o Improve collaboration with similar institution in regional and abroad; o Put in place a dedicated geo-hazard monitoring and research entity with allocated budget; o Capacity building; o Put in place a user guideline that will lead future urbanisation and infrastructure development along the rift valley; o A continuous real-time monitoring system for ash and gases is required to track spatial variation in air quality to the City of Rubavu and Musanze located in Volcanic areas.
Required budget to implement the proposed interventions is estimated at 2,171,450,785 Frw including 2,131,610,785 Frw for Risk monitoring and 39,840,000 Frw for environmental protection.

2. Pre and post disaster situation

Lava from eruption reached Rwandan territory on the area of around 5 hectares where crops evaluated to 6,900,000 Frw were lost and land evaluated to 125,000,000 Frw and about 10,000 people from DRC moved to Rwanda. 351 Rwandans from Cyanzarwe Sector were displaced to different areas of the country.

On the other hand, a series of earthquakes of different magnitude caused considerable damages in 10 days following the eruption. People in Rugerero, Gisenyi and Rubavu Sectors were highly affected due to earthquakes and the crack passing through their properties.

3. Overview of the risk (Hazard, exposure, and vulnerability)

Rubavu District is exposed to 4 types of geohazards:

- **Volcanic eruption**: re-eruption will depend on the refilling of the magma chamber and the drained Nyiragongo lava Lake
- **Earthquakes**: Earthquakes from eruption is less likely as far as Nyiragongo lava Lake is not replenished. However, rift valley system can generate earthquakes from active faults
- **Lake Kivu gas outburst**: Less likely to happened due to the water volume and the permanent stratification stability of the lake.
- **The air pollution** is likely to occur in case of Lake Kivu gas outburst and volcanic eruption

4. Volcanic eruption on 22nd May 2021

Volcanic eruption reactivated the existing fissure from 2002 Nyiragongo eruption. During reactivation, more than 500 earthquake events were recorded including small (below M_L3.5) and elevated magnitude earthquake (less than M_L5.1).

Seismic monitoring team based in Rwanda Mines, Petroleum and Gas Board (RMB) was giving timely updates on the situation of eruption and earthquake.

5. Recorded earthquake events (22nd-31st May 2021)

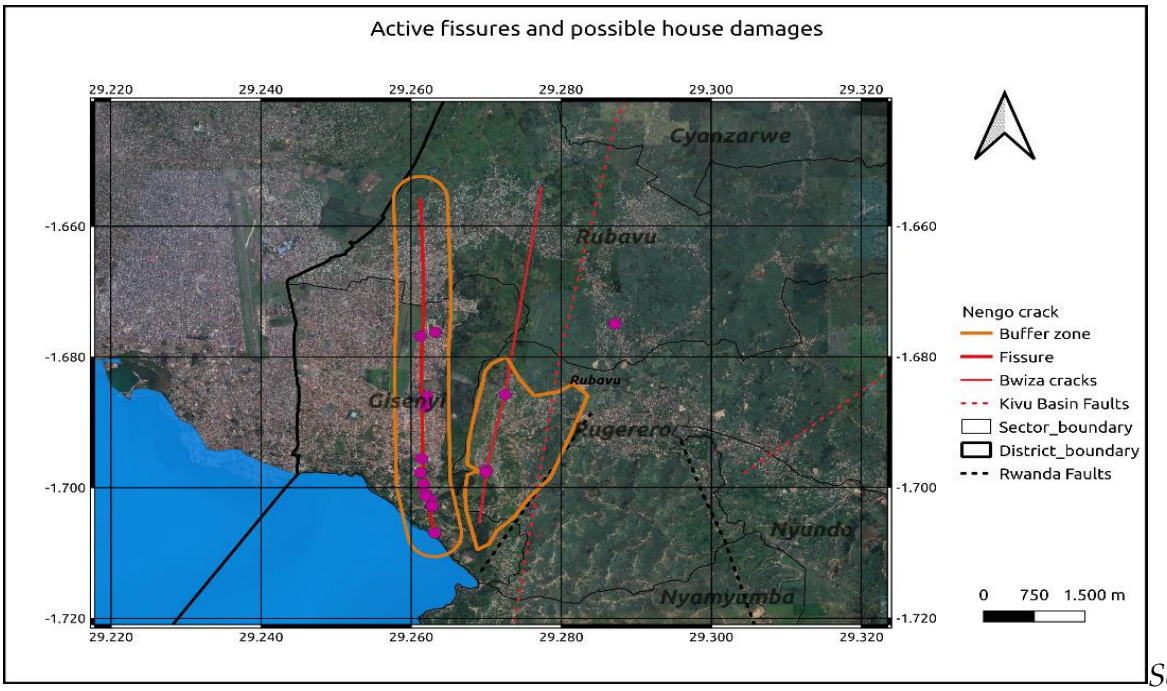
Table 2: Recorded earthquakes

No	Magnitude class (M_L)	Number of Records
1	3.5-4	83
2	4.1-4.4	29
3	4.4-4.8	11
4	5.1	2
Total		**125**

6. Risk status related to cracks and seismicity

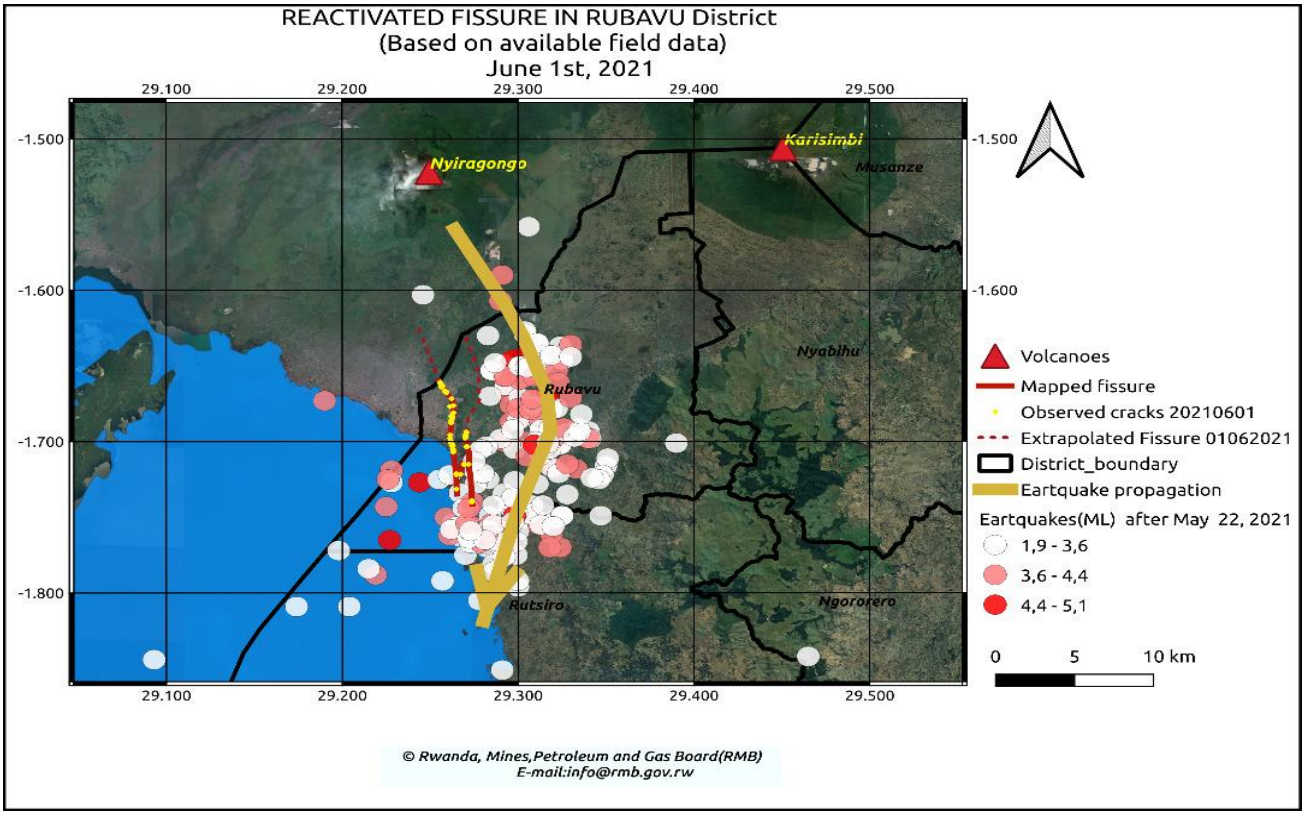
The existing cracks were reactivated after the eruption on about 8km long N10W line. The observed crack opening can reach 2-3m wide (at Gacuba/ ADEPR). As a result, associated cracks covers 40-60 m wide and 8km long zone. This zone extended from Nyiragongo Volcano to Lake Kivu in a N10W-SE trend as indicated on the map. Due to the Rubavu granite hill and volcanic rocks from past eruption events, two severe cracks were observed on both sides of the granite. These cracks deviates following the orientation of the hill and increase the vulnerability of the people living around the area in Rubavu district, Gisenyi Sector.

Identified High Risk Zones based on the reactivated fissure



Source: RMB

Distribution of seismic events



Source: RMB

7. Risk status related to Kivu lake gas outburst

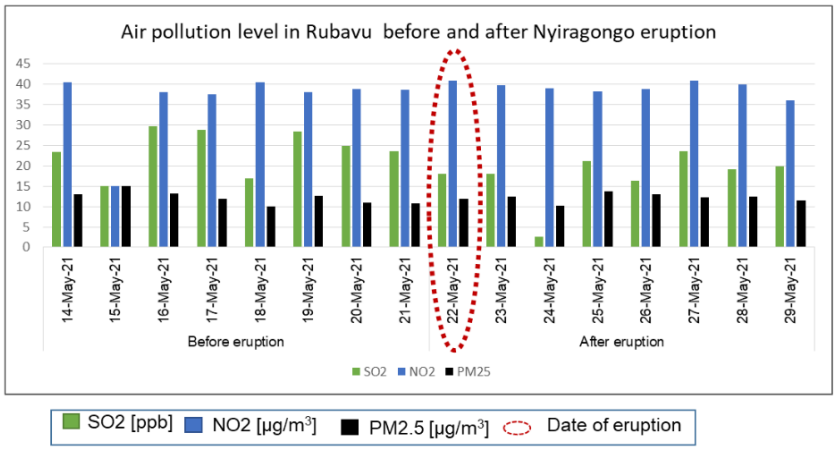
The lake Kivu has got permanent stratification layers and important surface (2370 sq.km) and volume of water (560 cubic km). In the main basin of the lake from 265 m up to the 485 m depth contains **Methane (CH_4)** gas (55 cubic km), **Carbon Dioxide (CO_2)** (250 cubic km) and other gases. All the dissolved gases in the lake (44 percentage of saturation) are stable. The risk associated to the lake Kivu is open to de-stabilization of gases condition, and lake Kivu permanent stratification. In case of catastrophic scenario, there may be a chance of gas outburst after total saturation of lake water bodies affecting the human habitation around the lake Kivu and beyond. The available information *(Klaus Tietze et.al, 1975, Martin Schmid et.al 2003, Michel Hallbwach et.al 2009, Digne Rwabuhungu et.al 2011, Natasha Pasche et.al 2011)* etc. says that there is no such incident that had occurred in lake Kivu, however further studies are recommended in this regard.

8. Risk status related to air pollution

Investigation of air quality status in Rubavu City after Nyiragongo eruption from 27th to 28th May 2021 was conducted using real-time air pollution mobile monitoring with RAMPS and ATMOTRACK monitors equipped with GPS. The data obtained from mobile monitoring were compared to data from existing fixed REMA air quality monitor located in Rubavu District.

The data from 2 air quality monitoring across Rubavu City showed that air quality was relatively clean air quality data (SO2 , NO 2 , PM 2.5) were collected from a fixed continuous

air quality monitoring station located in Rubavu from one week before the eruption and another week after Nyiragongo (14th to 29th May 2021). The revealed air quality levels were consistently below the Rwanda ambient air quality standards for 24 hours mean, suggesting that the influence of Nyiragongo emissions on Rubavu air quality was less significant (Fig 6). The level of NO2 was high on 22 May 2021 compared to other days, suggesting the influence of traffic emissions due to many populations from Goma and Rubavu moving to the safest places.



Source: LKMP

9. 2002 Nyiragongo eruption experience and initiatives and lesson learnt

On January 17, 2002 Mt. Nyiragongo erupted at approximately 9:30 AM local time (2:30 AM EST). The 11,381-foot volcano produced a fissure and three paths of lava, one of which headed toward the city of Goma, 18 kilometers to the south. Out of Goma's population of approximately 450,000 people, an estimated 300,000 people fled east to Gisenyi and Ruhengeri in Rwanda, while approximately 100,000 moved west towards Sake, Bukavu, and other locations within the Democratic Republic of the Congo (DRC). Lava covered 13 percent of the city, or approximately 1.8 square miles. Mt. Nyiragongo previously erupted in 1977, when lava flow covered 20 square km, destroyed 400 houses and 10 km of road, and reportedly killed up to 400 people.

10. Damages and losses for environment sector

The following tables provides with cost, the effects of the seismic effects as well as required interventions for environment sector.

Table 3: Summary of effects to environment

S/N	Item	Cost (Frw)
1	Land covered by lava	125,000,000
2	Damaged crops	6,900,000
3	Cracked land in fault zone	7,000,000,000
4	Shaked land in Rugerero	16,030,000,000
Total		**23,161,900,000**

Table 4: Summary of proposed interventions/needs for environment sector

S/N	Item	Cost (Frw)
1	Demarcation of high-risk zone	9,840,000
2	Updating Rubavu District Land Use and Master Plans	30,000,000
Total		**39,840,000**

11. Damages and losses for environment sector

Risk management did not record many damages but will required interventions to ensure resilience for all the sectors. The two tables below provide details:

Table 5: Losses and needs associated to risk management

S/N	Item	Cost (Frw)
1	Transport and mission allowances for risk assessment teams made of geologists for volcanic eruption and seismic activity and environmentalists for air quality	6,240,000
2	Mission allowances for risk assessment teams made of geologists for volcanic eruption and seismic activity and environmentalists for air quality	7,411,500
Total		**13,651,500**

Table 6: Required interventions associated with risk monitoring

S/N	Item	Cost (Frw)
1	Geo-scientific Investigation (detailed geological, geophysical, geotechnical, geochemical, geodesy), and assessment	500,000,000
2	Study on Lake Kivu to strengthen its monitoring including but not limited to the gas partial pressure measurement	500,000,000
3	Establish the Intersectoral collaboration between MINEMA, RMB, REMA, UR and other higher learning institution, research centers, RSA, MoH, MoE, RLMUA, RWB, Meteo-Rwanda, RSB, Security organs, Rubavu, Rutsiro, Karongi, Nyamasheke, and Rusizi Districts')	60,000,000
4	Strengthening regional collaboration on Nyiragongo volcanic eruption including appointing two scientific focal points to work closely with OVG;	64,160,000
6	Revision of Rwanda Urban and Building code to guide adaptation/resilience in Kivu Belt/ western province near the rift border faults	150,000,000
7	Acquire Risk surveillance/Monitoring equipment	845,450,785
8	Update National Volcanic eruption and Earthquake Contingency Plan	12,000,000
Total		**2,131,610,785**

The table below provides details for implementation of above-mentioned proposed interventions.

Table 7: Implementation framework for risk management and environment sectors interventions

S/N	Intervention	Priority Ranking	Outcome of proposed intervention	Cost (Frw)	Capacities		Timeframe			Duration (Months)	Responsible
					Needed to implement	Available	Short term	Mid term	Long term		
1	Physical demarcation of red/High risk zone	High	Identified high risk zone and reduced risk	9,840,000	Benchmarks (328)	0	X	-	-	2	**Leads:** RLMUA/Rubavu District **Stakeholders:** MINECOFIN, RMB, RHA,RTDA, MINEMA,MoE
2	Acquire Risk surveillance/Monitoring equipment			845,450,785				X	X		**Lead:** RMB&REMA **Stakeholders:** MINECOFIN, UR/INES, RLMUA
3	Revision of Rubavu secondary City Land use and Master Plan to consider geo-hazards features	high	Risk resilience enhanced	30,000,000	Multidisciplinary Staff engagement	0	x			3	**Lead**: RLMUA **Stakeholders:** MINECOFIN, MoE, MININFRA, RMB, DP, Security Organs, Districts
4	Geo-scientific Investigation (detailed geological, geophysical, geotechnical, geochemical, geodesy), and assessment	High	Reduced risk and covered data gap	500,000,000	Consultancy firm	0	X	X	-	12 Max	**Lead**: RMB **Stakeholders:** MINECOFIN, UR, MININFRA, MoE, NGOs, RSA, DP, Security organs

5	Study on Lake Kivu to strengthen its monitoring including but not limited to the gas partial pressure measurement	High	Gas outburst risk identified	500,000,000	Consultancy firm	0		X	X	24	**Lead**: REMA **Stakeholders:** MINECOFIN,RMB ,MoE, MININFRA, MINICOM, MINEMA,DP,UR, Security Organs
6	Establish the Intersectoral collaboration between MINEMA, RMB, REMA,UR and other higher learning institution, research centers, RSA, MoH, MoE, RLMUA, RWB, Meteo-Rwanda, RSB, Security organs ,Rubavu, Rutsiro,Karongi, Nyamasheke, and Rusizi Districts')	High	Multisectoral geological survey task force established	60,000,000	Quarterly meeting	0	X	X	X	Until a specialized entity is established	**Lead**: MINEMA **Stakeholders** MINECOFIN, MoH, MoE,RMB, REMA,UR and other higher learning institution, Research Centers, RSA, RLMUA, RWB, Meteo-Rwanda, RSB, Security organs ,Rubavu, Rutsiro,Karongi, Nyamasheke, and Rusizi Districts')
7	Strengthening regional collaboration on Nyiragongo volcanic eruption including appointing two scientific focal points to work closely with OVG;	High	Timely access to Nyiragongo volcanic and geodynamic information established	64,160,000	2 Geologists	0	X	X	X	Budget per year	**Leads:** MINAFFET& MINEMA **Stakeholders** MINECOFIN, MININFRA, MoE, RMB, UR, REMA, DP.

8	Establishment of a dedicated research entity on geology and geohazard	High	Enhanced early warning, regular, monitoring, and reference data	TBD	TBD	TBD		X	X	12	**Lead:** RMB **Stakeholders:** MIFOTRA, MINECOFIN, MINEMA, NCST
9	Establish regional bilateral Lake Kivu Monitoring committee	High	Recommend ation for appropriate, Lake Kivu gas extraction to reduce the existing risk	TBD	TBD	0		X		6	**Leads:** MOE/REMA, MINAFFET **Stakeholders** MINECOFIN, MINEMA, RMB, UR/INES, RSA, DP, Security Organs.
10	Revision of Rwanda Urban and Building code to guide adaptation/resilie nce in Kivu Belt/ western province near the rift border faults	High	Anti seismic building user guide reflecting ground conditions developed	150,000,000	Multidiscipl inary Staff engagement	0			X		**Lead:** RLMA **Stakeholders:** MINECOFIN, MoE, MININFRA, RMB, DP, Security organs
11	Update National Volcanic eruption and Earthquake Contingency Plan	High	Building resilience	12,000,000	Multidiscipl inary staff engagement	0		X	X	6	**Lead:** MINEMA **Stakeholders:** NADIMAC, NADIMATEC
12	Establishing a track record mechanism	High	Monitoring and evaluation of mitigation and recovery plans	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Lead: MINEMA **Stakeholder:** MINECOFIN

12. Recommendations:

Forecasting and predicting next incidents and associated probabilistic models are only based on the historical data and comprehensive studies. Therefore, proper studies are recommended to determine the status, key factors as well as medium and long-term mitigation measures.

The following interventions are recommended for mitigation, adaptation, preparedness for resilience building.

- Direct measures to relocate affected properties along the reacted fissure zones;
- Conduct a geoscientific investigation and details assessment in affected areas and beyond (along the rift valley in Rwanda);
- Research on Lake Kivu to strengthen its monitoring including but not limited to the gas partial pressure measurement;
- Develop a long-term plan for Lake Kivu gas extraction to reduce its likelihood of saturation;
- Improve collaboration with similar institution in regional and abroad;
- Put in place a dedicated geo-hazard monitoring and research entity with allocated budget;
- Capacity building at multi-layer with multi-stakeholders on constructing hazard resilient building;
- Put in place a user guideline that will lead future urbanisation and infrastructure development along the rift valley;
- A continuous real-time monitoring system for ash and gases is required to track spatial variation in air quality to the City of Rubavu located in volcanic areas.

ANNEX 6: EDUCATION

1. Introduction

Schools affected by earthquakes ground shaking amount to 28 schools but 7 of them were severely hit and need to be relocated as they were crossed and severely damaged by fault line (rift). These include: Ecole des Science de Gisenyi, Gacuba II, GS Muhato, CS Rubona, Institut Pentecotiste de Gisenyi, ES BF, and College Baptiste. Damages in schools included 135 classrroms, 48 latrines, 2 offices, 7 dormitories, 1 dining hall and 2 kitchen.

The above affected schools were relocated to GS Ubumwe, CS Gabiro, GS Buhaza, GS Nyarubande, GS Gacuba II/A, and Institut St Fidele (former RTUC campus, SC APEFE Mweya). The total effects of damaged houses are estimated at 2,025,750,000 while total amount of relocation of damaged schools are 8,852,483,000 (costed by housing sector) and continuous costs incurred by relocated schools in transportation,awareness and hygienic facilities are 39,830,682 Frw.

2. What was done so far

- Identification of damaged schools' infrastructures;
- Relocation of students to safer places/schools;
- Verification of students attending and missing class;
- Back to school awareness campaigns were conducted through meeting and advertisements on local radio stations, currently school attendance for affected school is at 95%.

3. Issues/challenges

- School overcrowding where students were relocated;
- Health and safety issues associated with relocation, for instance students relocated to Nyarubande from Muhato use a G+1 under construction;
- No access to science labs for schools having science combinations;
- Meals are prepared from affected schools to place of relocation, this incurs transport cost;
- High relocation cost of infrastructures affected/damaged by earthquakes.

4. Recommendations

- Immediate rehabilitation of damaged infrastructures (classrooms, latrines, water, electricity, etc.);
- Bring back a portion of students and teachers to schools where non-affected classrooms can still be used (e.g., CS Muhato);
- Replacement of totally damaged infrastructures;
- Strengthening back to school campaigns through constant meetings, local radio announcements and village campaigns through (amasibo).

5. **Identified damages and losses per school**

Ecole de science de Gisenyi

- The rift passed beneath 2 boys' dormitories, 3 classrooms and Head Teacher's office;
- The two dormitories were destroyed beyond repair, so to be replaced;
- Students were all relocated to Ex St Fidele.

CS Gacuba DC

- Five classrooms were destroyed, hanging with cracks - no longer in use;
- Students were relocated to Kivumu;
- Twelve latrines were also destroyed.

Institute Pentecotiste de Gisenyi

- The rift crossed 3 dormitories, 1 dining hall and 1 kitchen;
- Facilities no longer in use;
- Students relocated to TTC.

GS Muhato

- Twelve classrooms and 12 latrines were totally damaged;
- Students relocated to Nyarubande, Gabiro, Buhaza and Ubumwe (students travel long distance to access the schools).

CS Kirogi

- Seven classrooms were damaged;
- Students relocated to GISA Primary School.

CS Kinogo

- Six classrooms were damaged;
- Head Teacher's Office.

6. **Recovery needs**

Recovery needs include but not limited to:

- Immediate rehabilitation of damaged infrastructures (classrooms, latrines, water, electricity, etc.);
- Bring back a portion of students and teachers to schools where non-affected classrooms can still be used (e.g., CS Muhato);
- Replacement of totally damaged infrastructures.

The table below illustrates number of schools with damaged infrastructures and specific needs for recovery for each case.

Table 1: Schools affected

S/N	Name of the school	Damaged infrastructure	Figures	Number of relocated students	School hosting relocated students	Recovery needs
1	Ecole de science de Gisenyi	Dormitories	2	864	Saint Fidele	Replace damaged infrastructure
		Classrooms	3			
		Office	1			
2	CS Gacuba DC	Classrooms	5	527	GACUBA IIA	
		Latrines	12			
3	Institute Pentecotiste de Gisenyi	Dormitory	3	351	TTC	
		Dining hall	1			
		Kitchen	1			
4	GS Muhato	Classrooms	17	330	EP Nyarubande	
		Latrines	12			
5	CS Kirogi	Classrooms	7	209	EP GISA	
		Latrines	12			
6	CS Kinogo	Classrooms	6	0	NA	
		Office	1			

7. Actions for resilience

Actions for resilience for Education sector in Rubavu include but not limited to the aspects contained in the following table:

Table 2: Required actions for resilience

S/N	Resilience action	Responsible agency	Unit cost (in Frw)	Approach & Frequency	Cost (in Frw)
1	Increase level of awareness (e.g., meeting, local radio stations, etc.) in schools and communities on seismic activities in the region and proper conduct during disaster	MINEDUC MINALOC RUBAVU DISTRICT	18,290	Radio announcement twice a day for 30 days	1,097,400
2	Back to school campaign for missing teachers and dropped students	MINEDUC DISTRICT	5,000	For 84 cell executive secretary for 30 days	12,600,000
3	Cover cost of access to laboratories for those relocated to other schools (e.g., ESG, TTC Gacuba)	MINEDUC RUBAVU DISTRICT	295,000	Rent of bus for a month of 176 students on daily basis	8,850,000

4	Cover cost associated with relocation (transportation of food)	MINEDUC RUBAVU DISTRICT	20,000	For 60 days for ESG & TTC Gacuba	1,200,000
5	Provision of water tanks to schools	MINEDUC RUBAVU DISTRICT	1,818,127	6tanks of 10,000 liters	10,908,762
6	Provision of Group handwashing facilities to prevent spread of COVID-19	MINEDUC	862,420	For 6 schools	5,174,520
Total					**39,830,682**

The table below provides the implementation framework of required actions for resilience in education sector.

Table 3: Implementation framework

S/N	Intervention	Cost (Frw)	Priority	Timeframe	Responsible	Duration (Months)
1	Rapid response	1,200,000	High	Short time	**Lead:** MINEDUC **Stakeholders:** RUBAVU District and MINALOC	3
2	Facilitating all children back to school	12,600,000	High	Short time	**Lead:** MINEDUC **Stakeholders:** RUBAVU District and MINALOC	3
3	Increase level awareness (e.g., meeting, local radio stations, etc.) in schools and communities	1,097,400	High	Short time	**Lead**: MINEDUC **Stakeholders:** RUBAVU District and MINALOC	3
4	Provision of water tanks to schools	10,908,762	High	Short time	**Lead** MINEDUC **Stakeholders**: RUBAVU District and MINALOC	3
5	Installation of group hand washing	862,420	High	Short time	**Lead:** MINEDUC **Stakeholders:** MINALOC, RUBAVU District	3
	Total	**39,830,682**				

ANNEX 7: HUMAN IMPACT, LIVELIHOOD AND SOCIAL ASSISTANCE

1. Pre and post disaster context

When Nyiragongo erupted, the social situation of Rubavu was normal, in the context of covid-19, but all activities and livelihood routines were normal. The earthquakes that followed the eruptions have provoked many changes on the social setting due to the facts that many families have lost their houses; many people were not able to do their day-to-day income generating activities. Basic social infrastructures were deeply affected including the city hospital, markets, and utilities.

However, Government and partners' response efforts have been able to cover basic needs including food, non-food items (bed kits, hygienic and kitchen sets) and shelter. Social assistance was extended to displaced people who crossed from DRC and spent few days in Rwanda waiting for the situation to become more stable.

More generally, effects on social welfare can also be assessed with consequences to other sectors considered by this report.

2. Losses encountered by affected families

The table below describes losses related to human and livelihood impact.

Table 1: Description of losses related to human and livelihood impact

S/N	Description	Number of family affected	Type of affected area	Observation
1	Destroyed/damaged houses	2,990	Accommodation	Vulnerable People more affected have got rented house or are accommodated by families and neighbors.
2	Number of HH in need of temporary accommodation to be rent due to the fact that their houses have been completely destroyed while waiting for a permanent solution	359	Accommodation	
3	Limited health services	1,764 people (using daily services provided	Medical services	
4	Daily livelihood activities stopped	3107 families (bread winners)	Income	
5	School drop out	1206 students	Education	

3. Social assistance effects and recovery needs

Interventions conducted to provide humanitarian assistance to cover the impact on affected families' livelihood are also considered as losses since without the seismic incidents the expenditures should not have activated. The table below provides details:

Table 2: Cost of damages and losses

S/N	Description	Item	Cost (Frw)
1	**Damages and losses**	Cost of food items	124,808,200
		Cost of NFIs	99,312,000
		Emergency expenditures	30,183,600
		Assistance to DRC displaced population Refugees	128,701,600
		Renting (Emergency phase)	53,850,000
		Facilitate emergency operations	20,500,000
		Total	**457,355,400**
2	**Recovery needs**	NFIs	532,400,000
		Renting (Post emergency phase)	60,300,000
		Coordination of emergency interventions	12,600,000
		Total	**605,300,000**

Basing on the effects recorded and the interventions conducted, affected community shall be provided with essential infrastructures through other sectors (education, health, housing …). However, vulnerable groups will need to be considered into next financial year social protection schemes and continuous assessment will be required to ensure affected people are assisted.

ANNEX 8: THE LIST OF STAFF AND INSTITUTIONS THAT DEVELOPED THE PDNA REPORT AND RECOVERY PLAN

a) Multisector team

No	Names	Institution	Position	Tel
A. Technical coordination				
1	HABINSHUTI Philippe	MINEMA	Director of Response and Recovery	0788300216
2	NKURUNZIZA Aimé	MINECOFIN	Sector Investment Officer	0789176787
B. Risk monitoring				
3	Dr. RWABUHUNGU Digne Edmond	University of Rwanda	Dean of the School of Mining and Geology	0788665258
4	SAKINDI Gaetan	REMA	Geodynamics Specialist	0788515232
5	HABIYAKARE Titus	RMB	Seismology Stations Technician	0788472887
6	NTENGE Alain Joseph	RMB	Geology Specialist	0788287440
7	TWAGIRAMUNGU Deus Dedit	MINEMA	NECC Staff	0788858325
C. Environment sector				
8	KAYONGA Leonard	RLMUA	Ag/Land Use Compliance and Inspection Specialist	0788491881
9	MUHAWENIMANA Seth	MOE	Land Management Specialist	0788799338
10	HARELIMANA Innocent	RUBAVU DISTRICT	Environmental Officer	0788776202
11	Dr. NSANZIYERA Ange Felix	INES RUHENGERI	Head of Department of Land Survey	0787715706
12	YAMBABARIYE Elizabeth	MINEMA	Drought and Flood Risk Management Engineer	0788810262
D. Education sector				
13	MUSONI Bruce	MINEDUC	Environmental Safeguard Specialist	0788559928
14	NIRAGIRE Eric	RUBAVU DISTRICT	School Engineer	0782467710
15	BRENDA Chantal	MINEMA	NECC Staff	0788681229
E. Trade and business sector				
16	MUHIGI Zephania	MINICOM	Cross Border Expert	0788350686
17	MWISENEZA Emmanuel	RUBAVU DISTRICT	Director Business Development Unity	0788848602
18	NYIRANSABIMANA Fernande	MINEMA	NECC Staff	0788474104
F. Health and sanitation sector				
19	MUKAMUNANA Alphonsine	MINISANTE	Environmental health specialist	0788673500
20	UMULISA Brigitte	RUBAVU DISTRICT	Health Promotion and Disease Prevention	0788613636
21	TWISHIME Jean Claude	MINEMA	PRO	0788221479

G. Transport and water infrastructure				
22	UWANJYE MUNYANEZA Yvette	RTDA	District Feeder Roads Design Senior Engineer	0788687505
23	KABAGAMBE Innocent	MININFRA	Transport SWAP Secretariat Coordinator	0788300671
24	SSP KARISA Benon	MINEMA	NECC Staff	0788441145
25	MULINDABIGWI Gilbert	WASAC RUBAVU	Branch Manager	0788595962
26	NSABIMANA Edison	WASAC RUBAVU	Distribution Officer	0788317447
27	BUTERA Laurent	REG RUBAVU	Head of Branch	0788775679
H. Housing infrastructure				
28	MANIRAGABA Dieudonne	RHA	Construction Senior Engineer	0788785755
29	MIZERO Gisele	RHA	Building Inspection Engineer	0783640761
30	MUSONERA Jean Claude	RHA	Building Inspection Engineer	0788719488
31	Maj MFIZI Ernest	RDF	RDF	0788852442
32	GASUKU Oscar	RUBAVU DISTRICT	OSC- Rubavu District	0788863097
33	HABYARIMANA Jean	MINEMA	NECC Staff	0788463052
34	MUCYOWERA Isabelle	MINEMA	NECC Staff	0785150393
35	KARANGWA Eugene	RRCS	Head of Risk Reduction and Preparedness	0788434404
I. Human impact, social assistance and livelihood				
36	BAHAME Hassan	MINALOC	DG Social development	
37	HAGENIMANA Epimaque	RUBAVU DISTRICT	Director Social Development Unit	0788550289
38	BIKORIMANA Lucien	RUBAVU DISTRICT	DDMO	0788246752
39	KAYUMBA Liliane	MINEMA	NECC Staff	0788312731

b) Partners staff

1. Ms Marleen Masclee, Country Director, TROCAIRE representing NINGO.
2. Wilson Nyangusei, Security Officer, World Bank, representing DP.
3. Mr. Bibhuti Gadnayak DRM Specialist, UNDP representing the UN