United Nations Disaster Assessment & Coordination (UNDAC)

DEMOCRATIC REPUBLIC OF CONGO EARTHQUAKE IN THE GREAT LAKES REGION

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UNDAC Team

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1. Background Information

The East Africa Rift Valley System is one of the most seismically active regions in the African Continent. The Lake Kivu basin is among the most active region in this Rift. Earthquakes frequently damage villages and towns in the Lake Kivu basin. The earthquakes also generate landslides on slopes of mountains or hills surrounding Lake Kivu. Seismic studies and field observations show that, since 1997 the Lake Kivu basin has become more active than usual. Several moderate earthquakes with local magnitude more that 4.0 associated with foreshocks and aftershocks are recorded in the basin every year. People are frequently injured or killed by both earthquakes, and landslides. Bukavu city, located on the south-western shore of the lake, is worst affected.

An earthquake of magnitude 6.1 on the Richter scale struck the province of South Kivu, in Eastern Democratic Republic of Congo on Sunday 3 February 2008 at 07H35 GMT (09H35) local time. The epicentre of the earthquake lies approximately 20 km north of the provincial capital, Bukavu, in the locality of Katana (Kabare Territory) at a depth of 17 km. Continuous aftershocks have been felt. A second earthquake was recorded 25 kilometres from Bukavu at 02H07 GMT (04H07) local time with a magnitude of 5.4

The National Government of DRC requested that an UNDAC team carry out an assessment of the damage and provide a risk analysis report.

2. Mission Objectives

Engineering assessment of earthquake damaged buildings
Environmental assessment of earthquake damage
Preliminary disaster preparedness measures

3. National Response

The government was able to make a rapid assessment in the first few days of the first earthquake. Within hours of the UNDAC team's arrival a list of priority buildings had been drawn up for structural assessment. These buildings were those which might be in danger of collapse and a significant risk to the public. Many schools were awaiting assessment before allowing children back into the classrooms.

4. Assessments

a) The Built Environment

The immediate danger was from falling debris and the collapse of a number of buildings. Due to the shortage of structural engineers the government was not able to assess the buildings and determine their safety even when only slightly damaged. The risk of children returning to schools, patients and medical staff to hospitals and clinics, in these conditions made a structural assessment essential.

After an initial survey and non technical assessment by the Logistics cluster around Bukavu, a schedule of assessment inspections was prepared by the Mayor's office. The UNDAC building assessment team was composed of two structural engineers, a government official and a local driver.

As the engineers began assessing damaged structures the need for a common methodology and classification of damage was noted and addressed. The spreadsheet formed the common basis for reporting.

Structural Assessments

Assessments of the structural integrity of sixty structures were undertaken by the engineers.

- Government Buildings
- Educational Facilities
- Medical Facilities
- Commercial premises important for local economy
- Public Assembly

The assessments ranged from a relatively detailed inspection to a rapid overview. The main objectives of the assessments were to identify buildings that were safe to occupy and to recommend remedial action for those that had structural hazards. GPS coordinates were taken of all the structures surveyed. The details of each assessment are provided in the attached Appendices, which include an estimate of the amount of damage to a structure expressed in categories 1 to 7 ranging from 'no damage' to 'total damage' noted on explanatory charts with the text and appendices.

Public Building Construction

Typically there are two types of building construction used for public buildings and schools, those with an un-reinforced masonry frame and those with a reinforced concrete frame.

Un-reinforced Masonry Framed Structures

Structure:	Masonry piers with masonry ring beam and roof trusses.
Walls:	Brick in fill panels to full heights. Transverse walls generally not tied in to front and back lateral walls.
Roof:	Corrugated iron roofing sheets, or clay tiles over timber purlins.
Floor:	Typically thin un-reinforced concrete slab.
Foundations:	Mass concrete strip or pad footings

Reinforced Concrete Framed Structure

Structure:	Reinforced concrete beams and columns. Columns typically 300mm x 300mm, reinforced with 6mm or 10mm diameter mild steel bars. Concrete Ring Beam at eaves levels.
Walls:	Clay fired brick or concrete block panel infill, untied to the reinforced concrete frame.
Roof:	Timber Truss with corrugated iron sheeting.

Floor:	Reinforced concrete slab.
Foundations:	Reinforced concrete strip or pad footings.

Reinforced Concrete Framed Double Storey or Greater Structure

Structure:	Reinforced concrete beams and columns.
Walls:	Clay fired brick or concrete, panel infill untied.
Roof:	Concrete slab with waterproof membrane.
Floor	Reinforced concrete slab
Foundations:	Reinforced concrete strip or pad footings. Multi storey structure pile foundations.
Movement Joints:	20mm joints filled with compressible materials every 25m along the building. The joints allow the building to accommodate limited movement.

Factors influencing collapse/partial collapse

- Poor building design for example
- Distance between columns too large
- Columns/Beams incorrectly sized
- Walls too high without restraints
- Inadequate cross bracing or shear walls.

Poor Construction practices for example:

- No ring beam present
- No wall ties to columns
- Transverse walls not tied into lateral walls
- Inadequate compaction of concrete
- Inadequate lap lengths on reinforced bars in columns and beams
- Low compressive strength of concrete

Poor maintenance of buildings for example:

- Rotting timber purlins
- Ceiling panels exposed to elements
- Leaking roof

Poor quality control of construction materials for example:

- Insufficient cement in concrete min 200kg/m3
- Large size aggregate >25mm

Conclusion

The most extensive structural damage was sustained in the un-reinforced masonry framed buildings. The majority of public buildings and schools in this category were constructed pre 1950. Historically masonry framed buildings have not performed well in earthquake situations because the structural components act as individual elements rather than compact units. The common problems that are evident in these buildings are:

- Collapsed parapets
- Separation of gable walls
- Random cracking and plaster spalling of unrestrained compartment walls
- Unstable roof due to movement of support walls.

Fortunately this form of construction in relation to Public Buildings appears to have ceased in 1950 and the preferred method of construction adopted was the RC framed buildings. The large reinforced concrete structures built in the region in the early 1950s are testament to the understanding the designers had of the particular geological conditions that prevailed in the region. The construction of these buildings were considerable feats of engineering in the 1950s and have performed exceptionally well in an earthquake zone. The damage caused to these structures by the earthquake on 3 February 2008 is superficial and the majority of the buildings are at full occupancy.

The fundamental reason for the success of this form of construction is:

- Rigid concrete frame that can redistribute loads when additional pressure is placed on structural elements.
- Movement joints incorporated into the building approximately at 25 metre centres.
- Strong foundations built on good ground.
- Relatively small infill wall panels.
- Rigid concrete stairwell cores.

The buildings constructed in recent years have performed adequately during the earthquake. The construction methods for buildings other than domestic houses is relatively good. This has contributed greatly to the limited number of buildings that fully or partially collapsed as a result of the earthquake.

Approximately 12% of the buildings that were examined by the UNDAC team will require full or partial demolition. A further 10% require remedial work to be completed before they can be fully occupied. Of the buildings that require demolition only one was built post 1950.

Recommendations

Short term

Demolish unsafe buildings and provide temporary office accommodation.
Undertake remedial work on educational facilities that cannot be fully occupied.
Demolish non structural parapet walls which do pose a danger in an earthquake prone area.

Medium Term (next three months)

Existing masonry structures to be strengthened to improve their ability to withstand seismic forces. Information awareness campaign to building contractors on importance of good fundamental construction techniques. i.e. movement joints, rigid frame, etc….

Long term (next 12 months)

Rebuild the damaged public buildings to reinforce confidence in government and show way forward to public.
Ensure that all future structures built are sympathetic to the earthquake environment.

b) Landslides

As a result of the two earthquakes and aftershocks two old landslides have been reactivated in Bukavu city. There was no direct loss of life. However, the ITFM landslide damaged the electrical distribution network supplying public buildings infrastructure and residential homes. This remains unrepaired.

The reason that the city of Bukavu suffers from frequent landslides is a combination of the hot and humid tropical climate and the fact that the city is built on very old lava flows, and thick clay soils. It is also cut by several active faults (see annex 10) known as the Bukavu micro-rift. 15% of the town is at risk of landslides and the larger landslides occur in this micro rift triggered by both hydrological and seismic events.

Deforestation, and a large increase in the population, have been an indirect cause. On the steep slopes to the south of the city the high density of newly built houses has led to reduced water infiltration and enhanced run off, causing landslides and mudflows. This has caused continual damage and destruction of buildings, roads, waterworks, and sewerage infrastructure and in the worst cases loss of life.

Since 1997, the seismic activity has increased, accelerating the landslides already present in the basin. Landslides are more likely to happen in the rainy season increasing the risk from an earthquake of same magnitude.

Comment

Most Bukavu soil movements occur on previous slides. Even though the mechanism of landslides is not well understood, enough is known to guide the building regulation and town planning of Bukavu. This would minimize the danger to both people and infrastructure. This is particularly relevant to the ITFM landslide. Old landslides should be avoided.

c) Basic Needs

All basic needs were met after the earthquake. The government, the United Nations and humanitarian agencies have sufficient stocks to provide for all those directly affected by the earthquake.

Water

There was no interruption of town supplies and the network is robust enough to survive further seismic activity.

Medical

The government and humanitarian agencies were able to treat all those injured by the earthquake. However 56 medical facilities were damaged by the earthquake and require repairs.

Food Security

Bukavu is self sufficient in food. WFP distributes 1,500 MT a month to vulnerable groups and has reserve stocks of 3,000 MT in Bukavu. Supplies of food come from both Tanzania and Uganda where a strategic stock of 37,000 MT is stored. A policy of local purchase from both Uganda and Zambia mean that there is no dependence on an overseas supply. More than adequate food stocks were available for those affected by the earthquake and any future emergency.

Shelter

UNICEF and OCHA have a rapid response mechanism in place to provide relief items for those affected by a natural disaster.
UNHCR has limited stocks in Bukavu but enough blankets, kitchen sets and plastic sheeting for 2,000 families. Larger stocks are kept in Goma and regional stocks are held in Tanzania.
ICRC has its country logistics base in Bukavu and have large stocks of NFIs (7,000 families) as well as water and sanitation equipment.

d) Maintenance of Normal Market Mechanisms

Road access

The earthquake has not disrupted the road network. However, the roads are in a very poor state of repair.

Comment

International intervention in the event of a major natural disaster, whether earthquake or volcanic eruption, would be severely impeded by the condition of the roads.

Fuel supplies

Monthly fuel supplies held in Bukavu are on average 570,000 litres of petrol, 600,000 litres of diesel, 280,000 litres of JetA1 (aviation fuel). MONUC has its own fuel supplies in Bukavu. Fuel supplies come from Mombassa. There was no disruption caused by the earthquake.

Bridges

There are no reports of bridges damaged during the earthquakes and subsequent aftershocks.

5. Environmental Assessment

It is well known that the damage caused by earthquakes on infrastructure and industrial installations can pose a direct risk to human health, and a long term impact on the natural environment.

On arrival in Bukavu the UNDAC Team environmental experts assisted the government identify sites which might pose an environmental risk and needed to be assessed.

The following sites has been identified and assessed by the UNDAC Team:

Site #	Name & location	Potential risk	Date of visit	Contact person on site
1	Inspection provinciale de l'agriculture	Pesticides, fertilizers	14.02.08	Inspecteur provincial
2	Service national de l'electricité (administration)	Ruzizi dam Interruption of electricity distribution	14.02.08	Director
3	Régie des Eaux (water board)	Chemicals for water purification Interruption of water distribution	14.02.08	Director
4	Kotecha-Plastic industry	Chemical products	14.02-08	General director
5	Gas station	Oil spill/fire/explosion	14.02.08	Manager
6	Chinese public works	Oil spill	14.02.08	Operating manager
7	Custom warehouse	Hazardous substances Storage	14.02.08	General inspector
8	Business Petrol Oil	Oil spill	15.02.08	Technical operator
9	Société Exploitation du Pétrole	Oil spill	15.02.08	Operating manager
10	Bralima (Brewery)	Oil/chemical spill/toxic gas	15.02.08	General manager
11	Landslides 1. Institute Technique Fundi	Landslide posing direct risk to the population and	18.02,08	Technical director SNEL

	Maendeleo 2. Lycee Wima 3. Bagira	infrastructure		

During the site assessments it was clear that no direct impact on human health had been observed. Each site, including findings, conclusions and recommendations is described in the separate environmental report .

Summary

On arriving in Bukavu the UNDAC Team's environmental experts have worked with the government to identify infrastructure, and industrial installations, which could have been damaged by the two earthquakes and landslides. By inspecting these sites they have been able to assess the direct impact, potential long term impact on the population, and effects on the natural environment.

Bukavu suffers from landslides which pose a direct risk to population. Several landslides have been assessed (Institute Technique Fundi Maendeleo, Lycee Wima canyon, both within Bukavu and Nyakavogo in Bagira). ITFM and Lycee Wima canyon have both been affected by the 3rd and 14th February 2008 earthquakes whereas the Bagira landslide appeared to be unaffected.

During the assessment of the infrastructure and industrial installations no direct impact on human health has been monitored. The assessment clearly identified several issues, which in the event of another earthquake are dangerous to the inhabitants of Bukavu and the surrounding area. It also highlighted those issues which would have a long term impact or cause the pollution of Lake Kivu.

The storage of oil and other chemicals at industrial installations is conducted to very low safety standards. In the event of an earthquake these facilities are a major fire risk. None of the oil or chemical storage sites is designed to cope with a sudden leak. If affected by an earthquake or landslides they would be responsible for widespread pollution. Due to the location of the majority of these installations, the main risk would be pollution of Lake Kivu. All installations storing oil or other hazardous chemical must be brought up to a higher standard. This would include earthquake proof pipe connections, and secured storage. All tanks must be bunded.

Landslides are believed to be the biggest threat to the population. To identify the future potential risk to each installation from earthquake and/or from landslides it is important to produce a hazard map of the fault system in the region and all historical reported landslides in Bukavu. It may be possible to address the relationship between these two destructive mechanisms. The outcome should be used to plan improvements of the storages facilities. It should be a key element in the future city planning. The danger to sensitive infrastructure and installations and the population would be considerably reduced.

Recommendations

Improve the safety standards of the industrial installations containing hazardous substances

Detailed mapping of the landslides and existing faults

Relocate the people living on the steep slopes of the ITFM landslide

Setting up a risk assessment and management unit specialized in natural disaster prevention with a special focus on landslide and earthquake. The setup in Goma (Unité de Gestion des Risques) could serve as a model

Develop an environmental emergency contingency plan based on risk mapping and risk assessment

Mapping of the locations of landslides and fault lines which can disrupt the electric lines and either stabilizing the ground which support the poles or finding an alternative route.

Carry out a PCB inventory on old transformers

6. Regional Context

The earthquake in Bukavu has to be seen in the context of the unstable situation of Nyiragonga volcano 15 km north of the city of Goma. A major volcanic event could be triggered by further seismic activity releasing a high speed lava flow unto the town. The simulation carried out by the Volcano Risk Reduction/UNOPS-UNDP shows lava flows engulfing the town cutting escape routes to high ground to the East (Rwanda) which the population used in 2002. The road to Kigali and Kigali airport would also be cut off. In 2002 it was not an eruption but a leak of lava from a fissure which released 20 million cubic metres much of which flowed through the city. Nyiragonga's lava lake now contains 200 million cubic metres of molten lava. Another major earthquake could fracture the mountain and release 200 million cubic metres of lava onto the city.

There is an indirect risk of gas emissions from the volcano. It is the highest producer of sulphur dioxide in the world, between 50,000 – 60,000 tonnes a day and a cause of acid rain. Fluoride is also present in the gas. The wind blows in an east west direction but occasionally affects the city to the south. Fluoride manifests itself as a problem for people living in small villages who rely on collecting rain water for drinking. Measurements collected show that fluoride concentration is in excess of 25mg per litre. The recommended level is 1.2mg per litre.

Comment

The possible consequences of a volcanic emergency at Goma would be that access to Kigali, the airport and the good road to Rwanda would be blocked by lava flows. If this occurs the only air and road access for international support is Bukavu airport. The road in a poor condition and the journey takes seven hours. The runway at Bukavu airport is 2000 metres and the airfield is at 5,500 feet. Aircraft loads are limited by density altitude and the ramp space unsuitable for a major international relief operation.

7. Contingency Plans

Support for the population

Historic contingency plans focussed on conflict related risk to UN agency and NGO staff, their protection and evacuation. The increased seismic activity in the Lake Kivu rift has increased the

probability of the population being affected by both a volcanic emergency and future earthquakes. This has changed the focus from conflict related risk to the vulnerability of the general population.

Comment

In the event of another major earthquake it is important that the agencies, in conjunction with the government, have contingency plans to extend support to the general population.

Public Information Campaign

There is no information campaign about the dangers of both landslides and earthquakes. The population has very little knowledge of the cause of seismic activity in the Rift Valley and its impact on their lives.

Comment

There is a need to inform both local government and the population about the dangers of earthquakes and landslides.

Building Regulations and choice of Material

The increased seismic activity has made the choice of building materials and enforcement of building regulations an important component of risk reduction.

Materials used for building construction vary in the region. Building frames are commonly of reinforced concrete construction, however the quality of the concrete materials design and construction techniques are variable and commonly poor.

Cement is manufactured in the NE region. Gravels and sand from the lake are commonly used in concrete construction as there is limited availability of crushed aggregate.

There is only very limited use of structured steel. Around Bukavu clay fired bricks made from the clays from the nearby hills are commonly used.

Geo technical Aspects

The quality of the foundation pads or strips on small structures (1/2 storeys) is most likely of relatively poor quality un-reinforced or poorly reinforced concrete. These foundations are shallow which are particularly susceptible to ground movement.

Some of the more substantial buildings, particularly those with heavy loading may be supported on raft of pole foundations. Piles may have been driven down to bedrock or to frictional resistance within the deeper sediments.

As a result of seismic activity two forms of vibration or pressure waves are formed; P waves in which the motion is vertically up and down and S waves in which the movement is lateral along an axis emanating from the earthquake epicentre. The S waves travels at about one third the speed of the P wave, so that if there were a single event the lateral motion would be felt after the vertical

motion. In practice however, there are numerous wave generation events occurring consecutively so that the vertical and lateral motion commonly interact.

The above geo technical information is provided to assist understanding of the motion which is experienced by the foundation of a structure. The behaviour of the structure is then largely controlled by its structural stiffness and ability to withstand the vertical and lateral forces transmitted from the foundation.

Town planning

Houses have been built on or near old landslides. Others are built in areas where the probability of landslides is high.

Comment

There is the need for a hazard map so that building near landslides or in areas prone to landslides is avoided.

8. Key Issues

Provide reassurance where appropriate on the safety of public buildings so that normal life can resume.
Establish a repair programme for key public buildings.
Establish contingency plans for future earthquakes.
Reduce the threat of environmental hazards in the event of a future earthquake.
Strengthen local infrastructure damaged by seismic activity.

9. Overall Constraints

Assessments were constrained by Phase 4 security outside Bukavu and the extremely poor condition of the roads. Average road speeds were less than 15kph.

10. Recommendations

a) Disaster preparedness measures to be established

- Risk management unit established
- Contingency plans prepared
- Public awareness campaign for landslides and earthquakes
- Procedure for the dissemination of information to the public in event of an emergency
- Introduce building regulations for construction techniques suitable for seismic events
- Airport road repaired to allow international support in an emergency

b) Infrastructure should be strengthened and repaired

- Urgent repairs to the Ruzizi hydro-electric power station damaged by the earthquake
- Electricity distribution lines repaired and re-routed against landslides
- Government offices repaired and 5 new offices constructed
- Medical facilities repaired
- Schools repaired

c) Environmental measures

- Commercial premises advised on environmental risk if appropriate
- Relocate domestic housing and electric pylons at risk from ITFM landslide

11. Earthquake Rehabilitation Projects

a)	Repair to government offices		$600,000
b)	Health		$400,000
c)	Education		$430,000
d)	Disaster preparedness		$800,000
e)	Electricity Distribution		$450,000
		Sub total	$2,680,000
f)	Electricity generation		Uncosted
g)	Airport access road		Uncosted

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Annex 1

Medical Facilities

Background

The two earthquakes, 3rd and 14th February 2008 damaged healthcare facilities in Bukavu and surrounding areas. Bukavu city was the most seriously affected.

Some facilities have structural damage but even where there is only superficial damage it has been difficult to persuade both the medical staff and patients that the buildings are safe. Most facilities are in a very poor state of repair.

Bukavu city is in the centre of an area with high risk of a major earthquake. It is essential that the health facilities are able to cope with large number of injured if such an event occurred.

Proposal

It is proposed that the government is given assistance to refurbish 20 damaged medical facilities.

Provisional Budget

$20,000 would be required for each building.

Timescale

The project would be completed in six months.

Project Support

International management support would be required to assist the government for the duration of the project (6 months).

Budget

Total $400,000

Annex 2

Education

Background

The two earthquakes, 3rd and 14th February 2008 damaged schools in Bukavu and the surrounding area. The UNDAC team (deployed Feb 10-23) provided two structural engineers to provide a technical assessment and give advice on the safety of many of these buildings. Considerable structural damage has occurred to the worst affected schools and where there is only superficial damage cracked walls have caused great anxiety about the safety of the building to both staff and pupils. The schools are in a very poor state of repair.

Proposal

It is proposed that 20 of the worst affected schools are repaired. At 2 of these schools new class rooms are needed to replace those destroyed by the earthquakes.

Provisional Budget

$20,000 would be required for each school.
S30, 000 would be required to replace the 2 classrooms.

Timescale

The project would be completed in six months.

Project Support

One full time UNICEF staff member would be required to assist the government for 6 months.

Budget

Total $430,000

Annex 3

Government Offices

Background

Five public buildings have been have been severely damaged by the earthquakes.

SENASEM Dept of Agriculture/Centre for Seeds/Laboratory and Offices
Government Administration Building
Bureau Commandement GMI/Q Industrial
Bureau Communal Ibanda
Bureau Commandement PNC Ville de Bukavu

These buildings are structurally unsafe and need to be demolished. These buildings should be rebuilt. The reason for rebuilding these structures is twofold. One is to ensure that these institutions are functioning and to reinforce confidence in the Government. The other is to highlight the recommended building techniques for future structures. These buildings should be models of basic and practical construction techniques to overcome difficulties in earthquake zones.

Proposal

It is proposed to fund the demolition and construction costs of the five badly damaged public buildings in Bukavu. The proposed structures will all be single storey structures of similar footprint to the original buildings. The proposal envisages the buildings being completed to a standard where the government can take vacant occupancy of them. This means that finishes and services must be included in the project. The temporary accommodation for the staff will be a local government issue.

Provisional Budget

It is expected that $125,000 should cover the cost of each building.

Timescale

Twelve months.

Project Support

A project manager with a civil engineering background should be appointed to oversee the reconstruction. There is no local capacity within the governing administration to oversee such work.

Budget

It is expected that the total cost of repairs will be $600,000.

Annex 4

Bukavu Airport Road (Humanitarian Infrastructure)

Background

The increased seismic activity in the densely populated Lake Kivu region of the Rift Valley has increased the danger of a humanitarian emergency from both earthquakes and the Nyiragongo volcano at Goma.

The extremely poor air and road communications with Bukavu would have made it very difficult to deliver international support had the major earthquakes of February 3rd and 14th 2008 led to a major loss of life.

In the event of a renewed volcanic event at Goma simulation of lava lows from Nyiragongo would cut the road to Rwanda and the international airport at Kigali. Bukavu airport would have an important role in either another earthquake or volcanic emergency. Access to Bukavu would be seriously impeded by extremely poor road condition. The journey time from Bukavu to the airport in dry conditions takes two hours, an average speed of only 15 kph for the 30 kms.

Proposal

Emergency repairs to the Bukavu – Airport road

Timescale

Six months.

Budget

Financial appraisal for this project has already been made.

Project Support

Consultant adviser to provide training and management support.

Annex 5

Risk Management Unit and Disaster Preparedness

The increasing seismic activity in the Lake Kivu Rift has put the population at greater risk from both earthquakes and landslides. A comprehensive risk management mechanism is required to reduce this risk. A risk management unit set up by the government in Bukavu and supported by the international community could fulfill this role. This unit would should initiate preparedness measures and improve the response in case of a natural disaster.

Findings

In general, there is a lack of awareness amongst the private and public sectors about natural disasters and their possible consequences on the population, the infrastructures and the environment.

There is no mechanism in place for risk assessment, management and mitigation.

Existing information, studies and surveys concerning the natural disasters in the region should be collated in one focal point to serve as a base for further investigation and for risk management.

Conclusion

There is an urgent requirement to establish a risk management unit in Bukavu for earthquakes and landslides. This would provide:

- Reliable information on the most vulnerable area (risk mapping)
- An inventory of measures which should be taken to give better protection to the population, infrastructure and the environment
- Urban and rural planning which takes into consideration the risk of earthquakes and landslides

Recommendations

Create in Bukavu a Risk Assessment Unit (Unité de Gestion des Risques) similar to the one which exists in Goma.

Proposal

1. Establishment of the Bukavu Risk Management Unit (Expansion of Goma Risk Assessment Unit) Office/ Staff/ Equipment/ vehicle
2. Information Management and Workshops
3. Hazard mapping and contingency planning
4. International support

Provisional Budget

$800,000

Timescale

2 years

Annex 6

Electricity Distribution Network

Findings

13 lines of 15 kV supply the whole Bukavu region. Six of them are in poor condition and should be repaired or moved because they are crossing large landslides zones. Amongst these 6 lines, 3 are a priority because they are supplying important public buildings and infrastructure:

Line	Public building, public infrastructures and communities supplied
Institut technique "Fundi Mandele"	College Wima
	ITFM Technical Institute
	Radio and television aerials
	Orphan home "Village SOS"
	2 water pumping stations
	Villages
Hospitals of Braliva	2 hospitals (Only one is equipped with a back up generator. This is unfortunately not powerful enough to fully cover the needs of the hospital)
Bagira II and III	Main Bukavu water disinfection plant
	Hospital of Bagira
	Large boarding school for girls
	City of Bagira

Power failures are frequent because these 3 lines which have been repaired temporarily do not provide enough electricity to meet the needs of the inhabitants and of the public installations. For example, the water disinfection plant can only function at night because there is not enough electricity in the daytime.

Any reduction in the electricity network would lead to increased deforestation as the urban population return to charcoal as the principal fuel for cooking.

Recommendations

The 3 above mentioned lines should be relocated in safe area which are not prone to landslide and built in way which is sympathetic with the earthquake environment

Proposal

1. Purchase of material and equipment:
2. Local manpower
3. International support (consultant electrical engineer)

Provisional Budget

$450,000

Timescale

1 year

Annex 7

Electricity Generation (Humanitarian Infrastructure)

Background

Although the dam was not affected, the earthquake on Feruary 3rd 2008 damaged the valve on the No. 3 turbine of the Ruzizi hydro-electric power station. This hydro electric station provides power not only to Bukavu but also exports power to Rwanda and Burundi.

As a result of the damaged valve the turbine is running at maximum speed. This will damage the turbine if not repaired in the short-term (3 months) and could lead to Bukavu losing it's principle turbine and 8.4 MW. At the moment No 4. turbine, the other 8.4 MW turbine is out of commision (since1994) waiting for a major overhaul funded by the World Bank. Bukavu's water treatment plants are dependent on electrical power.

Electrical power is essential for the maintenance of two of Bukavu's basic needs, water supply and the functioning of Bukavu's medical facilities. Bukavu is vulnerable to a major humanitarian emergency from both earthquakes and landslides. The provision of medical facilities in the town is a major priority.

Proposal

The World Bank project to repair the No. 4 turbine should be accelerated. The damaged valved should be repaired as soon as possible to prevent serious damage to the turbine. This will allow the hydro-electric power station to operate at its full potential of 30 MW.

Timescale

3 months

Project support

World Bank project