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Chapter

Determinants of Coping Strategies to Floods and Droughts in Multiple Geo-Ecological Zones

Theobald Mue Nji and Roland Azibo Balgah

Abstract

Floods and droughts—the most frequent water-related hazards are negatively impacting livelihoods across the world, particularly in Sub-Saharan African countries, where poverty remains endemic. Naturally, victims adopt different coping strategies against burgeoning hydro-meteorological hazards. Contemporary research on determinants for coping decisions in SSA has been largely driven by isolated case studies, of little relevance for broad-based policy making. We analyze the determinants for coping with floods and droughts across multiple geo-ecological zones in Cameroon. Quantitative data primarily obtained from 2024 flood and drought household victims in the Western Highlands and Sudano-Sahelian Upland geo-ecological zones are analyzed alongside qualitative data obtained through 31 FGDs and 99 IDIs using descriptive statistics and regression analysis in MS Excel 2013 and SPSS 20 for the questionnaires and content analysis in Nvivo 11 for the unstructured interviews. Results reveal government policy, socio-cultural, economic and educational factors, and hazard experience as major shapers of coping decisions, irrespective of hazard type, timing and geo-ecology ($P = 0.05$). In contrast to the state-of-the-art, we observed livelihoods improvement after some hazardous events. The policy implications for long-term coping and resilience building are then discussed.

Keywords: determinants, coping strategies, hazards, floods and droughts, multiple geo-ecological zones, broad-based policy making

1. Introduction

Drought and flood-related disasters have been more devastating than other natural hazards (volcanoes, earthquakes, landslides, etc.), as far as deaths, sufferings and economical and cultural destructions are concerned. Apart from destructive direct effects, flood and drought events have been followed by secondary, indirect tragedies, such as famine, epidemics, fire, destruction of social networks, etc. [1]. Despite the progress in science and technology, man has remained very susceptible to extreme drought and flood events. Their escalation is facilitated by the continuous development of costly but inappropriate infrastructures, increase in population density, and a rather decrease in the buffering capacities (deforestation, urbanization, drainage wetlands, etc.). Understanding the way people in such areas, especially in SSA perceive these hazards, their experiences and interpretations
of patterns of occurrence, coping mechanisms, characteristic factors that drive household and community modus operandi when such anomalies strike are of great imperativeness for the design and implementation of household and community based strategies to curb the effects of floods and droughts; and build more resilient communities.

Bhavnani and colleagues for instance opine that droughts and floods alone account for up to 80% of the loss of life and 70% of the economic losses in SSA [2]. Frequent floods and droughts conditions have reduced the GDP growth of many African countries [1, 3, 4]; and have as well endangered their development advances [5]. Both water-related phenomena have direct and indirect impacts. Over the last 5 decades, floods and droughts have evolved to become major problems in SSA; causing depletion of assets, environmental degradation, impoverishment, unemployment and forced migrations [2, 5, 6]. Flood has been variously defined but for the purpose of this study we have operationally defined flood as a body of water which rises to overflow land which is normally not submerged [7, 8]. There are mainly five types of floods: river flood, flash flood, inland flood, storm surge, coastal flood [8, 9]. Floods are considered as one of the most frequent global hazards [10]. Floods account for approximately 40% of natural disasters and will possibly become more recurrent and severe due to global warming [11].

Unlike floods, droughts are characterized by a slow development, long duration, affects vast areas, and high severity [12]. Furthermore, droughts are expected to become more severe and frequent. This is expected to lead to more water demand, global climate change, and a limited water supply [13]. Based on the nature of water shortages, droughts can be classified into the following four types: meteorological, hydrological, agricultural, and socioeconomic [14]. Among these types, meteorological droughts occur more frequently and regularly than the other three drought types and normally trigger other types of droughts [13].

Floods and droughts are now the most frequent types of major disasters. The impacts of climate change are likely to increase their occurrence as they happen to be the most frequent types of major disasters nowadays especially in SSA. In the era of climate change, the reliability on predictability in rainfall patterns has been reduced significantly [15]. The frequency and severity of weather-related events such as floods and droughts have increased unpredictably and shall continue over time.

Cameroon is one of the SSA countries most hit by these climatic extreme anomalies. It is a country in Equatorial Africa, located on the Gulf of Guinea in Central Africa. It lies between latitude 1°40′ and 13°05′ north and between longitude 8°30′ and 16°10′ east; its area is 475,412 km². Cameroon’s beauty and relevance in SSA stems from her extremely diversified landscapes, rich natural resources (petroleum, bauxite, timber and many tropical crops), cultural and ethnic diversity and a multiplicity of climatic and geomorphologic zones. It is not surprising therefore that Cameroon has been nicknamed Africa in Miniature.

Cameroon’s geo-physical location, tectonic history and climate makes her one of the most susceptible countries affected by natural hazards in Africa. The regularity and devastation caused by such hazards along the active Cameroon Volcanic Line (CVL) are becoming more frequent and even more disastrous, affecting livelihood assets including human, social, financial, natural, physical capital [10, 16]. The country is becoming more prone to and persistently hit by floods and droughts but also by mud flows, rock fall, lahars, volcanic eruptions, toxic gas emissions, earth tremors and landslides which occur on a regular annual pattern.

Despite her diversity and abundant natural resources, Cameroon is also a victim of several hazards and disasters which have accompanied global climate change. Average temperatures have risen since 1930 [17] and average rainfall has reduced by
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more than 2% per decade since 1960 [17]. Projected changes in rainfall range from −12 to +20 mm per month (−8 to +17%) by the 2090s [18]. Furthermore, average annual temperatures are predicted to increase between 1.5° and 4.5° by 2100, with a 1.6° to 3.3° rise in coastal zones; and a 2.3° to 4.5° rise in the Sudano-Sahelian region [17]. Average rainfall is predicted to continue to decrease, leading to a prolonged dry season in the Sudano-Sahelian ecological zone. Desert conditions are expected to dominate this area by 2100. It is predicted that Lake Chad will be nearly completely dried up by 2060 [19].

IPCC has established that a 2° rise globally will result in a sea-level rise of between 69 cm and 1 m across the world [20]. Cameroon, given its location along the coast is also expected to experience the impacts of sea level rise over the next century. The above-mentioned statistics indicate that Cameroon is highly vulnerable to floods and droughts. Tiefenbacher et al. [21] have argued that such vulnerability presents a serious threat to the development of the leisure sector and in this case would pose serious problems in attaining sustainable development and generates new challenges for achieving the SDGs; and jeopardizes progress already made. The analysis of climate variability impacts in Cameroon indicates consequences in almost all sectors of development, with huge negative impacts on livelihoods especially at household level [19, 22].

Burgeoning floods and droughts are expected to inflict adverse effects on many Cameroonian households, given their heavy reliance on agriculture for livelihoods dependence of most households on agriculture [23]. Current agricultural contribution to the country’s GDP could drop by 14% points from 20% now to an estimated 6% in 2025 [16, 22, 24]. This drop will resolve mainly from increased desertification (drought) in the north and higher incidence of flooding in the south and in the north of the country.

A fundamental step towards reducing the effects of floods and droughts in Cameroon lies in identifying risk management strategies whose validity supersedes specific geo-ecological zones [16, 24]. In this paper we therefore undertake the agency to understand the array of household determinants of coping with the threats of floods and droughts, the shapers of the peoples’ perceptions, interpretations and experiences to these risks within their daily lives and how all of these tend to shape the way they respond to the threats presented by floods and droughts in their households across the western highlands and the Sudano-Sahelian geo-ecological and socio-cultural areas of Cameroon with the intention to identify drivers that are robust over space and time.

2. Study area and population, data collection and analysis

2.1 Study area

Cameroon is characterized by five geo-ecological zones with varied landscapes and climates. These are described as Zone I (Sudano-Sahelian); Zone II (High Guinea Savannah); Zone III (Western Highlands); Zone IV (Humid Forest with monomodal rainfall pattern); and Zone V (Humid Forest with bimodal rainfall pattern) [25] (Table 1).

The current study was carried out in two of the 5 geo-ecological zones; the Sudano-Sahelian upland and the Western highlands. The Sudano-Sahelian zone is located between latitude 7 and 13° north thus covering more than 21% of the national territory. It has a rippling relief with plateaus that have varying altitudes between 500 and 1000 m and plains with altitudes ranging from 200 to 300 m. The area is also characterized by mountains and flood valleys. In addition to the
geographical position of the zone, it has a distinctively dry climate as compared to the rest of the country with a single and short rainy season of about 4 months reaching its peak in August and a very severe and lengthy dry season of up to 7 months or more as one progresses up north from the Mandara Mountains. The annual mean rainfall ranges from 400 mm in the northern part to 1100 mm in the southern part of the zone with an average temperature of up to 28°C [25].

On the other hand, the Western Highlands is located between latitudes 5°40′ and 7° north and between longitudes 9°45′ and 11°10′ east. The zone is characterized by relief of massifs and mountains. It features several dormant volcanoes, including Mt. Oku and Mt. Bamboutos. A cool temperate-like climate, influenced mainly by mountainous terrain and rugged topography also characterizes the region. Average rainfall is about 2400 mm, temperatures averaging between 23 and 32°C [19]. There are two main seasons; the rainy season which starts from mid-March and ends in mid-November and dry season from Mid-November to mid-March. The dry season is characterized by the harmattan with dry air. Forests once largely covered the Western Highlands but because of the influence of anthropomorphic activities the forests were progressively cleared for farmland and grazing, and today, only patches remain. Although small, these patches are recognized as globally important sites for conservation.

2.2 Study population

Study participants were limited to the study areas; were of both sexes (male and female), aged 20 years and above and had been in the area for at least 10 years; and must have witnessed at least one flood and/or drought event. Data were collected from flood victims in 14 communities of the Western Highlands; and 17 drought-only communities, and 10 floods and droughts affected communities in the Sudano-Sahelian geo-ecological zone.

2.3 Data collection

Three Social Science instruments were used for data collection to ensure accurate and reliable data in order to attain the study objective. The combined approach was used in collecting the data. Three instruments (individual questionnaires, Focus Group Discussion (FGDs) guides and In-depth interview guides) were employed in collecting both quantitative and qualitative data to investigate the research question.

| SN | Geo-ecological zones | Regions | Surface areas (km²) |
|----|----------------------|---------|---------------------|
| I  | Sudano-Sahelian Upland | North and Far North | 100,353 |
| II | High Guinean savannah | Adamawa Region, Mbam Division and Lom and Djerem Division | 123,077 |
| III | Western Highlands | West and North West | 31,192 |
| IV | Humid Rainforest with monomodal rainfall pattern (marine coast) | Littoral and South West Regions | 45,658 |
| V  | Humid Forest with bimodal rainfall pattern (Tropical forest) | Centre, South and East Regions | 165,770 |
|    | Total                |          | 466,050 |

Table 1. Cameroon geo-ecological zones and surface areas.
2.4 Individual questionnaire

This was a structured questionnaire used to collect quantitative data from 2024 different floods and droughts household heads or their representatives. It was developed to understand victims’ perceptions and to identify the factors that influence their adoption of specific coping strategies in situations of floods and/or droughts. Socio-demographic information was collected as well. Questionnaires were administered to respondents on a face to face basis after obtaining their consent. We had two sets of questionnaires designed for the purpose of this study: one for floods victims and the other for drought victims.

2.5 Focus Group Discussions (FGDs) and In-depth Interviews (IDIs)

To generate qualitative data, 31 FGDs and 99 IDIs were conducted in different floods and droughts communities with household members to capture the general opinion and perception of household members on the hazards and disasters, the consequences of such phenomena in their households and the determinants of their preferred coping strategies. We also sort to understand how experience, cultural factors and location within a certain geo-ecological zone could influence the adoption of formal or informal coping strategies. The data collection instruments in this case were also designed separately to distinctively collect data for droughts and floods.

2.6 Data analysis

All quantitative data generated from the questionnaires were entered into a template designed in the Statistical Package for Social Sciences (SPSS version 20.0) (IBM Corp., Armonk, NY, USA). The data were cleaned and later on analyzed using both SPSS and Microsoft Excel 2013.

For qualitative data (FGDs and IDIs), they were recorded in the field using dictaphones (voice recorder) and later on transcribed and typed into a word processing program (Microsoft Word 2013). The transcribed data were analyzed using Nvivo version 11, and themes were established in relation to research objectives. This was to ensure a standardized analysis and interpretation of the qualitative data generated across tools.

3. Results and discussions

3.1 Socio-economic description of sampled population

This section presents and discusses the socio-economic characteristics of the sample. The discussions are done by comparing results from the Sudano-Sahelian region with those from the Western Highlands. It is worth mentioning that the distribution of respondents across geo-ecological zones indicates that 60% of the from the Sudano-Sahelian zone while 40% was from the Western Highlands. In addition, the sample comprises of victims of both droughts and flood events (45.2% drought victims, 40.7% flood victims and 14.1% both drought and flood victims). More so, while all the respondents in the Western Highlands were flood victims, in the Sudano-Sahelian region, only 0.7% of the respondents witnessed floods alone. 75.7% of the respondents were drought victims, 23.6% had witnessed both droughts and floods.
3.2 Education

In general, most of the respondents had attained only primary level of education (65%), seconded by those with secondary level education (21.9%), third by those with no formal education (7.2%) and lastly by those with High school level of education (5.9%). The results are presented in Table 2.

Most respondents had attained only primary school education, irrespective of geo ecological zone. This amounted to 69.8% of droughts victims, 55.6% of flood victims and 81% of both flood and drought victims in the Sudano-Sahelian region \((P < 0.001)\); and 54% of the flood victims in the Western highlands.

3.3 Sex

Over 60% of the entire sample are male, while <40% are female. The distribution in the different geo-ecological zones is presented in Figure 1. In the Sudano-Sahelian region, the males also had the higher proportion as compared to the females among those who witnessed droughts (69.1 and 30.9% respectively, \(P = 0.085\)) and those who witness both floods and droughts (63.9 and 36.1% respectively, \(P = 0.085\)). The Sudano-Sahelian region is in the northern part of Cameroon and most of the people here are Muslims living in a closed society. Access to women is generally more challenging than is the case for men. Interestingly, the majority of those who witnessed floods in the Sudano-Sahelian region were females (55.2 and 44.8% respectively, \(P > 0.05\)). This stems from the fact that women are the ones mostly involved in farming activities and fetching of water thereby exposing them to the daily realities of the environment. In the Western Highlands, majority of the respondents were males (55.2%) as compared to 44.8% who were females.

3.4 Marital status

The distribution in the entire sample according to the marital status of the respondents showed that majority of them were married (76.1%) while 17.7% were still single. In addition, while 4.8% of the respondents were widow(ers), a very small proportion of the respondents (1.3%) had divorced their spouses. Results from the geo-ecological zones are presented in Table 3. These are traditional societies where both boys and girls marry very young and divorce is almost viewed as a taboo. Since it is considered that a woman is married to a family, she is generally considered stilled married to the successor of her husband even after the dead of her real husband. Moreover, men generally remarry upon the dead of their wives because the wives facilitate their household chores which men are essentially not familiar with.

| Geo-ecological zone | Disaster type | Primary (%) | Secondary (%) | High school (%) | No formal education (%) | \(X^2\) (P-value) |
|---------------------|--------------|-------------|---------------|-----------------|------------------------|-----------------|
| Sudano-Sahelian     | Drought      | 69.8        | 18.8          | 3.4             | 8                      | 32.423 \((P < 0.001)\) |
|                     | Floods       | 55.6        | 22.2          | 0               | 22.2                   |                 |
|                     | Both         | 81          | 6             | 2.1             | 10.9                   |                 |
| Western Highlands   | Floods       | 54          | 31.1          | 10.1            | 4.8                    | 11.547 \((P < 0.001)\) |

Table 2. Educational attainment of respondents.
The results indicate that majority of the respondents in both geo-ecological zones as well as for the different disasters were married (66.4% in the Western Highlands and 81.7% for drought, 77.8% for flood and 86.7% for both flood and drought victims in the Sudano-Sahelian region, \( P > 0.05 \)).

### 3.5 Main occupation

As a livelihood source, most of the respondents were involved in farming activities to sustain their families (60%). However, while 32.1% were business persons, 8.8% of the respondents had salaried jobs. The comparative analysis as presented in Figure 2 also show that most of the respondents rely on farming for their household livelihoods (56.7% in the Western Highlands and 67.9% for drought and 77.8% for flood victims in the Sudano-Sahelian region, \( P = 0.001 \)).

For those who witness both floods and droughts, the majority of them were found to rely on their respective businesses for their livelihoods (52.4%) as compared to 43.7% who rely on farming.

### 3.6 Religious affiliations

In our sample, only a slight difference was observed between Christians and Muslims (48.1 and 48.4% respectively). However, a small proportion of the respondents (3.5%) were African Traditionalists. Figure 3 presents the distribution in the two geo-ecological zones.
From Figure 3, we can infer that most of the victims in the Western Highland region are Christians (91.5%). On the contrary, majority of the respondents in the Sudano-Sahelian region for all disaster types were Muslims (85.2% for both drought and flood victims, 66.7% for flood victims and 76.9% for drought victims, \( P = 0.02 \)). This is logical as the Western highlands and the Sudano-Sahelian Zones are both Christian and Muslim communities respectively. More description of the sample population has been presented in Table 4.

It can be inferred from Table 3 that the age of the respondents was significantly higher among respondents in the Sudano-Sahelian zone than those in the Western Highlands (45.41 ± 16.617 years and 43.4 ± 13.739 years respectively, \( P = 0.004 \)). Similar result was also observed with respect to the number of years the respondents have been living in their communities, as it was significantly higher among...
respondents in the Sudano-Sahelian zone than those in the Western Highlands (26.35 ± 11.507 years and 24.5 ± 11.575 years respectively, \( P = 0.001 \)). On the other hand, the estimated household income before and after the disasters were significantly higher among the respondents in the Western Highlands over those from the Sudano-Sahelian zone (FCFA 113,390 and FCFA 66,950 respectively before, \( P = 0.001 \) and FCFA 66,950 and FCFA 32,290 respectively after, \( P = 0.001 \)). Only the total household size was found not to differ significantly between the two geoeconomic zones (7 ± 3 persons for the Sudano-Sahelian and 8 ± 3 persons for the Western Highlands, \( P = 0.105 \)). Details across the different disaster types have also been provided in Table 3.

### Table 3.

| Geoeconomic zone | Variable | Sample mean | Disaster type | Mean | Std. dev | Std. error |
|------------------|----------|-------------|---------------|------|----------|------------|
| I                | Age/years | 45.41**     | Floods        | 43.22* | 22.532   | 7.511      |
|                  |          |             | Droughts      | 44.13* | 16.757   | 0.554      |
|                  |          |             | Both          | 49.99* | 15.284   | 0.905      |
|                  | Number of years living in the village | 26.35*** | Floods | 28      | 8.139    | 2.713      |
|                  |          |             | Droughts      | 25.16  | 11.99    | 0.396      |
|                  |          |             | Both          | 30.14  | 8.922    | 0.529      |
|                  | Total household size | 741 | Floods | 8.33 | 3.122 | 1.041 |
|                  |          |             | Droughts      | 7.6    | 2.933    | 0.097      |
|                  |          |             | Both          | 6.77   | 2.444    | 0.145      |
|                  | Income before disaster/FCFA | 64,990*** | Floods | 87,780 | 125,300 | 41.770   |
|                  |          |             | Droughts      | 66,950 | 72,440  | 2390      |
|                  |          |             | Both          | 57,975 | 46,650  | 2760      |
|                  | Income after disaster/FCFA | 34,050*** | Floods | 46,330 | 75,290  | 25,090   |
|                  |          |             | Droughts      | 32,290 | 48,220  | 1590      |
|                  |          |             | Both          | 26,480 | 23,930  | 1420      |

\( *, **, *** \) Significant at 10%, 5%, and 1% level respectively.

I = Sudano-Sahelian; II = Western Highlands.

### Table 4.

Age, household size, years in the community and income of respondents.

3.7 Characteristics of floods and droughts in the study areas

This section first of all looks at the number of times the respondents have witness disaster events in the last decade, before exploring their perceptions with respect to
damage of the disasters as well as the severity of the damage. From Table 5, we can infer that more floods have been witnessed in the last decade in the Sudano-Sahelian Zone than in the Western Highlands (5 and 3 respectively, \( P < 0.001 \)).

These disasters are known to bring about damages to the asset portfolio of their victims. Presented in Table 6 are some of the negative impacts of the disasters faced by the victims both at household and community levels. The results show mix impacts. For instance while damage to natural environment and livestock at the household level was higher in the Sudano-Sahel region than in the Western Highlands (reported by 91 and 43.8% respectively) loss of property was higher in the Western Highlands than in the Sadano-Sahel region (reported 72.6 and 59.9% respectively).

For the Sudano-Sahel region, the highest three damages are incurred through increase in sickness and diseases (reported by 96.9%), destruction of crops (reported by 93.4%) and damage to natural environment and livestock (reported by 91%). For the Western Highlands, the highest three damages are incurred through the destruction of crops (reported by 97.3%) increase in sickness and diseases (reported by 93.7%) and damage to ancestral links (reported by 89.1%). Details of these as well as the perceptions with respect to damages at the community level can be obtained from Table 5.

3.8 Severity of disaster damage

Base on the level of damage experienced by each household, the respondents provided information on the severity of the damages caused by the disasters both at household and community levels. The results have been summarized in Figures 4 and 5.

At the household level, a significantly higher proportion of the victims from the Sudano-Sahel region acknowledged the severity of the damage from the disasters to be very high than those from the Western Highlands (74.2 and 30.2% respectively, \( P < 0.001 \)). On the other hand those who said the severity of the damage was high was significantly higher in the Western Highlands than in the Sudano-Sahelian region (36.4 and 13.4% respectively, \( P < 0.001 \)).

The results at the community level with respect to the severity of the damages caused by the disasters are similar with those at the household level. For instance just as was the case at the household level, at the community level a significantly higher proportion of the victims from the Sudano-Sahelian region acknowledged the severity of the damage from the disasters to be very high than those from the Western Highlands (71.8 and 28.6% respectively, \( P < 0.001 \)). Similarly, a significantly higher proportion of those who said the severity of the damage was high was from the Western Highlands than in the Sudano-Sahelian region (39.8 and 13.5% respectively, \( P < 0.001 \)).

| Disaster | Geo-ecological zone | Mean | Std. deviation | Std. error mean | F-test |
|----------|---------------------|------|----------------|-----------------|--------|
| Both     | Sudano-Sahelian     | 6.68 | 1.300          | .077            | Not applicable |
| Drought  | Sudano-Sahelian     | 5.99 | 2.917          | .096            | Not applicable |
| Flood    | Sudano-Sahelian     | 4.89 | 3.060          | 1.020           | 0.000  |
|          | Western Highlands   | 3.43 | 1.615          | .057            |        |

Table 5. Number of disasters faced in the last 10 years.
3.9 Disaster management strategies adopted by respondents

This section presents the different strategies explained to be used by the respondents following disasters and especially the last event. As presented in Table 6, there were some similarities as well as differences in the disaster management strategies employed by the respondents in the Sudano-Sahelian and Western Highlands regions both at household and community levels. For instance it can be inferred that the respondents in both geo-ecological zones did not rely very much on insurance (0% all round) and borrowing from the Bank (1.6% for Sudan-Sahel and 1.3% for Western Highlands at household level and 0% for Sudan-Sahel and 1% for Western Highlands at community level). On the other hand, they reduced their household savings (94.5% for Sudano-Sahelian and 99.1% for Western Highlands at household...
level and 98.1% for Sudano-Sahelian and 98.5% for Western Highlands at community level), rely on stored food (80.3% for Sudano-Sahelian and 87.2% for Western Highlands at household level), and also rely heavily from help from friends and relatives (77.6% for Sudano-Sahelian and 83.6% for Western Highlands at household level and 62.3% for Sudano-Sahelian and 61.6% for Western Highlands at community level). Details of these and more are presented in Table 7. It is worth mentioning that of all the strategies captured, only insurance premiums was not used by any of the respondents in the study area.

Presented in Figure 6 is a summary of the above captured strategies. It can be observed from Figure 6 that the respondents in both the Sudano-Sahelian Region and the Western Highlands adopted and implemented mainly informal disaster management strategies in order to cope with the negative effects of the disasters (95.6 and 98.9% respectively, \( P < 0.001 \)).
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| Strategy                          | Geo-ecological zone | At household level (%) | At community level (%) |
|-----------------------------------|---------------------|------------------------|------------------------|
| Borrow money from Bank***         | Sudano-Sahelian     | 1.6                    | 0                      |
|                                   | Western Highlands   | 1.3                    | 1                      |
| Borrow from neighbors***          | Sudano-Sahelian     | 48.2                   | 0.1                    |
|                                   | Western Highlands   | 68.7                   | 19.4                   |
| Relocation***                     | Sudano-Sahelian     | 40.3                   | 41.9                   |
|                                   | Western Highlands   | 56.6                   | 52                     |
| Assembled at central location***  | Sudano-Sahelian     | 30.8                   | 33.2                   |
|                                   | Western Highlands   | 3.6                    | 0                      |
| Evacuated by the government***    | Sudano-Sahelian     | 11.8                   | 24.9                   |
|                                   | Western Highlands   | 11.4                   | 3.6                    |
| Got help from NGOs***             | Sudano-Sahelian     | 44.2                   | 63.9                   |
|                                   | Western Highlands   | 31.2                   | 44.9                   |
| Reduce household savings***       | Sudano-Sahelian     | 94.5                   | 98.1                   |
|                                   | Western Highlands   | 99.1                   | 98.5                   |
| Receive help from social groups***| Sudano-Sahelian     | 39                     | 19.4                   |
|                                   | Western Highlands   | 80.9                   | 49.9                   |
| Receive help from Church*         | Sudano-Sahelian     | 8                      | 53.2                   |
|                                   | Western Highlands   | 10.1                   | 49.9                   |
| Receive help from friends and relatives* | Sudano-Sahelian | 776                   | 62.3                   |
|                                   | Western Highlands   | 83.3                   | 61.6                   |
| Receive help from Central government*** | Sudano-Sahelian | 66.5                   | 0                      |
|                                   | Western Highlands   | 175                    | 0.2                    |
| Receive help from individuals***  | Sudano-Sahelian     | 12                     | 0.2                    |
|                                   | Western Highlands   | 64.7                   | 21.1                   |
| Insurance support                 | Sudano-Sahelian     | 0                      | 0                      |
|                                   | Western Highlands   | 0                      | 0                      |
| Received free medication***       | Sudano-Sahelian     | 67                     | 51.8                   |
|                                   | Western Highlands   | 12.1                   | 25.3                   |
| Sold family labor***              | Sudano-Sahelian     | 10.1                   | 69.4                   |
|                                   | Western Highlands   | 27.3                   | 92.4                   |
We also analysed to identify trends in similarities and differences in the disaster management strategies employed by the respondents from the different disasters faced. The results have been presented in Table 7. Mixed results were also observed here at the household and community levels. For instance the distribution according to insurance (0% all round) show that the respondents did not rely very much on it irrespective of the disaster faced. On the other hand, the distribution in terms of reduced household savings indicate strong reliance among the victims of the different disasters (98.9% for flood victims, and 97.5% for drought victims and 100% for both floods and drought victims at the household level, 99.2% for flood victims, and 93.9% for drought victims and 96.5% for both floods and drought victims at community level). Another important strategy used by the disaster victims is to rely heavily on help from friends and relatives (83.3% for flood victims, and 71.8% for drought victims and 96.1% for both floods and drought victims at the household level, 61.4% for

| Strategy                          | Geo-ecological zone | At household level (%) | At community level (%) |
|-----------------------------------|---------------------|------------------------|------------------------|
| Sold household assets             | Sudan-Sahelian       | 66                     | 0.1                    |
|                                   | Western Highlands    | 74.2                   | 18.7                   |
| Sold household livestock          | Sudan-Sahelian       | 82.2                   | 0.1                    |
|                                   | Western Highlands    | 36                     | 21.5                   |
| Rely on stored food               | Sudan-Sahelian       | 80.3                   | 0.1                    |
|                                   | Western Highlands    | 87.2                   | 17.1                   |
| Building of embankment            | Sudan-Sahelian       | 62.4                   | 0.4                    |
|                                   | Western Highlands    | 6.1                    | 48.7                   |

*Significant at 10% level.
**Significant at 5% level.
***Significant at 1% level.

Table 7. Disaster coping strategies.
| Strategy                      | Disaster type | At household level (%) | At community level (%) |
|-------------------------------|---------------|------------------------|------------------------|
| Borrow money from Bank**      | Floods        | 1.3                    | 1                      |
|                               | Droughts      | 2.1                    | 0                      |
|                               | Both          | 0                      | 0                      |
| Borrow from neighbors***      | Floods        | 68.8                   | 19.2                   |
|                               | Droughts      | 62.6                   | 0                      |
|                               | Both          | 1.1                    | 0.4                    |
| Relocation***                 | Floods        | 51.6                   | 47.9                   |
|                               | Droughts      | 25                     | 43.4                   |
|                               | Both          | 96.8                   | 0                      |
| Evacuated by the government   | Floods        | 11.5                   | 4                      |
|                               | Droughts      | 15.2                   | 32.5                   |
|                               | Both          | 0.7                    | 0                      |
| Got help from NGOs***         | Floods        | 31.3                   | 45.3                   |
|                               | Droughts      | 38.3                   | 57.7                   |
|                               | Both          | 63.2                   | 83.9                   |
| Reduce household savings**    | Floods        | 98.9                   | 99.2                   |
|                               | Droughts      | 97.5                   | 93.9                   |
|                               | Both          | 100                    | 96.5                   |
| Receive help from social groups*** | Floods    | 80.6                   | 49.8                   |
|                               | Droughts      | 44.8                   | 24.5                   |
|                               | Both          | 20                     | 2.8                    |
| Receive help from Church      | Floods        | 10.1                   | 50                     |
|                               | Droughts      | 10.2                   | 52.9                   |
|                               | Both          | 1.1                    | 54.7                   |
| Receive help from friends and relatives*** | Floods    | 83.3                   | 61.4                   |
|                               | Droughts      | 71.8                   | 62.4                   |
|                               | Both          | 96.1                   | 62.5                   |
| Receive help from Central government*** | Floods    | 178                    | 0.2                    |
|                               | Droughts      | 576                    | 0                      |
|                               | Both          | 95.8                   | 0                      |
| Receive help from individuals*** | Floods    | 64.2                   | 21.1                   |
|                               | Droughts      | 14.9                   | 0.2                    |
|                               | Both          | 2.5                    | 0                      |
| Insurance support             | Floods        | 0                      | 0                      |
|                               | Droughts      | 0                      | 0                      |
|                               | Both          | 0                      | 0                      |
| Received free medication***   | Floods        | 12.6                   | 25.7                   |
|                               | Droughts      | 58.1                   | 47.4                   |
|                               | Both          | 95.8                   | 65.3                   |
flood victims, and 62.4% for drought victims and 62.5% for both floods and drought victims at community level). Details of these and more are presented in Table 8.

The Binary Logistic Regression was adopted for this analysis. In this analysis, the dependent variable (Disaster coping strategies) took 1 for Mainly Informal Strategies and 0 for Mainly Formal strategies. 16 explanatory variables were used in the analysis. The attributes of our models as presented in Table 9 and show strong relationships between the dependent and independent variables in the analysis ($X^2 = 109.423, P < 0.001$).

In addition, the attributes of Table 10 show that our model explains 23.3% of the factors that affect coping strategies among the drought and flood victims in the two geo-ecological zones.

The factors that affect the coping strategies among the drought and flood victims in the two geo-ecological zones are presented in Table 11. The results show that the type of disasters faced, belonging to a social group or network, number of disaster faced, the main occupation of the household head and the number of years living in the community (residence time) positively affected the decisions of the disaster victims to adopt mainly informal disaster coping strategies. On the other

| Strategy                  | Disaster type | At household level (%) | At community level (%) |
|---------------------------|---------------|------------------------|------------------------|
| Sold family labor***      | Floods        | 26.9                   | 92                     |
|                           | Droughts      | 13.1                   | 75                     |
|                           | Both          | 0.7                    | 51.9                   |
| Sold household assets***  | Floods        | 74                     | 18.4                   |
|                           | Droughts      | 56.4                   | 0                      |
|                           | Both          | 97.2                   | 0.4                    |
| Sold household livestock*** | Floods    | 36.3                   | 21.2                   |
|                           | Droughts      | 77.5                   | 0                      |
|                           | Both          | 979                    | 0.4                    |
| Rely on stored food***    | Floods        | 80.3                   | 171                    |
|                           | Droughts      | 0                      | 0                      |
|                           | Both          | 872                    | 0.4                    |
| Building of embankment*** | Floods        | 6.7                    | 48.2                   |
|                           | Droughts      | 53.6                   | 0.5                    |
|                           | Both          | 91.2                   | 0                      |

***Significant at 5% level.
**Significant at 1% level

Table 8.
Disaster management strategies adopted by disaster type.

The results show that the type of disasters faced, belonging to a social group or network, number of disaster faced, the main occupation of the household head and the number of years living in the community (residence time) positively affected the decisions of the disaster victims to adopt mainly informal disaster coping strategies. On the other

| Step              | Chi-square | df | Sig  |
|-------------------|------------|----|------|
| Step              | 110.948    | 15 | .000 |
| Block             | 110.948    | 15 | .000 |
| Model             | 110.948    | 15 | .000 |

Table 9.
Omnibus tests of model coefficients.

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Hand, the age, educational level, household size, marital status and the sex of the respondents showed negative relationships with adopting mainly informal disaster coping strategies. In addition, both incomes before and after the disasters as well as the per capita income before and after the disasters seem not to be important variables that could be used to differentiate households in terms of disaster coping strategies (B = 0.000 for all four variables). These therefore indicate that the financial/economic status had no influence on the decisions of the disaster victims to adopt one form of disaster coping mechanisms over the other [16, 20, 26, 27].

Of significance to this study is the number of disasters faced (B = 0.210, \( P < 0.001 \)), religious affiliations (B = 0.675, \( P = 0.096 \)) and the residence time (B = 0.044, \( P = 0.002 \)).

The number of disasters experienced by households (B = 0.210, \( P < 0.001 \)) is therefore seen to be an important variable influencing household decisions to adopt mainly informal disaster management strategies. This is normal, considering that experiencing too many disasters often affect the ability of households to bounce back. Consequently, these households tend to lean on community based informal response mechanisms to deal with aftermaths of disasters [28, 29]. This is probably why [30] explained that if people are made aware of any potential disasters they might face and their collective responsibility in preventing or minimizing the

### Table 10.
Model summary.

| Step | \(-2 \text{Log likelihood} \) | Cox & Snell R square | Nagelkerke R square |
|------|-------------------------------|----------------------|--------------------|
| 1    | 416.685a                      | 0.053                | 0.233              |

### Table 11.
Regression determinants.

|                         | B     | S.E.  | Wald  | df  | Sig.  | Exp(B) |
|-------------------------|-------|-------|-------|-----|-------|--------|
| Age                     | -0.058| 0.012 | 22.708| 15  | 0.000 | 0.943  |
| Type of disaster        | 0.190 | 0.325 | 0.341 | 15  | 0.559 | 1.209  |
| Educational level       | -1.523| 0.602 | 6.401 | 15  | 0.011 | 0.218  |
| Geo-ecological Zone     | -2.114| 1.147 | 3.394 | 15  | 0.065 | 0.121  |
| Household size          | -0.040| 0.055 | 0.539 | 15  | 0.463 | 0.961  |
| Marital status          | -0.046| 0.333 | 0.019 | 15  | 0.890 | 0.955  |
| Belong to a group or network | 18.098 | 7067.871 | 0.000 | 15  | 0.998 | 23.64 |
| Number of disasters faced | 0.210 | 0.064 | 10.835| 15  | 0.001 | 1.234  |
| Main occupation of household head | 0.116 | 0.274 | 0.181 | 15  | 0.671 | 1.123  |
| Religious affiliations  | 0.675 | 0.406 | 2.767 | 15  | 0.096 | 1.965  |
| Residence time          | 0.044 | 0.014 | 9.708 | 15  | 0.002 | 1.045  |
| Sex                     | -0.536| 0.319 | 2.831 | 15  | 0.092 | 0.585  |
| Household income before disaster | 0.000 | 0.000 | 0.894 | 15  | 0.344 | 1.000  |
| Household income after disaster | 0.000 | 0.000 | 1.701 | 15  | 0.192 | 1.000  |
| Per capita income before disaster | 0.000 | 0.000 | 2.851 | 15  | 0.091 | 1.000  |
| Per capita income before disaster | 0.000 | 0.000 | 1.544 | 15  | 0.214 | 1.000  |
| Constant                | -18.243| 7067.872 | 0.000 | 15  | 0.998 | 0.000  |

*Significant at 10% level*
effects of the disasters, it will help them to make preparedness part of their lives according to the disaster management options available to them. Over time, experience in managing (especially long term) shocks becomes an asset, as victims plough back these experiences into strategies aimed at preventing, mitigating, coping or resisting similar (and even dissimilar) shocks in the future. Similar contentions have been raised in the topical literature by [31, 32]. One can therefore conclude that experience with disasters can be quite robust in determining the management practices that victims (especially in developing countries) adopt to deal with natural hazards.

In an area where people roughly share the same way of life, occupation and are subjected to similar shocks, they are likely to employ similar coping strategies when hazards strike as response opportunities and available coping mechanisms are relatively homogeneous [27]. This probably explains why in the research area, the main occupation of the household head affected their household coping strategies. Improving agricultural techniques can therefore enhance the coping capacities of our sampled households to future floods. Improving education to enhance access to off-farm income activities should also be contemplated.

Though not significant, belonging to a social group or network showed the strongest contribution to the use of mainly informal disaster coping strategies in this study (B = 18.098, P > 0.05). Therefore, the more networks a household head belongs to, the more the household is going to rely mainly on disaster coping strategies to handle disaster effects. This therefore suggests that households who belong to groups or networks are likely to dissipate risks through livelihood diversification. This aligns with the findings of [31] who explained appropriate forms of social capital especially belonging to networks usually appear to have the potential to aid rural income generation as well as reduce vulnerability to livelihood shocks of poor households. Thus for any additional group that the household head joins, the probability that the household will employ mainly informal disaster coping strategies increases by 23.64 times.

The probability of the Wald statistics for the variables age and educational level for instance (22.708 and 6.401 respectively) suggests that the disaster victims who are older and more educated are likely to move away from using mainly informal risk management mechanisms to both informal and formal mechanisms. The negative coefficient on education leads us to hypothesize that the more educated a household head is, the more he/she is likely to use formal than informal instruments in managing disasters. These results however contradict the findings in the topical case studies [26, 27, 32]. About 34 for instance in his work in India found education to be a very cost-effective strategy for influencing and implementing schooling decisions in poor households in India. A probable explanation for this is the generally low levels of education observed in the Cameroon case study.

4. Conclusion

Our research demonstrates that Cameroon has diverse geo-ecological zones with climate-related hazards and disasters that are specific to some while others cut across. Through a comparative analysis, we differentiate that the Sudano-Sahelian zone is characterized by severe droughts and very deadly floods in both the urban and rural settings while the Western highlands are typified by floods in both the urban and rural settings as well. Further, we gained insights into the different drivers of household determinants of coping with droughts and floods in both geo-ecological zones. Respondents identified Informal coping mechanisms as their major fallback positions and include amongst others; reducing their household
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savings, relying on stored food and heavy reliance on assistance from friends and relatives. Formal coping strategies were not identified as major drivers at both household and community levels in any of the zones. This explains that building social networks is a very important component in building policies that aim at making households more resilient in these zones.

We also observed that socio-cultural factors and experience with previous disasters influenced the type of strategies people would adopt in subsequent events. The nomadic nature of the Muslim households in the Sudano-Sahelian area elucidates why temporal or permanent migrations will easily be an option in coping with droughts and/or floods. This was not the case with most of the sedentary population of the Western Highlands where most people reported the wish to maintain their residence even after experiencing the floods except in the neighborhoods that have been completely and permanently inundated.

In addition, this was the first of a kind to have witnessed a positive change in income levels of some household members, especially in the Western Highlands where the huge floods have given the opportunity for change in socio-economic activities. Most have now engaged in lumbering and illicit sale of fuel which are considered more economically rewarding than the farming activities they formerly practiced. The presence of water routes now facilitates the transportation of timber from the hinterland to the coast as well as the transportation of fuel from neighboring Nigeria to Cameroon. The energetic male about the ages of 35 and 45 are gainfully employed in this new found economic sector.

Above all, this study is a first step in developing a robust methodology for comparing household determinants for coping with climate-related vagaries within and across multiple geo-ecological zones and within and across hazards/disasters. It serves as a platform for broad-based policy making and implementation not only within Cameroon but across SSA where similar realities abound.

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