



Perception of Non-migrant Communities to Geo-hazard Threats in the Mount Cameroon Volcanic Region

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Authors' contributions

This work was carried out in collaboration between both authors. Author SSK designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author KEM managed the literature searches. Both authors read and approved the final manuscript.

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ABSTRACT

Whilst the issue of migration has received widespread and international debates on the geometric number of people displaced daily from one region to another, the environmental unfriendliness, socio-economic and political situations have been accused for the progressive migrant trend in most parts of the world. Bearing in mind these unprecedented situations, the tendency had always been the decision to migrate or stay to cope with adverse situation. It is against these mix feelings that the study investigates the perception of non-migrant communities to geo-hazard threats along the Mount Cameroon Volcanic Line (CVL). The study made use of both primary and secondary sources of data. Interviews were conducted with some traditional authorities, officials of the Limbe Botanic Garden, government officials and municipal authorities on the environmental impacts associated with the decision of the non-migrants in vulnerable zones. From the interview conducted a representative survey of households was then undertaken to gather the opinion of non-migrant households within the geo-hazard environment. This was aided by the use of some 120 questionnaires distributed to on-spot households exposed to geo-hazards within the Mount Cameroon mobile region. 120 questionnaires were administered and distributed to 5 sampled communities using random a sampling technique. The Mount Cameroon Volcanic Region alongside

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the location of communities were mapped out using ArcGIS. The Pearson Product Moment Correlation results revealed that communities have strong perception of geo-hazards despite the threats. About 80% of the communities perceived the occurrence of such hazards as mixed blessings especially the associated benefits from fertile volcanic and alluvial soils as well as floodwaters in depressions used for agricultural activities. The study further states that the myths of households to geohazard occurrence kills the science and technology as well as the resilient strategies to such geo-hazards. While the socio-cultural mechanism remains a winding driver of on-spot location in hazard-prone zones, the future of community safety should not undermine human knack responses to geo-hazards. The study recommends proper planning and adaptive measures along this volcanic line such that the traditional and cultural myths of the communities should be integrated with the modern and technological structures to resist or minimize the effects of nature on the non-migrant communities within the flanks of the Cameroon Volcanic Line.

Keywords: Perception; non-migrants; geo-hazards; threats.

1. INTRODUCTION

From time immemorial, people have exposed and vulnerable to most of the deterministic phenomena that are today termed natural hazards. The occurrence of these hazards are more peculiar to the geographical location and the risk of community threats have varied socio-cultural perceptions linking to them as 'acts of God', 'luck', fortune, or fate [1]. However, the physical processes were the same but natural-mystical ways of thinking determined awareness. Natural disasters interpreted as "acts of God" paralyzed scientific arguments, prevention and technical measures. Over time the explanations of the causes of natural disasters have shifted from supernatural or mystical forces, to nature, and with some reluctance, to humans (or to society as a whole) who have made incorrect" decisions (Weichselgartner, 2000). In this perspective, a natural disaster, in a pure sense does not exist; rather there is the interaction of changes in physical systems with existent social conditions (Weichselgartner, 2000). Disasters are therefore more accurately seen as social phenomena whereas the overall damage due to natural hazards is the result both of natural events that act as 'triggers', and a series of societal factors. This prolonged exposure of the human race to natural and man-induced problems has had devastating consequences as these leave behind untold damages to property and human lives. Worldwide, there are more than 1500 potentially active volcanoes on land with around 20 physically erupting at any one time (Siebert & Simkin 2002). Volcanic eruptions are highly variable in style, magnitude, intensity and duration. The variable style and magnitude of eruptions means that the extent and degree of impact can vary from localised total destruction to global climatic and environmental impacts.

Over 2 million people died in earthquakes during the 20th century; approximately 75% of those deaths were caused by building collapse, with the secondary hazards of landslides and tsunamis accounting for most of the remainder [2].

Although there is an increase of in environmental disasters and migration over the past years, the relationship is complex. While some studies find that environmental disasters increase migration, others show that they have only a marginal or no effect or are even negative. Migration appears to be an insurance mechanism against environmental shocks. Environmental disasters are often considered an important driver of migration. However, historical evidence shows that this relationship is not new. Drabo and Mbaye [3] held that natural disasters mainly related to climate change increase overall migration especially with the most educated people, who can afford migration costs. The mixed evidence related to the role of disasters on migration is probably due to the fact that this relationship is complex and less straightforward than perceived by common knowledge. Naudé [4] and Beine and Parsons [5] do not find a direct effect of natural disasters on migration but rather an indirect effect. The indirect relationship is opined by the fact that some communities perceive environmental disasters more in the perspective of a blessing and so constitute the non-migrant group that neglects the incidence of environmental disasters on migration [6-9]. While the migrant triggered mechanisms are obvious the decision of the non-migrants to stay on the spot have been received with a lot of mixed feelings. This gap created by the inability of certain communities to migrate from the disaster-prone zones kills the scientific knowledge [10-12]. This paper intends to bridge the science and

socio-cultural myths of communities to hazard perception. This becomes pertinent to address the perception of communities towards hazard occurrence and migration nexus. In line with these, the paper identified the spatial incidence of geohazards, non-migrant community perception to geohazards as well as the response of communities to these hazards within the mount Cameroon region.

2. BACKGROUND OF THE STUDY AREA

The Mount Cameroon region is located in the South West region of Cameroon. It is located between latitudes 4° and 9° north of the equator and between longitude 9° 10' and 9° 31' East of the Greenwich Meridian. It is bounded by the Atlantic Ocean to the south, by Meme Division to the north, by Wouri Division to the east (Fig. 1). It comprises four administrative sub-divisions being Buea, Limbe, Muyuka, and Tiko. Located within the coastal and tropical (monsoonal) zone, the region appears to be exposed and vulnerable to the prevailing environmental problems which are epochal of tropical disturbances such as storm surge, floods and landslides. The communities in

the Mount Cameroon region seem to lie in an active (mobile) volcanic zone extending from the mid-oceanic ridge system into the hinterland.

Located in this active volcanic belt, the region appears to have repeated occurrence of monumental geo-hazard problems remarkably earthquakes, volcanic eruptions, landslides, floods and storm winds. The frequent or repeated activities of such geo-hazards make this mobile zone a dynamic landscape or a potentially dangerous paroxysmal area on the coast of Cameroon. While inappropriate development may bring short-term benefits, the long term problems and consequences could present future generations with extremely costly consequences. The city of Limbe and the surrounding towns of Buea, Tiko and Mutengene appear to be highly constructed on scoria deposits which appear to be unstable and more susceptible to the geo-hazard occurrence. In order to build a sustainable environment, we need to have a deeper knowledge of these hazards taking into consideration the perception of communities and their vulnerability in this mobile and problematic region of Cameroon.

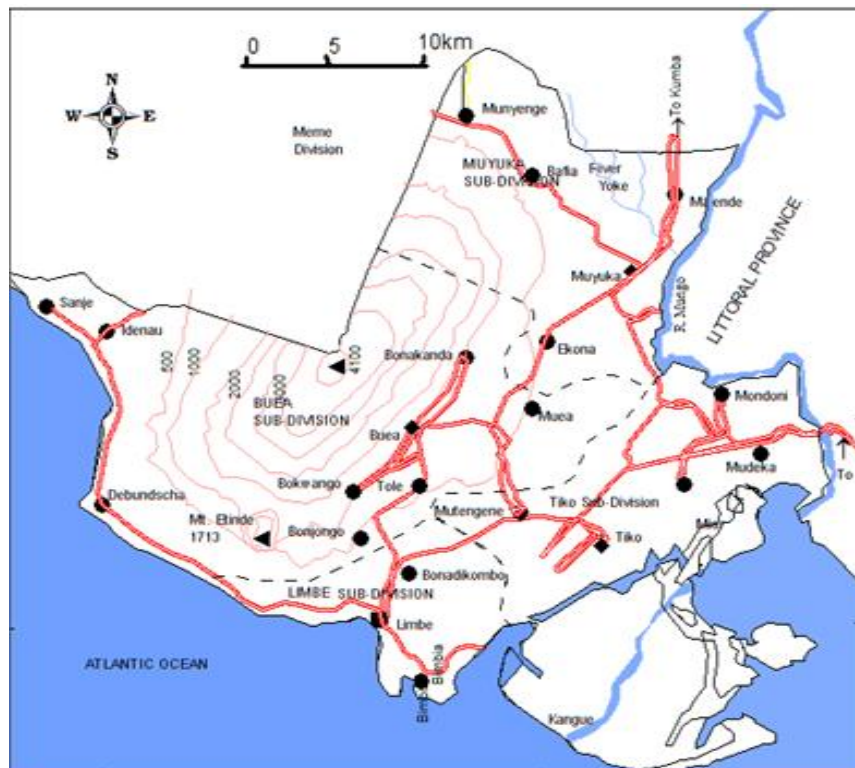


Fig. 1. Location of Mount Cameroon Region on the Atlantic coast
Source: Fieldwork, 2019

The occurrence of these geo-hazards within the Mount Cameroon Region appears to be more peculiar to the geographical location presenting the risk of community threats to these routine hazards. While the natural hazards continue to cause in-depth human distress and unbearable incidences, communities in this region appear to have varied perceptions on these natural phenomena [13,14]. Most communities liken such occurrences to the socio-cultural myths as the acts of God, luck, fortune, or fate. This, however, appears to subject the communities living in this mobile zone of Cameroon to turn blind eyes to their vulnerability to geo-hazards while hoping for nature to have mercy. The geo-hazards in this region seem to have contributed to the loss of lives, infrastructural collapse and submergence buildings by floodwaters, agricultural land and other property damage. Hurricanes, tsunamis, volcanoes, earthquakes and surface processes such as floods, landslides are the most common hazards that produce catastrophes in this active (mobile) volcanic zone of Cameroon [15,16]. During the last few decades, there has been an apparent increase in damage caused by environmental hazards in the Mount Cameroon Region. It could however, be a function of increased population and its concentration in marginal areas, less suited to human settlement because of the community attachment to the hazard-prone zone vis-à-vis the inherent associated risks in inhabiting this geo-hazard environment.

3. MATERIALS AND METHODS

The paper made use of both primary and secondary data collection techniques to obtain information from the field. Extensive field observation and in-depth administration of questionnaires enabled the acquisition of information related to community perception and vulnerability to geo-hazard characteristics. This provided first-hand information on the perception

or issues related to non-migrant communities in this hazard prone zone. Qualitatively, an extensive interview was conducted with the councilors of the Buea and Limbe city councils on the spatial construction of settlement on hazard-prone zones. Equally, interviews were conducted with the traditional authorities on the allocation of land to the inhabitants taking into consideration the safety of the population in disaster environment. Some sampled household heads were interviewed on the relationship between hazard perception and non-migrant tendency. Based on the interview conducted, questionnaires were administered and distributed to households pertaining to the frequency of household exposure to geo-hazards and the perception of non-migrants to geo-hazard incidence. A total of 120 questionnaires were used to sample household opinion on non-migrant perception on the frequency and intensity of households' to these geo-hazards in peculiar localities. The questionnaires were distributed only to households in communities with recurrent geo-hazard manifestation (Limbe, Tiko, Idenau, Mutengene, and Buea). Household heads were sampled and the questionnaires distributed using a random sampling technique. Quantitatively, the rainfall trend was gotten from the CDC meteorological station in Buea to establish the relationship between monthly rainfall and geo-hazard (floods, volcanic eruption and landslides) characteristics. Data on population and settlement construction trends were obtained from the Buea and Limbe City Councils. The settlement and population growth pattern provides proofs on community determination to settle in hazard-prone zones irrespective of the threats associated with the occurrence of these geo-hazards. The coastal areas and mountainous risk zones within the Mount Cameroon region were mapped out using the Geographic Information Systems (GIS) and Digital Elevation Model (DEM). Measurements of the scars left by landslides were taken and the

Table 1. List of variables with analytical techniques

Variables	Techniques in analysis	
	Qualitatively	Quantitatively
Trend and pattern of landslide, flood and lava flow	X	
Socio-demographic characteristics of non-migrant perception to geo-hazards	X	
Socio-cultural perception of the household to geo-hazards		X

Source: Fieldwork, 2019 The results of the Correlation Coefficient were adjusted using the Coefficient of Determination r^2 . The adjusted r^2 enabled the researchers to determined the influence of non-migrant myths on households' vulnerability to geo-hazards in the Mount Cameroon Region. The results were presented using maps, tables, charts and graphs

gradient of the slopes measured to show the magnitude of these landslides. Tension cracks were also examined and measured to determine their network intensity and lengths. the aerial extent of flood waters were delimited while the flood heights were measured in vulnerable areas of Limbe, Idenau and Tiko. The essence of flood measurement was to determine the intensity and susceptibility of households to floodwater effects. The perception of non-migrants households and the frequency of hazard occurrence over time and space were analysed using the Pearson Product Moment Correlation (r). This enabled an establishment of the relationship between socio-cultural myths and households' vulnerability to these geo-hazards.

4. RESULTS AND DISCUSSION

While the occurrence of floods, landslides and volcanic eruption remains indispensable, the trend and pattern of these hazards have attracted national attention for land use planning and management within the mobile mount Cameroon region. The results presented follow the sub- themes of trend and spatial pattern of geo-hazard incidence, socio-demographic characteristics and non-migrant perception of geo-hazards within the mount Cameroon region.

a. Trend and pattern of geo-hazards within the Mount Cameroon Region

The Mount Cameroon Region is a fragilized region along the coast of Cameroon. Exposed to series and plethora of geo-hazard occurrence with varying degree of intensity and frequency, the region has been known for the geological, climatic and geomorphological hazards. While these hazards have witnessed a historic evolution and changes in magnitude, the hazards' manifestation recorded have been tilted towards the South Western slopes of Mount Cameroon. The historic trend of volcanic eruption recorded within the Mount Cameroon Region suggests that the region is an active and mobile zone that is highly subjected to earthquakes and volcanic eruptions (Table 2). The trend in the eruption of Mount Cameroon revealed that the mountain has erupted 7 times in the 19th Century, 6 times in the 20th Century and just once in the 21st Century as of 2000 to 2018. The fact that this mountain has erupted in each of the centuries indicates its mobile and active nature. As of 1800 to 2000, the mountain has been active and erupted 14 times. The active nature of the mountain is justified by the interval of eruption throughout history.

The interval range of the eruption has been classified as short, very shot and long depending on the successive eruption periods. The pattern of eruption within the mount Cameroon region has been described in terms of location and the areal coverage or extension of the volcanoes on the mobile zone (Table 3). Findings revealed varied eruption direction and flow orientation of lava with variation in the surface area coverage of lava.

Table 2. Historic eruption trend of Mount Cameroon

Years of eruption	Quiescent period (years)	Nature
1800	/	/
1815	15	?
1835	20	Long
1845	10	Short
1852	7	Very Short
1865	13	Short
1868	3	Very short
1909	41	Very long
1922	13	Short
1954	32	Very long
1959	5	Very short
1982	23	Long
1999	17	Long
2000	1	Very short

Source: Adapted from Lambi, [17]

The 1868 eruption occurred dominantly in the northeast flank of mount Cameroon with lava emitted near to the peak of the mountain. A similar flow pattern was recorded in 1909 and 2000 with lava flow covering some 1500 m and 4000 m respectively. By implication, the 2000 volcanic eruption was with high magnitude and intensity as justified by the extensive surface area occupied by lava flow. The eruption pattern has also occurred in the southwestern slopes of Mount Cameroon. This dominant flow direction of lava in the south west was recorded in 1922, 1982 and 1999. In 1922, the eruption occurred some 1500 m from the summit and flew towards the south western slopes of Bakingili.

The areal extent was estimated about 1300 m away from the summit with destruction of farmlands and houses located along this track. The magnitude and intensity of eruption in 1982 increased from 1500 m surface area lava coverage to about 2700 m in 1982. The magnitude of the eruption witnessed in 1999 was intensive witnessed a similar strength with surface areal lava coverage ranges between 2400 m to 2600 m. The lava flow destroyed

enormous palm plantation, farmlands and houses within the southwestern direction. The eastern flow direction was equally recorded in 1959 with extensive lava flow covering 1500 m towards Muea-Ekona flanks. Perhaps the occurrence of landslides remains a frightful and disastrous event, which comes along a chilling loss of lives and property. These rapid mass movements are lethal and dangerous because most slides are estimated to move 25 to 30 m per second. Landslides or slope failure which bring disaster are rapid and complex phenomena as they have their origins from a number of factors. The presence or reactivations of sedimentary or loose unconsolidated materials have been responsible for many hazards throughout the world. The triggered mechanisms for the catastrophic mass movements could be earthquakes, man's activities through the various forms of crustal modifications, unfavorable geologic structure and heavy precipitation. The active mobile zones of the earth, which are associated with the young fold mountain systems and volcanic eruptions are more prone to landslides. Water is the principal agent in the causation of landslides. It is, indeed, a universal vehicle of alteration and over-saturation, which initiates the instability along steep mountain slopes. The natural processes by themselves can generate landslides irrespective of human activities. The mapped distribution of landslide scars in this region runs along the direction of the CVL. Hence, earthquakes, which occurred in this region in 1999 and 2000, might have been the major contributing factor to the landslides that hit this region. This is so because in 1999, there was heavy rainfall and although these areas were inhabited, nothing happened. There is the extensive occurrence of scoriaceous deposits and plenty of volcanic tuff. These scoriaceous deposits are layered and friable and once opened up, they can even be scratched with bare hands (Fig. 2). The slopes are capable of moving down with slight quakes or pressure exerted on the fragilized volcanic scoria. With rainfall that exceeds 2000 mm a year amongst other factors trigger landslides within the Mount Cameroon volcanic region. The range of these factors tells us that landslides have a complex origin. Although it is normal to hold the natural factors and the adverse geologic setting at the central stage, man-induced conditions usually upset the delicate environmental balance that gives birth to landslides.

This is commonplace in Idenau, Bakingili, Tole and the Mabeta Hills of Limbe which are

localities in the south and southwestern parts of mount Cameroon. The landslides, which usually occur at Mile two, result in the downslope movement of huge quantities of regolith mixed with water, which completely damaged houses and farms. Other material mostly rock boulders are sometime brought down, completely blocking the main road, making it impossible for vehicles and people to circulate. Flood occurrence is the issue of the day in some localities within Mount Cameroon. Limbe, Tiko and Idenau have over the years recorded severe floods especially during peak rainy months of August and September. Heavy pre-monsoon rainfall (April-May) causes local runoff to accumulate and saturate the soils. Between June and August, when the rains are very heavy and intense, sea-level rise at high tides and streams swell and consequently flow into this area, much of which is only slightly above sea level. Table 4 presents successive yearly occurrence of flood within the southern Limbe zone of Mount Cameroon.



Fig. 2a. Scoriaceous deposits liable to landslide in areas of river incision



Fig. 2b. Tole landslide incidence in the western slopes of Mt Fako

Table 3. Historic trend of mount Cameroon eruption

Date	Location and Remarks
Between 1800 and 1815	Eruption at about 2600 m
Before 1835	Eruption with no further information
1838	Summit eruption
Between 1845 and 1865	Eruption above Buea
1865	Summit Eruption
1868	Eruption on northeast flank with lava emission near summits
26 th April, 1909	Eruption at about 2750 m on NE flank
February 1922	Eruption at about 1.5 km from summit and at about 1300 on SW flank; destroyed large farms and a few houses
June 1954	Summit eruption
6 th February 1959	Eruption at about 1500 m on eastern side. Lava flow destroyed small farms but stopped within 1 km of the town of Ekona
16 th October 1982	Eruption at about 2700 m on SW flank
25 th March – April 17 th 1999	Erupted at about 2400 m to 2600 m on the southwestern side. Lava flow destroyed palm plantations at Bakingili
May 2000	Eruption at about 4000 m on the NE flank

Source: Adapted from Ubangoh et al. [18]

Table 4. Trend in flood occurrence and intensity in the Limbe coastal zone

Year	Beaches	Average Depth	Observation
2013	Leaman Beach	290 mm	Serious
2014	Douala Ekutu Beach	100 mm	Little effect
2015	Mokoro Beach	210 mm	Serious
2016	Martin Beach	140 mm	Little effect
2017	Baribo Beach	310 mm	Serious
2018	Apollos Beach	110 mm	Little effect

Sources: Limbe Botanic Garden/GIS Unit & Fieldwork, 2019

The extent and depth of rainwater flooding vary within the rainy season (Fig. 3). Since the level of the sea combines with floodwater from the continental landmass to such alarming levels, the consequence on the squatter settlements in such creek environments are only too obvious [1].

The bridge linking both parts of the stream have been regularly known for flood space zone. Floodwaters often rise as high 1.5 m above the bridge. With such flood intensity, water-borne pipes and sewage pipes and some foundations are often subjected to destruction. Church Street was also been identified as flood-prone zone given the low-lying nature of the area. At Down Beach, intense wave activity causes frequent flood outbreak. Flooding usually cause widespread disruption to transportation, power and communication systems as well as structural damage to buildings and other infrastructure. Due to the high intensities of rainfall during the rainy seasons, the absence of efficient and large drainage infrastructure and the failure to maintain the existing systems, account for the recurrent

flooding within the already low lying nature of Limbe and Tiko. In poorly drained areas like the Clerks Quarters, ‘Crab Quarter’ and Motowo in Limbe and the Tiko Creeks with inadequate sanitation, runoff and floodwaters mix with excreta thereby spreading pathogens around communities and increasing risks to health from various water-borne diseases.

b. Non-Migrants Perception to geo-hazards occurrence

The socio-cultural and economic factors explain the perception of non-migrant communities in inhabiting the environmental unstable zone within the Mount Cameroon Region. The perception of households was analyzed from four main communities that have expanded over the years irrespective of the threats impose by the frequent occurrence of geo-hazards even at the pace of high intensity and magnitude. Table 5 presents the frequency of exposure and vulnerability of non-migrant households to geo-hazards occurrence within the Mount Cameroon Region.

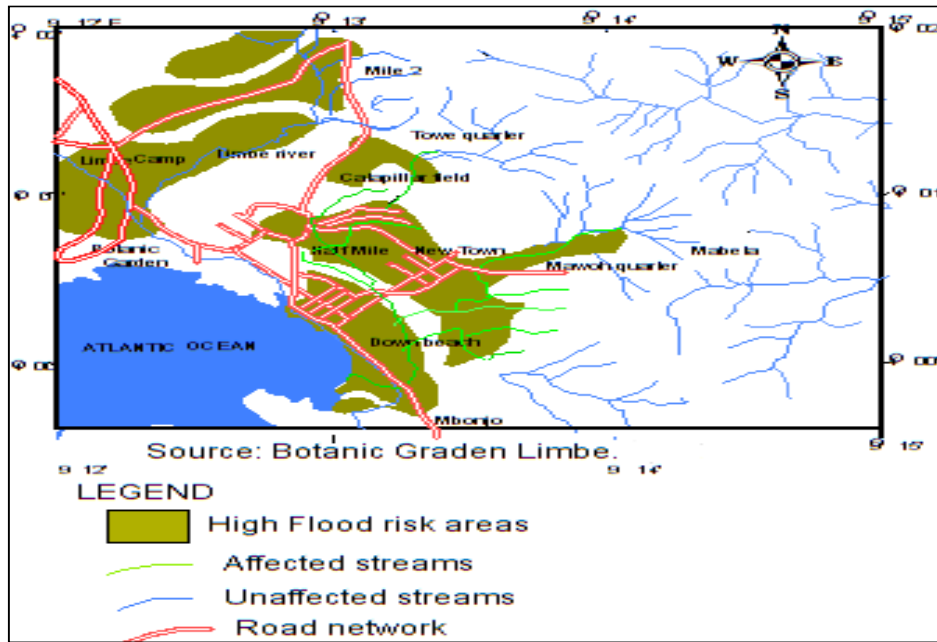


Fig. 3. Spatial mapping of flood-prone areas within the Mount Cameroon Region
 Source: Field mapping and cartography, 2019

Table 5. Perception of Household to Landslides exposure within the Mount Cameroon Region

Communities	No. of households	High	Moderate	Low
		N/(%)	N/(%)	N/(%)
Limbe	30	11 (36.67)	6 (20)	13 (43.33)
Buea	20	6 (30)	4 (20)	10 (50)
Tiko	25	2 (8)	3 (12)	20 (80)
Idenau	25	7 (28)	12 (48)	6 (24)
Bakingili	20	8 (40)	7(35)	5 (25)
Total	120	31 (25.83)	33 (27.5)	56 (46.67)

Source: Fieldwork, 2019

The results show spatial variation in the intensity of community vulnerability to geo-hazards within the mobile mount Cameroon region. The Bakingili and Limbe households are more exposed and vulnerable to landslides with 40% and 36.67% respectively. In a similar manner, Tiko and Idenau households are the least exposed and vulnerable communities to landslides representing 8% and 28% respectively. This is associated with the fact that the area appears to be dominantly a gentle sloping terrain. The high percentage of vulnerable houses in Limbe and Bakingili neighborhoods is explained by the steep slopes that characterize the area as well as the coastal action of sea waves the continuously undercuts the steep slopes of the area. As a whole, about 25.83% of the households have been affected by landslide scars within the mount Cameroon region. 27.5% and 46.67% of households are

moderately and least vulnerable to landslides. This indicates that despite the volcanic nature of the area, the majority of the topography is relatively gentle. The perception of household exposure and vulnerability of lava flow originated from historic volcanic eruption varies from one community to another in terms of intensity and magnitude. Table 6 shows household vulnerability perception to volcanic lava flow within the Mount Cameroon region. The results revealed that about 20% of the communities within the mount Cameroon region are least vulnerable to lava flow indicating that, majority of the communities (80%) are highly and moderately exposed and vulnerable to such geological hazard manifestation or occurrence.

For individual communities, Bakingili stands out as the most exposed communities with (55%) linked to the disastrous effects of lava flow. The

1999 and 2000 lava flow caused a lot of damage to the natural vegetation, farmlands, road network and other infrastructural damages recorded. This is followed by the Limbe communities representing about 53.33%. The high value for the perceived communities exposed to intense lava flow is justified by the fact that most of the houses have been constructed on scoria materials prone to landslides and plastic deformation. Findings further show that the least affected communities to lava flow are Tiko and Idenau with 24% and 28% respectively.

Given the complex topographic landscapes backed by unconformity with remarkable lowlands, gentle and steep slopes, the vulnerability of communities to floods follows the nature of the topography. The variation in the flood intensity perceived by different households presented a situation of either highly, moderately and least exposed and vulnerable (Table 7). Findings revealed that the Mount Cameroon Region is highly prone to landslides 44.17% of the communities experience flood hazards especially during the peak rainy months between July and September. About 35.83% are moderately affected while 20% of the communities are least exposed to flood hazards.

Floods are severe or high in Limbe and Tiko creeks than any other communities within the mount Cameroon region. Field investigation identified the Church streets, Motowo, Down beach, Crab and Clerk's quarters of Limbe and the Tiko Creeks are the most vulnerable areas to floods (Fig. 4).

Ironically, the flood-prone zones, landslide and lava susceptible areas within the mount Cameroon region are the most inhabited areas within this fragilized topographic mastodon. The occupation of these unstable and mobile slopes by increasing settlement construction has been greeted with a lot of mixed feelings. Such feelings are linked or connected to the benefits and losses incurred by households or communities during the episodic period of geo-hazards incidence. Fig. 5 presents the perception of individual household related to the occurrence of either floods, eruption or landslides.

Findings show that the majority of the households (52%) in geo-hazards environment were of the view the occurrence of geo-hazards brings to the communities several benefits. Field

investigation discarded the generalization of such assertion or perception and specifically attached the benefits to particular hazards. The benefits linked to the occurrence of volcanic eruption was undeniable given that the emission of lava during the eruption provide aftermath benefits associated to fertile volcanic soils. These soils provide an avenue for agricultural productivity justifying the extension of palm, rubber, banana and tea plantations. The fertile volcanic and alluvial soils provide certain conditions for food security within the region. Nevertheless, the occurrence of floods and landslides are more of a curse than a blessing to the communities given that most households suffer frequent destruction of property, house submergence and other infrastructural damage during intense floods that has become commonplace in the low lying areas of Limbe, Tiko and Idenau. This explains why about 45% of the households in the region were of the opinion that the occurrence of geo-hazards over the years has brought untold damage and distress to some communities. About 3% of the households remained indifferent as to whether geo-hazards are providing positive or negative impacts to communities.



Fig. 4a. Church street flood area



Fig. 4b. Down beach flood area

Table 6. Household perception to lava flow exposure within the Mount Cameroon Region

Communities	No. of households	High N/(%)	Moderate N/(%)	Low N/(%)
Limbe	30	16 (53.33)	9 (30)	5 (16.67)
Buea	20	13 (65)	5 (25)	2 (10)
Tiko	25	6 (24)	9 (36)	10 (40)
Idenau	25	7 (28)	14 (48)	4 (24)
Bakingili	20	11(55)	6 (30)	3 (15)
Total	120	53 (44.17)	43 (35.83)	24 (20)

Source: Fieldwork, 2019

Table 7. Household vulnerability perception to flood incidence within the Mount Cameroon Region

Communities	No. of households	High N/(%)	Moderate N/(%)	Low N/(%)
Limbe	30	22 (73.33)	6 (20)	2 (6.67)
Buea	20	2 (10)	3 (15)	15 (75)
Tiko	25	13 (52)	8 (32)	4 (16)
Idenau	25	12 (48)	10(40)	3 (12)
Bakingili	20	5 (25)	8 (40)	7 (35)
Total	120	54 (45)	35 (29.17)	31 (25.83)

Source: Fieldwork, 2019

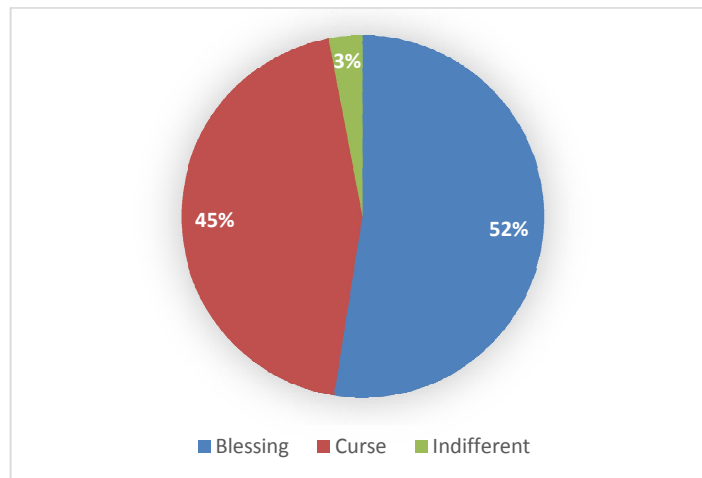


Fig. 5. Percentage of household opinion to geo-hazards within the Mount Cameroon region

Despite the threats imposed by floods, landslides and signs of future eruption of mount Cameroon, communities have remained adamant and turn blind eyes to the caprices. Settlement expansion into these unbearable risk zones has intensified for the past decades. Pushing houses unto steep slopes expose the population to landslides. On the other hand, further encroachment into the coast and reclaiming wetlands invite the population to coastal floods and socio-economic damage. The perception of non-migrant households or communities to geo-hazard

incidence was based on the socio-cultural beliefs of the people (Fig. 6).

Fig. 6 presents the ranking of non-migrant decision in response to geo-hazard threats within the mount Cameroon region. Field investigation shows that most households in hazard-prone zones were adamant to move based on the fact that they view volcanic eruption and coastal flooding as the response of the gods or ancestors. The incidence is always attributed to ancestral revelation and interpreted by many in

different ways. To some, when the intensity is high, it signifies that the gods are angry. The ancestral factor with 58.5% of respondents remains highly convinced by the local population given that the traditional authorities and communities sometimes make sacrifices to the gods. This mechanism is so strong so much so that, most indigenes do not see the need to leave their ancestral ground elsewhere in response to the intensity and frequency of geo-hazards within the region. Hence, about 46.5% of the households agreed that they have strong bonds to their ancestral sites such that rather prefer to put in place coping strategies in response to geo-hazards manifestation. About 36.5% of the households were of the view that the occurrence of such hazards is the "Act of God". Such perception only leaves the vulnerable households and communities at the mercy of God. The act of God was revealed as the driving option that all is well and the destiny of mankind depends on God's fate. Consequently, the people deliberately occupy such fragile zones with the perception that nature knows best while hoping for calamity to rest. Also, about 41.5% of the households viewed geo-hazards as fortune that may come as a blessing or curse depending on the intensity and damage associated with such hazards. Findings equally identified that poverty contribute to the non-migrant decision to continuously occupy hazard prone zones such as fragile steep slopes and marshy areas of the region. Poverty pushes many to acquire land in such areas at affordable price while setting up low-quality houses in such areas which are liable to submergence and collapse. Table 8 presents a correlation between socio-cultural myths of non-migrant decision and community vulnerability to geo-hazard threats. The factors of

the independent decision of non-migrants to inhabit the disaster-prone environment within the mount Cameroon region was statistically assessed. Findings equally revealed that the perception of communities or households to geo-hazard manifestation within the Mount Cameroon region is a function of the socio-economic and demographic characteristics. As a consequence, household perception is strongly connected to the age, education level, income status and the length of stay within the hazard-prone zones (Fig. 7).

The results show that socio-demographic attributes have a strong influence on household perception to geo-hazards. The aged and ageing population perceive the occurrence of geo-hazards more in the perspective of a blessing and curse. A lower percentage of the aged are of the view that the occurrence is attributed to nature. This is highly manipulated by the socio-cultural myth and practices that has become innate of the aged. Equally, those with formal education have a low perception of the blessing and curse factors. About 80% of the educated were of the view that the occurrence of floods, landslides and eruption is controlled by nature which is scientifically accepted. They believe in science and anthropic influence to provoke the incidence of floods and landslides. Those that have not attended formal education blame the incidence as a blessing or curse to the society as they have little scientific background on the man-nature based system. While over 60% of the rich were of the opinion that geo-hazards are ignited by natural occurrences, a lower percentage viewed this as a blessing and a curse. In a similar way, a greater proportion of the poor (57%) perceived the occurrence as a curse.

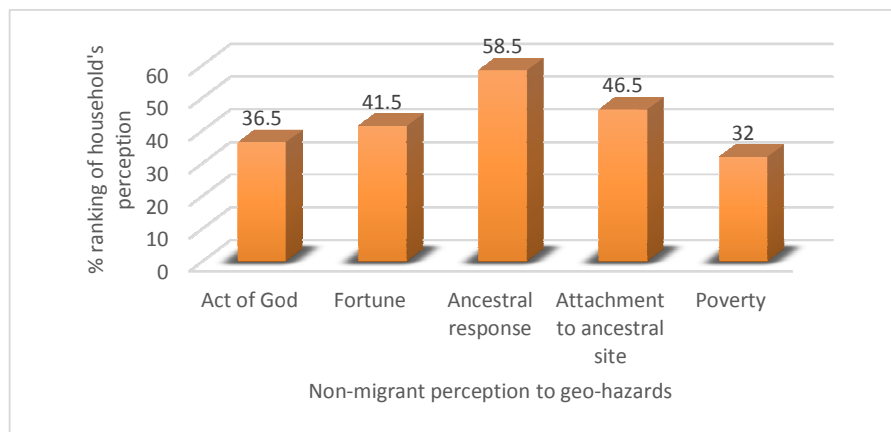


Fig. 6. Non-migrant perception to geo-hazard in the Mount Cameroon Region
 Source: Fieldwork, 2019

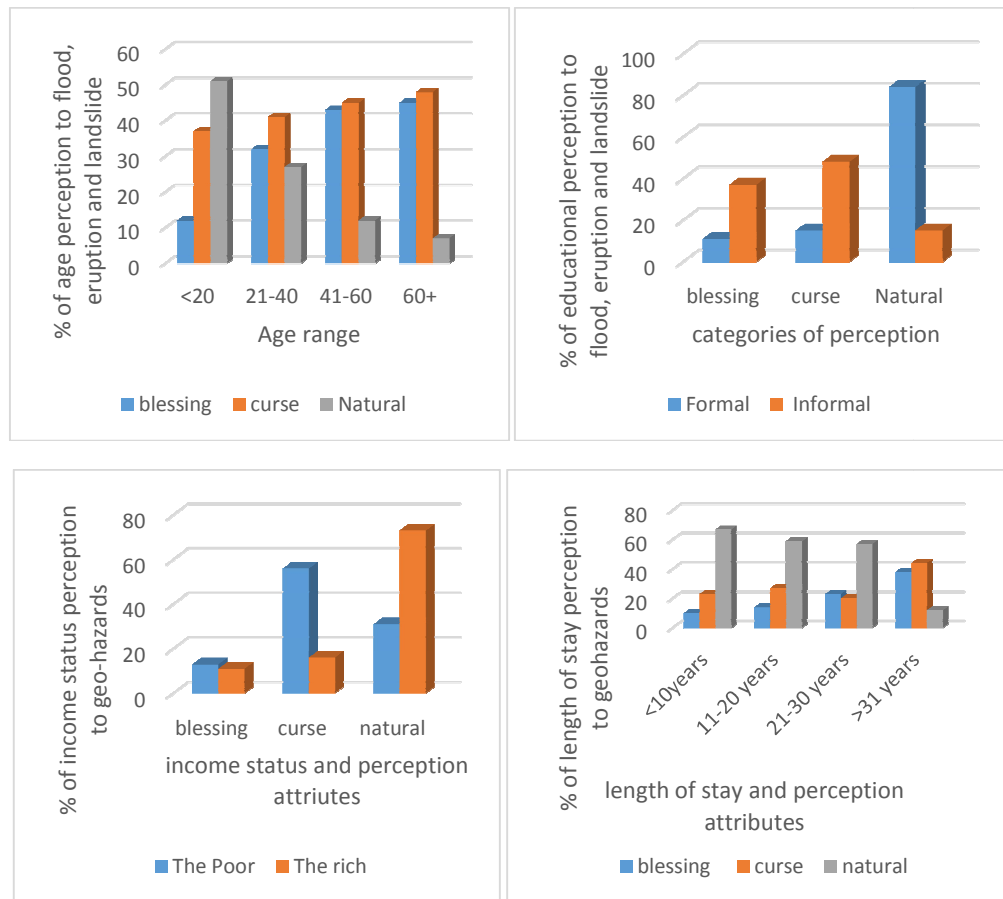


Fig. 7. Socio-demographic characteristics and perception attributes to geo-hazards within the Mount Cameroon Region

Source: Fieldwork, 2019

Table 8. Correlation between socio-cultural myths of non-migrants and household vulnerability to geo-hazards incidence

Measurable variables		Socio-cultural myths of non-migrant decision	Community vulnerability to geo-hazards
Socio-cultural myths of non-migrant decision	Pearson Correlation	1	.768**
	Sig. (2-tailed)		.000
	N	120	120
household vulnerability to geo-hazards	Pearson Correlation	.768**	1
	Sig. (2-tailed)	.000	
	N	120	120

**Correlation is significant at the 0.01 level (2-tailed)

Table 9. Descriptive statistics

Measurable variables	N	Minimum	Maximum	Mean	Std. deviation
Socio-cultural myths of non-migrant decision	120	1.00	2.00	1.2083	.40782
Community vulnerability to geo-hazards	120	1.00	2.00	1.3083	.46374
Valid N (listwise)	120				

The correlation reveals a strong and perfect relationship of 0.768 between non-migrant decision and household vulnerability to geo-hazards. This indicates that a more positive perception of the socio-cultural myths to geo-hazards, the more vulnerable households are to the incidence of geo-hazards. This positive correlation kills the science of the natural occurrence of hazards as well as the poor spatial planning in response to the topographic units in the mobile mount Cameroon region. The low standard deviation of 0.40782 suggests that non-migrant perception has a significant impact on household vulnerable to geo-hazard threats. Equally, the low value indicates that community vulnerability to geo-hazards is a function of the socio-cultural myths of communities within the mobile mount Cameroon region.

5. CONCLUSION AND RECOMMENDATIONS

Geo-hazards occurrence within the mount Cameroon region remains indispensable given that this is an active region within the national territory. The active region appears to have complex topographic units characterized by lowlands, valleys, depression and highlands. The geological setting of the landscape provides a breeding ground for the regular occurrence of floods, landslides, tsunamis and volcanic eruptions. These geo-hazards are known to occur at varied intensity and frequency over time. The increasing construction of settlement and the setting up of plantations, farmlands and other infrastructures only go a long way to expose these structures to the incidence of geo-hazards. Houses have been constructed almost in all the topographic units given the scarcity of land within this region. At the same trend of urbanization and agricultural setup, the geo-hazards incidence of floods and landslides have become commonplace in Limbe, Tiko, Mutengene and Idenau. While the trend of geo-hazard continues to be positive, communities have varied perceptions as to the occurrence of these hazards. To some communities, these hazards have been regarded as fortune, fate and act of God. Others view it as an ancestral response to communities which is often greeted with mixed feelings. Nevertheless, the result shows a strong correlation of 0.76 between the socio-cultural myths of the non-migrants decision to geo-hazards and household vulnerability to such hazards. Poverty situation and strong attachment of communities to their ancestral sites make communities turn blind eyes to geo-hazard

effects and therefore their adamant ability to resettle elsewhere in response to the threats of geo-hazards within the region.

Considering the strong correlation between community perception and the vulnerability of households to geo-hazards, the paper opts for better land use planning in relation to the unwillingness to non-migrant to abandon their ancestral sites. Given the spontaneous growth in the settlement, there is the need to embark to a new paradigm of allocation of land for construction taking into consideration the instability nature of the region. If people must construct, resistant materials, the minimization of slope undercutting, elevation house foundation in coastal areas and building of strong coastal embankment are therefore recommended. Land use planning must involve all stakeholders specifically, individual households, local authorities, municipal councils and government departments. Given the high resettlement cost, restriction of people to construct in hazard risk zones must be respected while urging the government to undertake high-cost projects such as installation of seismographs, coastal embankment and information technology and communication lines within the mobile mount Cameroon region.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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