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Mitigating and Managing Regional Geo-environmental Hazards within a Decentralisation Transition in Cameroon

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ABSTRACT The management of natural hazards in Cameroon is currently executed by some ministerial and inter ministerial institutions and observatories whose means and methods are stipulated by centralised texts and decisions. The eminent decentralisation of the administration of Cameroon calls for a revisit and reformulation of the texts and institutions that cater for regional geo-environmental hazards. The double justification is that such innovation peters out the overlap in role-execution by the existing criss-crossing institutions. It equally sets a region-catastrophe-institution compliance scale for specific institutions to be region specific by taking into consideration regional geo-environmental hazard differentiation. It would be a sham if the status and functions of current institutions are exported into the would-be regions, and especially so because their hazards do not portray a national spatio-temporal uniformity. The hypothesis of this paper is that, the current institutions are too centralised to be successful in serving a pragmatic decentralised regional administration in future. The aim here to x-ray and analyse specificities and challenges for the future management of civil protection through newly marked out hazard provinces that must become unavoidable objects for policy action. This is a scientific petition to the power brokers that be, so that forthcoming regional and inter regional anti-hazard institutions should be versed with the hazard history and dynamics of each hazard province, and trim down bureaucracy and bottlenecks in decision taking when the need arises.

1. INTRODUCTION

The environmental stakes implementing the Law on Decentralisation in Cameroon would be the way politico-administrative units or regions cope with hazards and catastrophes. Hazards are issues of national concern and portray homogeneous tendencies into the future in parts of Cameroon that span across several latitudes and longitudes with three tendencies. First, they are time and/or space variable since most of them span across current administrative units. Secondly, there is no direct coincidence between the hazard-ecological regions and the current provincial and divisional boundaries. Thirdly, there exists a direct proportional relationship between population density and hazard recurrence. There, thus, exists hazard clusters provinces and hazard desert provinces. These must be considered the attribution of hazard management responsibilities in a decentralised Cameroon.

2. METHODOLOGY

The methodology involved a census of existing institutions that manage hazards in Cameroon an evaluation of their attributes and natural hazards as they have occurred in the various parts of Cameroon in order to project into the future of a decentralised Cameroon. This article aims at suggesting hazard provinces in Cameroon which could be the basis for any form of decentralised management. The objectives are to assess the weaknesses of the current system and through regional specificities, show how these affect the government's decision on the implementation of the law on Decentralisation.

3. RESULTS AND DISCUSSION

II. - Spatio-temporal Diversity of Natural Hazards in Cameroon

The types of geo-environmental hazards that have occurred and have been reported by the scientific and media world in Cameroon are dominantly geological and climatic. Their area of occurrence closely corresponds to the major geomorphological units of the country. The common natural hazards and disasters that are reported are diverse but can be differentiated into three types:

II.1. - Dominantly Geologic Hazards in Southern and Western Cameroon

The main geological hazards in Cameroon are earthquakes, volcanic eruptions, mass move-

ments and subsidence. Geological hazards have been occurring along the Cameroon Volcanic Line (CVL), affected by crustal compressional and tensional forces along its SW-NE orientation since the Tertiary period (Fig. 1).

The mountainous highland from the Gulf of Guinea to Tibesti passing through the Adamawa is a volcanic empire with dormant and active volcanoes like the Mount Cameroon that has created geomorphological units such as the Bamenda low plateau, topographic accidents of the Adamawa and the Benue faulted steps. Documented and reported evidences of the last three decades show that crustal movements and imperceptible seismic waves of the old and neo-tectonic terrains are produced in areas of high population density. Seismic shocks of variable intensity occur at different areas; 1987 Magba on the Mapé dam earthquake, Ndu in 1980, an earthquake of magnitude IV on the Richter Scale, recurrent Mount Cameroon pre-eruption earthquakes and tremors, earthquakes in Kribi in 1990 and Monatele in March 2005. These crustal disturbances provoke recurrent mass wasting and related geomorphological processes that destabilise slopes of mountains, hills and escarpments in the Western and Bamenda Highlands. Studies by Ndenecho and Eze Bassey (2004) confirm that, landslides in towns such as Bamenda, Limbe, Dschang, Bafoussam, Bangangte, Nkongsamba, Kumbo, Belo, Njinikom, and Fundong have been reported in recent years,

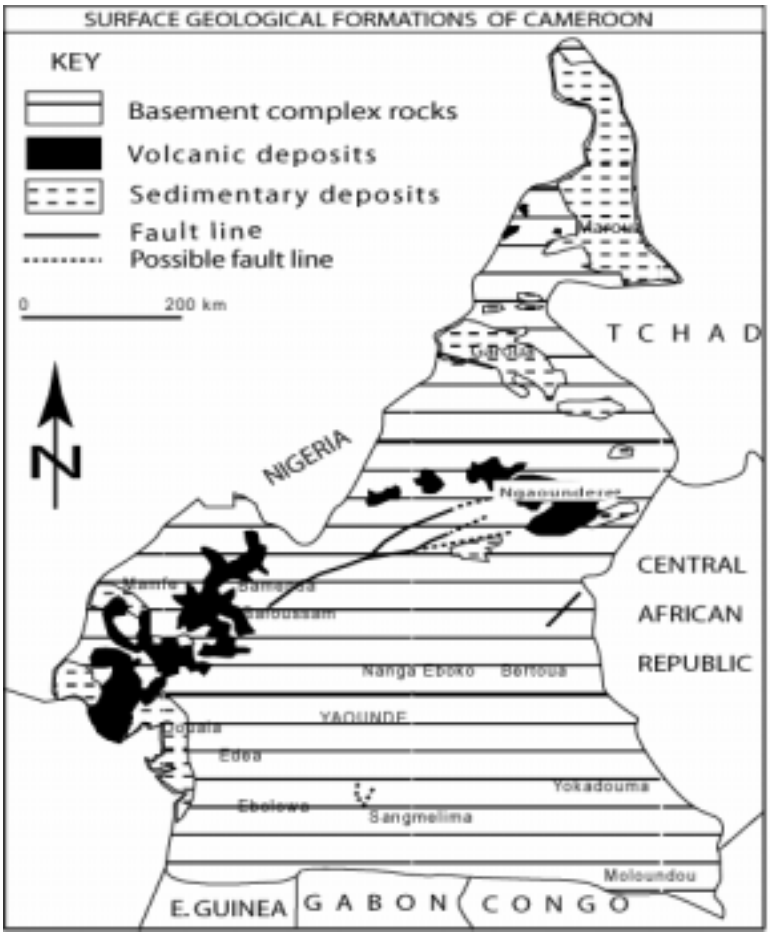

Fig. 1. Geological formations of Cameroon
Source: Adapted from Eno Belinga (1984)

though Lambi 2004, even dates the seriousness of these landslides to the late 1970s.

The spatial occurrence of natural hazards in these areas also show the dysfunction of the ecosystem and natural milieu that produces landslides along roadsides and road surfaces (Fogwe 1999; Lambi 1987), mudflows on the slopes and escarpments from sand and gravel quarries, earth fall landslide, and active subsidence along the Mbouda-Bamenda highway, at Akum near Santa and very frequent on the Ndop Sabga road (Lambi 1987 and Fogwe 1997 and 1999), Bamenda station escarpment (Ndenencho 2003), rainstorm in urban areas and dam water floods in the Mape, Bamendjin, gaseous eruptions at Monoun 1983 and Nyos 1986, killing over 40 and 1700 people respectively, earthquakes of the Magba (September 1983) and Ndu (1990).

II.2. Dominantly Atmospheric Hazards in the Coastal and Northern Cameroon

Cameroon that spans from the equatorial to the tropical region is affected by extremes of tem-*peratures, and high annual rainfall permitting the development of atmospheric hazards. Atmospheric hazards in Cameroon are hurricanes, tornadoes, and droughts even though (Ayonghe 1998) associated the drying up of streams, springs and decreases in the volume of the rivers. This is illustrated by the Bamendjin dam which since 1998 lost much of its volume resulting in power rationing (Shei 2001). Severe hurricanes and thunderstorms affect coastal areas like Kribi, Tiko, and Douala resulting in wind damages and saline water incursions as the case of Douala in 1982. Lightening and associated thunderstorms destroy trees and electricity and telephone poles as the case between Pouma and Boumnyebel in 2005. Frequent heat waves affect the population of cities like Douala. Rainfall excesses of the early 2000 led to floods in towns as coastal as Douala, Limbe, and Kribi, as continental as Yaounde, Bamenda and Maroua and even at high altitude like Buea. Recurrent 3 to 5 km/hr wind storms and squalls have damaged 10% of the plantation crops and property in the Tiko area of South West province (Ndenencho and Fonsah 2001) and crops in farmland on the Ijim Kilum mountain slopes of the North West province

III. Inadaptations of the Current Management to Decentralisation

The management of hazards in Cameroon is currently carried out by several structures in ministries along side the Directorate of Civil Protection in the Ministry of Territorial Administration and Decentralisation. Some of these structures include the Sub Directorate of the Cartography of Risks in the Ministry of Mines, the National Council for Civil Protection, the National Observatory of Risks, the National Programme for the Prevention and Management of Catastrophes, and the Programme for the Study and Cartography of Risks in Cameroon.

These institutions undertake hazard assessments, develop risk assessments tools and decide where and how resources are to be expended to minimize risk. They also work with scientists and engineers to reduce vulnerability by making planning decisions (zoning laws) and building codes that help reduce risk and vulnerability. They inform the public about imminent dangers based on predictions and warnings issued by scientific community and monitoring equipment like the seismographs around the Mount Cameroon area. They also develop plans for evacuation, emergency response, rescue, and recovery like after the 2000 floods in Douala and 1999 eruption of Mount Cameroon in the Bakingili area as well as communicate with the scientific community and the general public to disseminate information

All are controlled, funded and run by government ministries. There is no regional or zone specific government institution that handles hazards. Should these institutions be replicated in the decentralised regions, then there would be a dispersal and unnecessary multiplication of the efforts of the scientists. Such regions would suffer from the dearth of techniques to determine where natural hazards exist in their regions, and monitoring of processes that enable prediction. They would need information on how to reduce vulnerability and risk and suggest zoning regulations and building codes.

These poor adaptations therefore require that for hazards to be well mitigated within the context of Decentralisation there is need to pinpoint the peculiarities of each region. This is because the population needs to be aware of the effects of natural hazards on their communities, to have some understanding of what might occur in the event of a disaster. They must be informed about what their response should be when a warning is issued. They ensure that public officials make available the necessary information and effectively carry out their responsibilities for hazard and risk reduction.

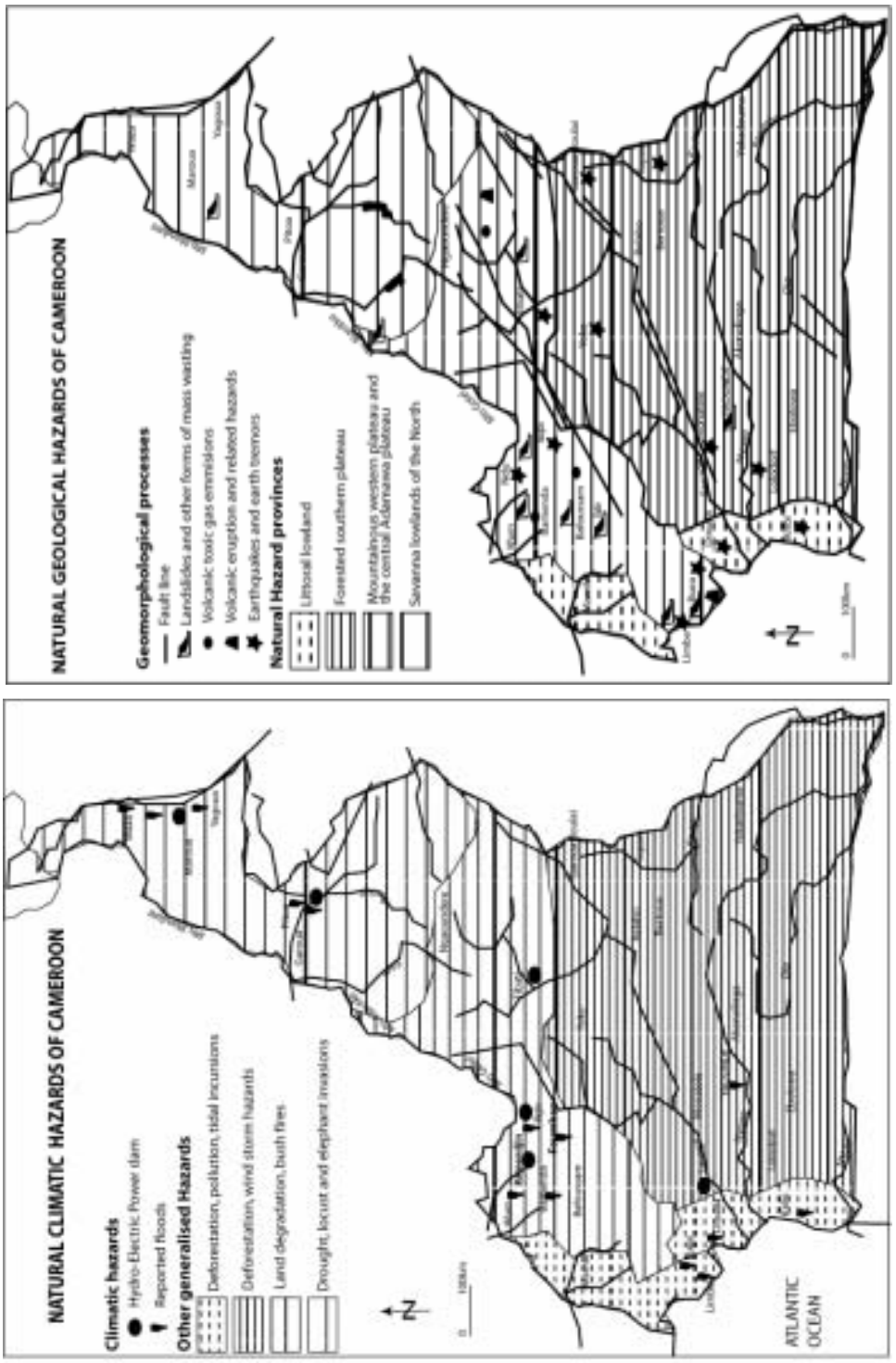

Fig. 2. Map of the four natural hazard provinces of Cameroon
Source: Adapted from Fogwe (2005)

IV. Broad Hazard Provinces: Specificities for Efficient Management

The broad hazard pattern show regional peculiarities tallying with the major ecological zones that can be referred to here as hazard provinces or regions whose spatial traits do not match with the current administrative boundaries (whether provinces or divisions). This study identifies four hazard provinces in Cameroon on the basis of broad uniformity in the hazard event and frequency (Fig. 2). These provinces are the southern forested coastal lowlands and plains, the forested southern plateau, the mountainous highlands of western Cameroon and the central Adamawa plateau region, and the savanna region of the north.

The southern forested coastal lowlands and plains hazard province falls within the Zone 2 of the seismic hazard frequency in Cameroon which has had earthquakes since the colonial period in 1903, 1911, and 1913 recording 7 on the Richter scale and 9 on the Mercalli Scale at Lolordof. Though by 1911, there were no seismographs, macro seismic evaluations showed that houses and trees fell.

The forested southern plateau hazard province is the domain of the highest magnitude earthquakes but no deaths have been recorded because the population density is generally very low. This area falls within the Zone 4 of the eastern part of the southern plateau and Zone 5 of the seismic hazard frequency in Cameroon being the central southern plateau (Fig. 3). The Sanaga River fault running from the Atlantic Ocean through Lolodorf, Monatele and Garoua Boulai to Central Africa. The March 2005 earthquake was felt as far as Yaounde and other parts of the southern Cameroon plateau in a large radius. The Kribi area is a tectonically active seismic zone and in 2002, an earthquake occurred with the risk of causing a tsunami. There are also tornadoes, animal invasions, and epidemics.

The mountainous highlands of western Cameroon and the central Adamawa plateau hazard province has a geology whose volcanic age varies: 50 million years in Foumban, 48 million in Bali, 1 million in Foumbot and less than 1 million in Mount Oku. This area has volcanic hazards, earthquakes in Ndu (1990), Buea (1990, 1999, 2000), toxic gas emanation such the Nyos (1986) and Monoun (1983). This is the hazard province where mass movements are common. Some of the movements are slow (1mm/yr - 1mm/day) like through creep with signs seen through tilted posts, soil profile, roots, and amongst others. Some of the movements are moderate (1 cm/day - 1 cm/sec) like the downward and outward movement of earth (slumps) travelling as a unit or as a series of units that are characteristic of the hillsides slopes of the High Lava Plateau. There are also earth flows helped by excessive moisture in the region which become mudflow in heavily cultivated areas. The rapid movements in this region are made up of earth fall and rock fall often creating a build up of rocks at the base of cliffs.

The savanna lowland hazard province of the north shows great vulnerability to floods and drought since the 1960s so that the Lake Chad area lost more than half of its area. Grazing in the area provokes whirl fires and erosion. Frequent invasions by insects like migrating locust since May 8, 2005, black birds and stray animals associate to high risks of epidemics like the out burst of cholera and meningitis.

V. Region Specific Hazard Management for Decentralisation

1. The State as the Guarantor of National Security and Safety

The management of hazards was a state obligation but now has to be undertaken by decentralised authorities at four levels. The first concerns geological and climatic upheavals wherein they could be helpless to react. The second is that of vulnerability and the way it affects human life and property being a function of proximity to the hazardous event, population density, scientific understanding of the hazard, public education and awareness of the hazard, existence or non-existence of early-warning systems and lines of communication, availability and readiness of emergency infrastructure, construction styles and building codes and cultural factors that influence public response to warnings. Thirdly is the hazard risk as human intervention in natural processes through the development and habitation of lands susceptible to hazards, like building on floodplains in the coastal towns like Limbe, Douala and Kribi; land subject to landslides in Limbe and Yaounde, coastlines subject to hurricanes and floods like Tiko, or slopes subject to volcanic eruptions like Buea. Human interventions also increase the

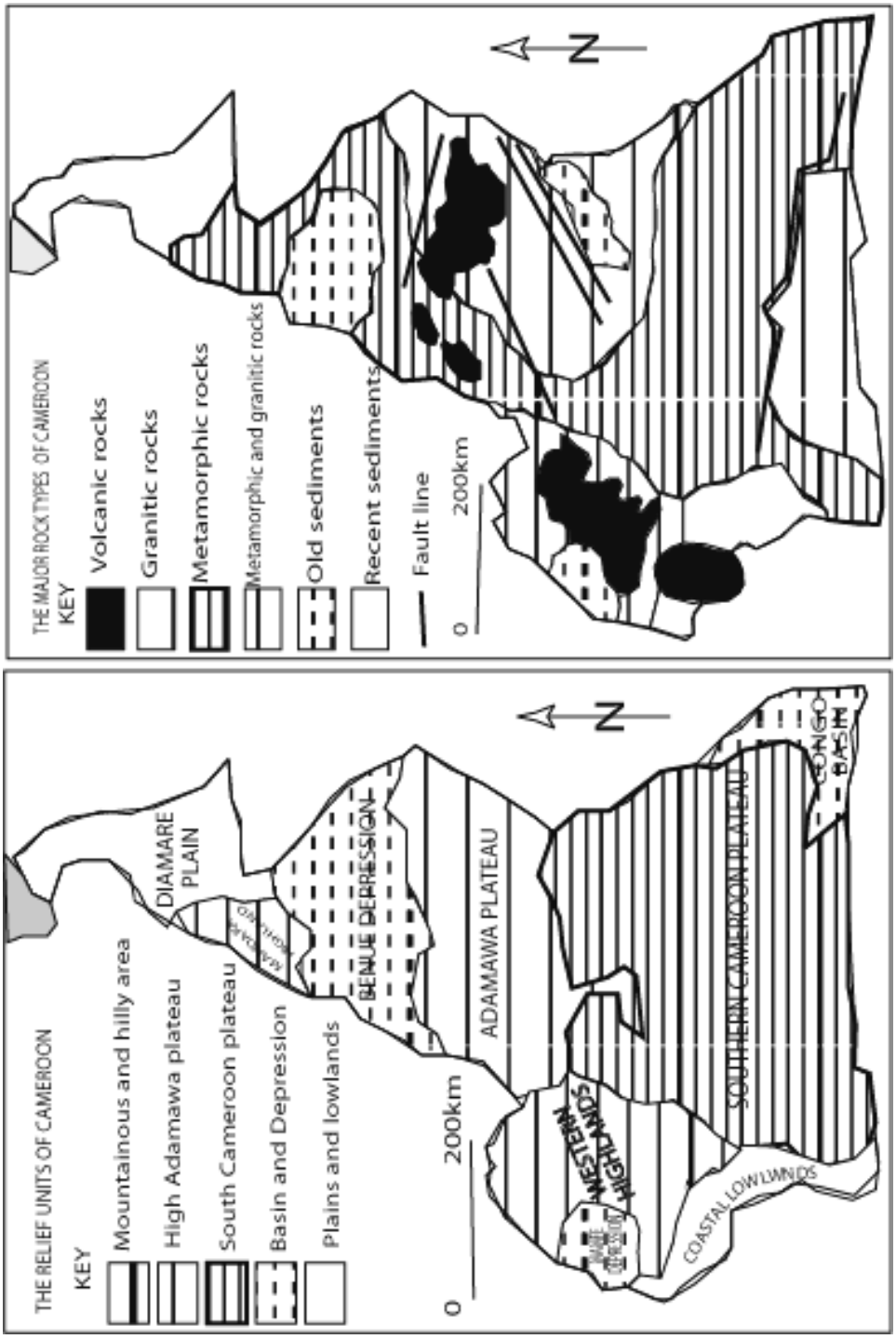

Fig. 3. Map of the morpho-geological units of Cameroon
Source: Adapted from Fogwe (2005)

severity or frequency of natural hazards like overgrazing or deforestation in the Western Highlands leading to severe erosion (floods, landslides), mining groundwater in parts of Douala, Limbe and Yaounde leading to subsidence, and the construction of roads on unstable slopes like the Bamenda escarpment triggering landslides. The fourth involves measures to be taken to mitigate the effects of the hazard before, during and after its occurrence. State responsibilities before hazards are preventive and may include urban architecture, urban development plans, and construction norms of various types.

2. Hazard Province Institutions and Hazard Management Roles to Play

The new natural hazard management institutions should be created with the implementation of the decentralisation. They would determine where, why, and the frequency of occurrence of and above all the way each disaster could be predicted and/or mitigated. The institutions thus carry out region specific risk assessment involving the appraisal of hazards from a scientific point of view, and also the socio-economic impacts of a hazardous event. These roles would concern hazard assessment to aid decision makers and scientists to compare and evaluate potential hazards within different parts of the region so as to set priorities on what kinds of mitigation are possible, and also where to focus resources and further study. They would therefore carry out prediction, forecasting and early warning.

The new institutions may each be anchored on four hazard provinces that from the natural hazard point of view constitute the most logical bases for decentralisation units in Cameroon. No matter the appellation that these institutions might take within the four provinces it is incumbent to identify the focal points and domain of action that each the hazard mitigation institutions of each hazard province would be preoccupied with. This focus is based on the major hazards that characterise each hazard province though internal variations exist.

The Institutions of the Littoral Lowlands Hazard Province

The institutions in this hazard province shall have two major preoccupations; handling river floods and earthquake flood (tsunami) risks. The coastal flood mitigation consists of predicting river flooding through three approaches. The first approach shall use statistical studies to determine the probability and frequency of high discharges of streams that cause flooding. Floods would be modelled and flood hazard maps drawn to determine the extent of possible flooding when it occurs in the future. The second approach shall map flood hazards so as to reveal the areas prone to flooding. Use is made of historical data on river stages and discharge of previous floods, along with topographic data, to construct maps that can show areas expected to be covered with floodwaters for various discharges or stages. In constructing such maps, aerial photographs and satellite images of earlier floods are studied to determine the areas. In the third approach, the hazard institutions construct scale models of areas prone to flooding. These institutions update the models with current flood prevention structures and drainage modifications for them to be efficient and work sustainably. The hazard institution would determine rainfall, degree of ground saturation, degree of soil permeable, and amount of vegetation factors which can be correlated to give short-term prediction, or forecast of possible floods. It issues forecasts and communicates a flood warning to the public about the possible extent of the flood, and to give people time to move out of the area.

The second focus of the hazard institutions in this littoral hazard province concerns tsunami risks, which may soon become a catastrophe in the southern part of this hazard province between Kribi and Campo. The hazard institution could set up a Gulf of Guinea warning system that could be called the Southern Cameroon Coast Tsunami Warning Centre consisting of a national network of seismographic and tidal stations around the Gulf of Guinea that can all send information to the Centre to be located in Kribi. When an earthquake occurs somewhere in the coastal region, the Kribi Centre analyzes the data looking for signs that the earthquake could have generated a tsunami. The tidal stations are also monitored, and if a tsunami is detected, a warning is sent to towns on the Cameroon coast. This institution would benefit a lot by affiliating to The Global Seismic Hazard Assessment Program (GSHAP) and the International Tsunami Warning System.

- The Institutions of the Forested Southern Plateau Hazard Province

The focus here should be earthquake predic-

tion through long-term forecasting based on the knowledge of when and where earthquakes have occurred in the past. Thus, present tectonic setting, historical records, and geological records could be studied to determine locations and recurrence intervals of earthquakes. Two studies should be of great importance. First, is paleoseis-mology in which prehistoric earthquakes would be studied. There are no systematic records of earthquakes for this hazard province so long-term forecast would also be needed to reduce seismic risk.

The determination of Yaounde-Obala-Mbalmayo seismic gaps along a tectonically active area where earthquakes have occurred recently, might be building elastic strain in the rocks. Once this seismic gap is identified, then it might be an area expected to have a large earthquake in the near future. In addition, the role of the region specific hazard institution would involve the prediction, monitoring of precursor events for the coming earthquake in the vicinity of earthquake prone faults. The precursor events to be looked for may include ground uplift and tilting causing micro-cracks, foreshocks, the changes in water levels in wells, changes in the electrical resistivity of rocks, unusual radio waves and strange animal behaviour

The Institutions of the Mountainous Western Cameroon and the Central Adamawa Plateau Hazard Province

This hazard province is where volcanic hazards and mass movements dominate. The hazard institution may focus on a long - term forecasting and volcanic hazards studies. The geologic history of the volcanism of the Lava and Adamawa Plateau would permit an assessment of the types of hazards posed and the frequency at which these hazards have occurred in the past. The institutions would examine sequences of layered deposits and lava flows to determine the past behaviour of volcanism in the hazard province. Radiometric age dating of the deposits permits the past frequency of events to be determined and to make volcanic hazards maps that aid scientists, public officials, and the public at large to plan for evacuations, rescue and recovery in the event that short-term prediction suggests another eruption. Such hazards maps delineate zones of danger expected from lava flows, pyroclastic flows, tephra falls, mudflows, floods, and other hazards.

Along the active zone of the Cameroon Volcanic Line, the hazard institution should also engage in short - term prediction based on volcanic monitoring to determine when magma is approaching the surface and monitoring for precursor events that often signal a forthcoming eruption. Some precursor events they may use include changes in magnetic field, changes in electrical resistivity, ground deformation, and in groundwater system, changes in heat, and in gas compositions. The native people living around volcanoes are aware of some of the precursor phenomena, and they would be able to communicate their findings of anomalous events to scientists who can begin monitoring on a regular basis and help prevent a pending disaster. Education and communication should be a key tool of the hazard institution in reducing risk from volcanic hazards.

Mass-wasting events in this hazard province are extremely hazardous and result in extensive loss of life and property. The hazard institution would determine areas that are prone to such hazards so that such slopes can be stabilized or avoided, and warning systems can be put in place that can minimize such hazards.

The hazard institutions must get involved in mass wasting prediction and hazard assessment by looking at the events in hindsight to determine hazardous conditions that exist prior to the event. It is possible, for the institution to construct maps of all areas prone to possible mass-wasting hazards so that planners can use such hazards maps to make decisions about land use policies in such areas or, steps can be taken to stabilize slopes to attempt to prevent a disaster. The magnitude of mass wasting events in this hazard province shows that slope destabilization and undercutting triggered events require the constant attention of the hazard institutions undertaking or observing the slopes. Due to its volcanic geology, mass-wasting hazards from volcanic eruptions could be predicted with the same degree of certainty that volcanic eruptions can be predicted. Once the threat has been realized the warnings need to be heeded to. Hydrologic conditions such as heavy precipitation in July and August can be forecast with some certainty, and warnings can be issued to areas that might be susceptible to mass-wasting processes caused by such conditions.

The Institutions of the Savanna Hazard Province of the North

Being a region whose hazards are mostly due

to climatic extremes, the roles and focus of the hazard institutions in the coastal and western highland hazard province equally works well for this hazard province, in addition to special units to handle disasters caused by migrating locust and stray elephants in farmland.

4. CONCLUSION AND RECOMMENDATIONS

The goal of this article was to show the state of the art of natural hazard and disaster occurrence in Cameroon, where it has and still occurs. There is very little that can be done to prevent the occurrence of natural hazards, but their results, such as loss of life and property, can be reduced by proper planning. The current natural hazard management system in Cameroon does not attain this role because its means and headquarters are centralised in ministries in Yaounde. Should the decentralisation take place without taking these geo-environmental specificities provided in this article, then the existing hazard institutions would be ill-adapted to the new realities. This justifies why region specific hazard institutions need to be created in the hazard provinces. While considering hazards as the bases of such ecentralisation, this article has identified new roles that the hazard institutions within the decentralised units are called upon to play.

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