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Coping with flood hazards in Cameroon: the role of community based strategies

Abstract

Floods are increasingly rupturing livelihoods in Cameroon. Very often, flood victims develop a plethora of strategies to cope with their aftermaths, given that state and market mechanisms are often insufficient to buffer flood shocks. If strategies embedded in community interactions can reduce suffering, then they are likely to compensate for the shortcomings of state and market institutions, rampant in developing countries. We assess the role of community based strategies to support floods-affected households to cope with recurrent floods in two geo-ecological zones in Cameroon. 1445 systematically drawn household heads participated in the quantitative part from the two zones (816 from the western highlands and 629 from the sudano-sahelian upland geo-ecological zones), using a structured questionnaire. 72 In-depth Interviews (IDIs) and 24 Focus Group Discussions (FGDs) were also conducted. The results reveal that in addition to socioeconomic variables and very limited state support, community based strategies (e.g. placing barriers around the house, temporal displacement of children to safer havens, informal savings, migration, and social networks) consistently and significantly influenced the coping choices of flood victims, irrespective of geo-ecological zone (p=0.00). Based on these results, we suggest that at lower levels of development, community based strategies should be integrated into long term flood-coping strategies in the researched geo-ecological zones in Cameroon.

Keywords: coping, flood hazards, geo-ecological zones, community, strategies, Cameroon

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Introduction

Since immemorial times, human wellbeing has been intricately torpedoed by natural hazards and disasters. Containing these undesirable phenomena and their adverse effects has therefore been inherent in all human endeavours at household, community, regional, national and international levels.[1] Floods, droughts, mudflows landslides and tsunamis are among recent and increasingly frequent global examples of climate related anomalies, which resolve in huge human, economic, physical and environmental losses. According to data from the International Emergency Disaster Database, over 3.5 million deaths were attributable to natural disasters between the decade running from 1996 to 2006; in comparison with 15 million registered during the entire second millennium.[2] Within the same period, flood was very severe, leading to multiple losses. In 1999 for instance, severe flooding in northern Ghana destroyed crops, irrigation networks, homes, dams, and livestock, and also killed several people,[3] leading to scarcity of clean water; which resulted in a drastic rise in water-borne diseases such as cholera, diarrhoea, and typhoid, affecting almost 300,000 people.[4] In 2010, 55 communities in the Savannah region of Ghana were also affected by floods. About 700,000 people were displaced, 3,234 houses collapsed, and 23,588 acres of farmlands were destroyed estimated at a cost of 116,340.22 US Dollars.[5]

Climate variability has globally been identified as a major contributor to hydro-meteorological hazards and disasters[16] such as floods, droughts, tropical cyclones, and storm surges. We designed this study to focus on floods,[2] given that they are ranked amongst the deadliest type of natural (hydro-meteorological) disasters and are responsible for some of the most severe global economic, social and cultural losses and challenges.[7] According to Doocy et al.[8] for instance, around 2.8 billion individuals were affected by flood events between 1980 and 2009, with an estimated 4.6 million rendered homeless.[9] It is anticipated that climate variability will further aggravate, especially, the frequency of floods in the years ahead.[12,13] Currently, floods affect over half a billion people globally every year, a number that is predicted to increase to two billion by 2050.[13] That notwithstanding, it is argued that this estimate is far from being definitive, since only about 65% of the relevant flood cases are reported, studied and cited. Therefore, there is more implicit human suffering due to floods than is explicitly reported.[8] OFDA-CRED[14]; Tapsell et al.[15] and Boamah et al.[14] have consistently argued that during the last half century until 2002, hydro-meteorologically related disasters accounted for almost three-fifth of the total number of natural disasters that occurred in Sub-Saharan Africa with floods accounting for up to a quarter of them.[9,14,15]

Overall, the ripple effects of recurrent floods have been causing serious damages on farmlands, food shortages higher cost of living, separation of families, destruction of cattle and wildlife, reduction in the available space for development and the destruction of the quantity and quality of natural resources especially in developing countries.[16,17] Floods everywhere in the world are difficult to prevent, control or even cope with. The situation is further compounded in sub-Saharan Africa by increasing economic hardship and the inability of most governments to adequately support their citizens in the process.[18] The loss of trust

[1]Hazards are potentially damaging physical event, phenomenon or human activity that may cause loss of live or injury, property damage, social and economic disruption, or environmental degradation. On the other hand, disasters are serious disruptions in the functioning of a community or a society causing widespread human, material, economic or environmental losses that exceed the ability of the affected community or society to cope using its own resources.[10]

[2]Floods have been variously defined but for the purpose of this study we have operationally defined a flood as a body of water which rises to overflow land which is normally not submerged. There are mainly five types of floods: river flood, flash flood, inland flood, storm surge, coastal flood.[11]

in the governments and other formal (market) support structures like insurance has also exacerbated disaster outcomes. However, with the right capacity, their effects can be minimized through apposite coping strategies to enhance welfare. The quest for an appropriate coping strategy to floods that has encouraged communities and households in the sudano-sahelian upland and western highlands geo-ecological zones of Cameroon to systematically develop coping mechanisms that bring them together to provide fall-back positions for one another in times of disasters has been the supplication of the communities.[11] This has resulted in communities building capacities and networks to collectively respond to the threats of disasters by intuitively aligning with informal support mechanisms locally oriented to meet the demands of the neighbourhoods.

By and large, flood-related coping strategies in Cameroon are overwhelmed by ad hoc relief from the government, providing insufficient capacity for affected households to bounce back.[19] Therefore, households continue to remain very vulnerable to (future) floods, with yearly persistent calls for aid from government, non-governmental organisations and other donor agencies. Household vulnerabilities and persistent demand for aid by communities prone to floods can be reduced if their coping strategies are enhanced. Given that social networks often play key roles in the survival of households,[20] it is our desire to understand to what extent this and other endogenous, community based strategies are helpful or not, to (short term) coping strategies for floods – affected households in Cameroon.[17]

In this perspective, this paper aims to assess how social networks,[3] other community based strategies and socio-demographic factors attenuate the complex relationship between stressful life experiences in flood experienced households and their ability to cope or eventually adapt. Social networks are multifaceted and comprehensive, in the context of this paper, we refer to family and social ties or family and social supports which allow those who have it to appropriately serve as nodes and links necessary to cope with floods. In both geo-ecological zones, familial ties are quite strong and serve as the first line of support for coping in the event of floods. Additionally, we explore how and if social networks and other community strategies adopted by households in response to floods vary across two geo-ecological zones of Cameroon; and the extent to which such coping strategies of choice affect households'well-being in both geo-ecological zones.

Materials and methods

Study area

The study was conducted in 24 communities in two of the five geo-ecological zones of Cameroon, namely the western highlands and the sudano-sahelian geo-ecological zones (Figure 1). 14 of the research communities are located in the western highlands while 10 are in the sudano-sahelian geo-ecological zone of Cameroon. All the communities in the western highlands zone were experiencing ongoing floods in October 2017, when the data for this study were collected. This zone lies between latitudes 5° 20' and 7° North, and longitudes 9°40' and 11°10' East, and covers an estimated area of 31,400 sq. km. The mean annual temperature here is currently estimated at 20°C. Annual average rainfall varies from 1,600 to 2,300mm. The mean daily maximum and minimum temperatures are 28°C and18°C, respectively. This geo-ecological zone is characterised by two seasons, a dry season that runs from mid-November to mid-March and a rainy season that runs from mid- March to mid-November, with a tropical humid type climate. The relief of the area is mountainous with many plains, plateaus, lakes and rivers running across the several communities located in the zone. The population density here is estimated at about 128.5 inhabitants per sq. km with most of its population being rural dwellers largely engaged in diverse rudimentary agrarian practices.[21]

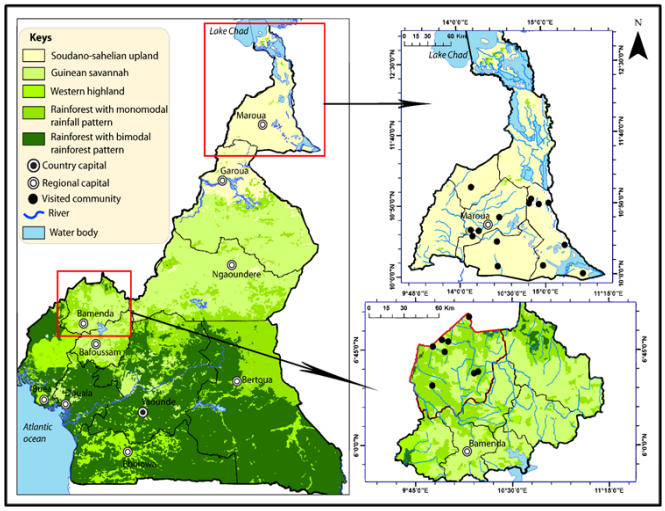

Figure 1 Map of Cameroon showing study sites generated from field data 2017.

On the other hand, the Sudano-sahelian upland geo-ecological zone had just come out of a flood situation in August 2016 when we collected data for this study. The area covers the territory designated as North and Far North Regions of Cameroon and covers an area estimated at 100.353Km^2.The mean annual temperature of the Sudano-sahelian upland is 28°C, while average rainfall is between 500-1200 mm yr-1[22]. Main food crops are sorghum (*Sorghum bicolor* L.), maize (*Zea mays* L.), rice (*Oryzasativa*) and groundnut (*Arachishypogeae*), beans (*Phaseolus vulgaris),* cowpea (*Vignaunguiculata*), onion (*Allium cepa* L.) and sweet potatoes (*Ipomoea batatas* L.).[23] Mainly subsistence animal production is widespread. The predominantly traditional animal production systems vary from free range (scavenging, nomadism and transhumance) in less populated areas, to year-round confinement and cut-and-carry feeding in densely populated areas.[24] The sudano-sahelian geo-ecological zone stretches across latitude 8° to latitude 13° North and covers a total surface area of 100,595km^2 and the area has a very short rainy season of four months running from June to September and a long and very severe dry season that lasts for eight months that is, from October to May.

Study design, sampling, survey instrument, and data collection methods

The study was a cross-sectional household survey realised by use of a standard-structured questionnaire. The research employed a multistage sampling technique. At the first level we purposively selected the western highlands and sudano-sahelian upland geo-ecological zones in Cameroon because they have contrasting geo-ecological features and are reported in literature as having recurrent floods episodes. At the time we designed this study and during the implementation phase, the western highlands zone was experiencing

[3]Social network is a "structure of relationships linking social actors" or "the set of actors and the ties among them". Relationships or ties are the basic building blocks of human experience, mapping the connections that individuals have to one another.

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ongoing floods so we choose to collect the information first-hand from the flood victims. At a second level the 24 study communities were selected on the basis of their previous or current experience of floods and continuous exposure to the ongoing hazards and disasters resulting from floods. This was done by obtaining a list of all exposed communities from the local administrative authorities in both zones and by simple random sampling, 24 communities were drawn to represent both study sites. The third level involved the selection of households for the study using systematic random sampling. At this level 1445 household heads were systematically drawn to participate in the quantitative part from the two zones (816=western highlands and 629=sudano-sahelian upland zones) while 72 In-depth Interviews (IDIs) and 24 Focus Group Discussions (FGDs) were conducted for the qualitative research. The inclusion criteria included being ≥20 years of age, must have lived in the community for a period ≥10 years, long enough to have observed at least one disaster in the community. To complement the quantitative data Focus Group Discussions (FGDs) and In-depth Interviews (IDI) with community members and traditional rulers were organised in all 14 study communities. In each community 01 FGD was organised following a sampling frame designed for the purpose to include male or female as the case warranted in an interchangeable manner (12 for males, 12 for females). IDIs were organised with community members as well as community rulers. The number varied across communities and depending on the availability of resource persons. After 35 IDIs we got to the satiation level in qualitative data collection. FGD and IDI guides were developed to facilitate the interaction and guide the discussions between the researchers and the study participants. The guides were drawn up with specific variables of interest to the research relating to social capital in coping with natural disasters and discussed with participants of respective groupings and categories.

Data management and analysis

After data collection, the questionnaires were grouped, cleaned and coded. The coded questionnaires were entered in a template created in Epi info 6 and later exported to SPSS version 20 for analysis. The data were analysed and results presented using figures and tables. The qualitative data were collected in both English and Pigdin English. The data in pidgin were translated into English and together both dataset were transcribed using MS Word 2016. The data were then coded in Nvivo 11 for analysis. From the analysis of this data trends were identified and presented as narratives and quotes.

Empirical model

The analytical framework from which the empirical model is developed to understand the determinants of coping strategies used by households in both sudano-sahelian and western highlands geo-ecological zones is adapted from the theoretical framework developed by.[25] The empirical model projected herein is aimed at determining the dynamics which influence household adoption of coping strategies during flood disasters and the effects of such adopted strategy on the welfare of the households. The treatment effect model offers greater opportunities to do a concurrent estimation of the adoption and welfare equations.

While the estimation of the adoption model enables us to know which factors influence the choice of a coping strategy (with an interest in the role of social networks), the welfare model helps us to measure the effects of the chosen coping strategy on the households' welfare as well as other determinants of such welfare. In our study, the coping strategies were categorized as formal and informal. "Formal strategies" refer to coping strategies that were government and institutionally related while "informal strategies" are coping strategies which are essentially community based.[18]

The codes given were one (1) for relying on government for subventions and subsidies as coping strategy and zero (0) for no reliance on government for coping with floods. The model was estimated using Stata software by the maximum likelihood approach. Table 1 below provides the definition and the a priori expectations of the different variables used in the construction of the model.

Table 1 Definition of variables

Variable	Definition
Adoption of coping strategy	1 if respondent depended on government for subsidies and relief as a coping strategy; 0 if not.
Age	Age of the respondent in years
Gender	1 if male; 0 if female
Occupation	1 if farmer; 2 if trader; 3 employed
Education	0 if no formal education; 1 if primary; 2 if secondary; 3 if tertiary
Household size	Number of family members eating from the same pot
Household income	Average monthly income of household
House ownership	1 if respondent owns a house; 0 if not
Social network	1 if respondent belongs to a social network; 0 if not
Perceived severity	1 if respondent perceived flood to be severe; 0 if not
Access to loan	1if respondent has access to loan; 0 if not
Geo-ecological zone	1 if western highlands; 0 if Sudano-sahelian
Welfare	Household per capita income (household income divided by household size)

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Adoption model

Adoption of coping strategy = γ0+γ1Age+γ2Sex+γ3Occup+γ4Educ+γ5Hsize+ γ5Hownership + γ6Income+γ7Network+γ8Severity+ γ9Acc_Loan+ γ10 Geo_Zone + ei.. 1.

Welfare model

Welfare = γ0+γ1Age+γ2Sex+γ3Occup+γ4Educ+γ5Hsize+ γ5Hownership + γ6Income+γ7Network+γ8Severity+ γ9Acc_Loan+ γ10 Geo_Zone + γ11 Adoption + ei.

Results and discussion

Households' ratings of floods impacts in the different geo-ecological zones

From our analysis, it was observed that the two sectors most affected by the floods were crops (99.2%) and the economy (99.5%). The least impact reported were loss of human life (7.3%) and physical injury (57.1%). Generally, significantly more damages resulting from floods were reported in the Sudano-sahelian zone than in the western highlands (Table 2).

Table 2 Households' ratings of floods impacts in both geo-ecological zones

Impact	Frequency (%)			p-value
	All	Western highlands zone (n=816)	Sudano-sahelian zone (n=629)	
Damage on livestock	988 (68.4)	359 (43.9)	629 (100)	<0.001**
Damage on property	1291 (89.3)	711 (87.1)	580 (92.2)	0.002**
Damage on crops	1433 (99.2)	804 (98.5)	629 (100)	<0.001**
Economic loss	1438 (99.5)	814 (99.8)	624 (99.2)	0.136
Damage on infrastructure	1347 (93.2)	731 (89.6)	616 (97.9)	<0.001**
Injury	826 (57.2)	223 (27.2)	606 (95.9)	<0.001**
Death	107 (7.4)	21 (2.5)	86 (13.7)	<0.001**
Disease	1410 (97.6)	795 (97.4)	615 (97.8)	<0.001**

**means significant at 5%

Source: Field survey, 2017

Determinants of the likelihood of Households being affected by Floods

We assessed the likelihood under which different households in the two zones may be affected by floods. The results presented on Table 3 point to the fact that a plethora of factors account for the increase in the likelihood of households being affected by floods: educational level, occupation, resident time, monthly income, social network and geo-ecological zone. The most educated respondents were significantly more likely to be affected by the floods (No formal education, 53.8%; primary education, 70.7%; secondary education, 75.5% and tertiary education, 84.2%, p<0.001). This is probably because their levels of investments are likely to be higher than those with low educational level; thereby exposing them to higher potential losses from floods. Farmers were significantly more affected by flood compared to the other occupations (Farmer, 72.3% and Business, 66.6%, p=0.01). Concerning monthly income, respondents with monthly income <37,000FCFA (71.9%) were significantly more affected compared to their counterparts with higher income levels (60.6%, p=013). With respect to residence time, the respondents with higher number of years lived in the community were significantly less affected by floods compared to relatively new residents. As concerns geo-ecological zones, western highlanders (99.9%) were significantly more affected by flood than their counterparts from the Sudano-sahelian zone (52.1%, p<0.001). This is probably due to more frequent occurrence of floods in the latter agro-ecological zone, on the basis of which experiential knowledge and survival networks could have been accumulated over time.

Table 3 Determinants of the likelihood of being affected by floods

Category	Household affected by floods n (%)		χ^2	*p-value*
	Yes	No		
Overall	1445 (71.4)	580 (28.6)		
Household size			5.012	0.059
≤5	384 (73.0)	142 (27.0)		
6-10	849 (72.1)	328 (27.9)		
>10	212 (65.7)	110 (34.3)		
Educational level of household head			35.409	<0.001**
No formal education	78 (53.8)	67 (46.2)		
Primary education	930 (70.7)	385 (29.3)		
Secondary education	335 (75.5)	109 (24.5)		
Tertiary education	102 (84.2)	19 (15.8)		

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Table Continues...

Category	Household affected by floods n (%)		χ^2	*p-value*
	Yes	No		
Occupation			17.491	0.01**
Farming	878 (72.3)	337 (27.7)		
Business	420 (66.6)	211 (33.4)		
Employed	147 (82.0)	32 (18.0)		
Resident time (in years)			76.362	<0.001**
<10	33 (94.3)	2 (5.7)		
10-20	599 (81.8)	133 (18.2)		
>20	813 (64.6)	445 (35.4)		
Monthly income (FCFA)			6.217	0.013**
<37,000	1381 (71.9)	539 (28.1)		
≥37,000	64 (60.6)	41 (39.4)		
Mode of saving			3.305	0.192
Bank/Micro-finance	84 (67.2)	41 (32.8)		
Njangi/tontine	1314 (71.9)	513 (28.1)		
None	47 (63.9)	26 (36.1)		
Social network			21.735	<0.001**
No	11 (34.4)	21 (65.6)		
Yes	1434 (71.9)	559 (28.1)		
Geo-ecological zone			544.4	<0.001**
Western highlands	816 (99.9)	1 (0.1)		
Sudano-sahelian	629 (52.1)	579 (47.9)		

**means significant at 5%

Source: Field survey, 2017

Households' ratings of level of severity of floods across geo-ecological zones

We used the Likert scale to capture the severity of floods in the two agro-ecological zones. First on the scale was "Very High," followed by "High," "Moderate" and "Low."This rating was relevant in this study since households' interpretations and experiences with floods events had implications on their coping decisions. The perceived degree of severity of flood varied across geo-ecological zones (Figure 2). Most respondents in the Sudano-sahelian zone perceived the severity of floods as significantly very high compared to those in the western highlands (Sudano-sahelian, 82.4% versus 30.9%, p<0.001). This trend was also observed in the qualitative data in both geo-ecological zones where participants at the FGDs were unanimous on the fact that the severity of flood disasters has been high. They all used different analogies to explain the degree of severity but the converging argument established that floods were highly severe in both the western highlands and the sudano-sahelian upland geo-ecological zones. This finding aligns with those of previous studies carried out in the same geo-ecological zones.[26,27]

Determinants of households' perception of severity of floods

The perception of the degree of severity of floods was influenced by several factors across geo-ecological zones and households. The determinants of such perceptions were captured to understand the basis of such dynamism in the views expressed by study participants. On Table 4, we present the determinants of the perceived severity of floods across zones. The following factors were identified: age of respondent, gender, marital status, household size, education, occupation, and religion, mode of saving and geo-ecological zone. Regarding age, older respondents were significantly more likely to perceive the severity of floods as high compared to the younger respondents (p<0.001). As concerns gender, male respondents were significantly more likely to perceive the severity of floods as high compared to their female counterpart (82.0% versus 73.0%, p<0.001). Regarding household size, the likelihood of perceiving flood as being severe increased significantly with increase in household size. The most educated respondents were significantly less likely to perceive the severity of floods as high (No formal education, 75.6%; primary education, 84.6%; secondary education, 68.7% and tertiary education, 52.5%, p<0.001). As concerns occupation, farmers (82.7%) were significantly (p<0.001) more likely to perceive the severity of floods as high compared to the other occupations. Concerning religion, Muslims were significantly more likely to perceive the severity of floods as high compared to Christians (p<0.001: 91.1% versus 68.9%). Relating to the modes of saving, respondents who reported informal savings as main mode of saving (Njangi/tontine: 76.6%) were significantly less likely to perceive the severity of floods as high compared to their counterparts saving in banks and microfinance institutions (91.7%)(p<0.001). Western highlanders (67.2%) were significantly (p<0.001) less likely to perceive the severity of floods as high compared to those in the sudano-sahelian zone (92.4%).

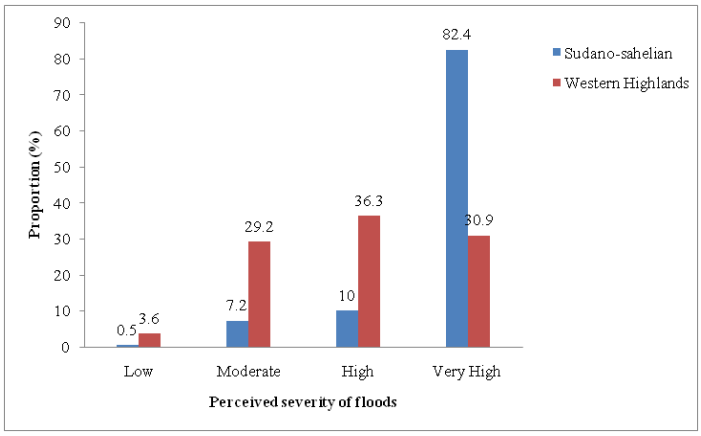

Figure 2 Perceived severity of flood across geo-ecological zones.

Source: Field survey, 2017

Table 4 Determinants of perceived severity of floods on households

Category	Perceived severity of flood n (%)		χ^2	*p-value*
	High	**Low**		
Overall	1129 (78.2)	316 (21.8)		
Age (in years)			97.51	<0.001**
20-39	419 (66.9)	207 (33.1)		
40-59	461 (82.9)	95 (17.1)		
60-79	209 (95.4)	11 (4.6)		
≥80	40 (93.0)	3 (7.0)		
Gender			16.49	<0.001**
Male	682 (82.0)	150 (18.0)		
Female	447 (73.0)	166 (27.0)		
Marital status			59.70	<0.001**
Single	153 (64.6)	84 (35.4)		
Married/Cohabiting	915 (82.7)	192 (17.3)		
Divorced/Separated	16 (76.2)	6 (23.8)		
Widow(er)	45 (57.0)	34 (43.0)		
Education			79.88	<0.001**
No formal education	59 (75.6)	19 (24.4)		
Primary education	787 (84.6)	144 (15.4)		
Secondary education	230 (68.7)	105 (31.3)		
Tertiary education	53 (52.5)	48 (47.5)		
Occupation			30.05	<0.001**
Farming	726 (82.7)	152 (17.3)		
Business	307 (73.1)	113 (26.9)		
Employed	96 (65.8)	51 (34.2)		
Religion			9759	<0.001**
Christian	561 (68.9)	253 (31.1)		
Muslim	524 (91.1)	51 (8.9)		
African traditionalist	44 (80.0)	12 (20.0)		

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Table Continues...

Category	Perceived severity of flood n (%)		χ^2	*p-value*
	High	Low		
Household size			6.39	0.041**
≤5	290 (75.5)	94 (24.5)		
6-10	661 (77.9)	188 (22.1)		
>10	178 (84.4)	34 (15.6)		
Monthly income (FCFA)			2.13	0.135
<37,000	1075 (77.8)	306 (22.2)		
≥37,000	54 (85.7)	10 (14.3)		
Mode of saving			23.82	<0.001**
Bank/Micro-finance	77 (91.7)	7 (8.3)		
Njangi/tontine	1006 (76.6)	309 (23.4)		
None	46 (100.0)	0 (0.0)		
Social network			0.085	0.77
No	9 (81.8)	2 (18.2)		
Yes	1120 (78.2)	314 (21.8)		
Geo-ecological zone			131.4	<0.001**
Western highlands	548 (67.2)	267 (32.8)		
Sudano-sahelian	581 (92.4)	49 (7.6)		

**means significant at 5%

Source: Field survey, 2017

Households' preparedness strategies to contain floods

In Table 5, we describe the preparedness strategies employed by households to prepare for anticipated floods. As concerns formal preparedness strategies, the most reported strategy was interviewees' willingness to attend training on flood risk managements (96.7%) and the least reported strategy was relying on insurance (0.003%). Most sudano-sahelian respondents reported they relied on government intervention compared to western highlanders where almost nobody relies on government for coping with anticipated floods (87.6% versus 0.6%, p< 0.001). Regarding informal preparedness strategies, the most common strategies used were participating in public prevention schemes (92.7%), liaising with community members (88.9%) and increasing networks (87.8%). The least used preparedness strategies were placing barriers along the house (38.1%) and building houses with sufficient aerated space (46.8%). All the informal preparedness strategies showed a significant variation between geo-ecological zones except for searching for alternative income sources, saving money in formal financial institution and investing in household assets. This trend is accounted for by the number of flood disasters experienced. The sudano-sahelian zone that has been more prone to disaster events has more preparedness strategies developed than those in the western highlands. These arguments presented during FGDs and IDIs go to inform us that disaster coping schemes are further develop with experience, time and exposure to flood events.

Table 5 Households' Preparedness strategies to contain floods

Coping strategies	Frequency (%)			p-value
	All	Western highlands zone (n=816)	Sudano-sahelian zone (n=629)	
Formal coping strategies				
Search for alternative income sources	66 (4.6)	782 (95.8)	598 (95.1)	0.492
Insurance	6 (0.004)	1 (0.001)	5 (0.008)	<0.001**
Applied for government intervention	557 (38.5)	6 (0.6)	551 (87.6)	<0.001**
Save money in formal financial institutions	15 (1.0)	9 (1.0)	6 (1.0)	0.958
Attend formal training on flood risks management	1398 (96.7)	799 (97.9)	599 (95.2)	0.004**
Informal coping strategies				
Placing barriers around the house	551 (38.1)	57 (6.9)	494 (78.5)	<0.001**
Plant trees around the house	946 (65.4)	356 (43.5)	590 (93.8)	<0.001**
Participate in Public prevention schemes	1340 (92.7)	790 (96.8)	550 (87.4)	<0.001**

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Table Continues...

Coping strategies	Frequency (%)			p-value
	All	Western highlands zone (n=816)	Sudano-sahelian zone (n=629)	
Informal coping strategies				
Build houses with sufficient aeration spaces	677 (46.8)	329 (40.2)	348 (55.3)	<0.001**
Plant shed trees around water sources	759 (52.5)	249 (30.4)	510 (81.1)	<0.001**
Attend informal training on flood management schemes	1250 (86.5)	690 (84.5)	560 (89.0)	0.013**
Invest in household assets	999 (69.1)	575 (70.4)	424 (67.4)	0.218
Increase network	1217 (87.8)	782 (95.8)	435 (69.2)	<0.001**
Send children to temporarily live in safe communities	973 (67.3)	724 (88.7)	249 (39.6)	<0.001**
Save money in informal financial institutions or at home	1208 (83.6)	796 (97.4)	413 (65.7)	<0.001**
Store food items in more secure places	941 (65.1)	696 (85.3)	245 (39.0)	<0.001**
Migrate or relocate to safe sites	1238 (85.7)	677 (82.9)	561 (89.2)	0.001**
Liaised with community members	1284 (88.9)	706 (86.5)	578 (91.9)	0.001**
Created association to formulate strategy	1167 (80.7)	746 (91.4)	421 (66.9)	<0.001**
Fell all flood promoting trees around water sheds	1251 (86.6)	722 (88.5)	529 (84.1)	0.016**

**means significant at 5%

Source: Field survey, 2017

Coping strategies used during floods by households in both geo-ecological zones

The key objective of this paper was to identify the different strategies households in both Sudano-sahelian upland and Western highlands geo-ecological zones used in response to flood disasters. To attain this, respondents were asked in the questionnaire, IDIs and FGDs to indicate and/or explain the strategies they used to cope with floods whenever such events occurred in their communities and touching on their households. The questionnaire generated responses have been grouped into formal and informal and documented on Table 6 below. Regarding the formal coping strategies, the most commonly reported strategies were withdrawal from formal saving (99.6%) and borrowing from formal institutions (74.0%). The least used formal coping strategies were temporary migration (37.7%) and dependence on government for subsidies and relief (43.2%). Sudano-sahelian respondents were significantly more dependent on formal coping strategies like depending on government relief, temporal migration and depending on NGOs than the western highlands respondents. With respect to informal coping strategies, the most commonly reported were relying on family and friends (97.0%) and selling of invaluable assets (93.8%). The least used informal coping strategies were withdrawing from savings (1.7%) and withdrawing children from schools (2.6%). Western highlanders were significantly more dependent on informal coping strategies than the Sudano-sahelian study participants.

It was also realised in the qualitative data that perceptions of the cause of floods influenced the coping strategy adopted. Those whose social representations made them view floods as a punishment either from God or gods resorted to appeased God (e.g. through thanks giving activities in Churches) or the gods (through traditional sacrifices). This cut across geo-ecological zones and most often went side by side with other coping strategies like diversifying income generation sources and relying on friends and family. Generally, drawing on social capital to cope with floods disasters appeared to be more dominant in the qualitative data because most people reported receiving aid from their churches, family members or friends and from groups to which they retain membership in. Those with longer stay histories in the communities reported benefitting more from their networks as compared to those who had spent fewer years. This is also evidence of long standing relations established within communities as people interact for longer periods and build relations of trust.[20]

Table 6 Coping strategies used by households in both Geo-ecological Zones during floods

Coping strategies	Frequency (%)			p-value
	All	Western Highlands zone (n=816)	Sudano-sahelian zone (n=629)	
Withdrawing from formal savings	1439 (99.6)	807 (98.9)	629 (100.0)	0.031**
Borrowing from formal institutions	1070 (74.0)	474 (58.1)	596 (94.8)	<0.001**
Temporal Migration	546 (37.7)	12 (1.3)	534 (84.9)	<0.001**
Depend on relief and subsidies from the government	625 (43.2)	0 (0.0)	625 (99.4)	<0.001**
Depend on relief and subsidies from NGOs	670 (46.3)	47 (5.6)	623 (99.0)	<0.001**

Table Continues...

Coping strategies	Frequency (%)			p-value
	All	Western Highlands zone (n=816)	Sudano-sahelian zone (n=629)	
Send children to work	54 (3.7)	27 (3.2)	27 (.4.3)	0.268
Withdraw children from school	38 (2.6)	12 (1.3)	26 (4.1)	0.001**
Borrowing from neighbours, relatives or friends	1181 (81.7)	793 (97.2)	388 (61.7)	<0.001**
Withdrawing from informal savings	26 (1.7)	14 (1.6)	12 (1.9)	0.651
Selling of valuable assets	1093 (75.6)	540 (66.1)	553(87.9)	<0.001**
Selling of invaluable assets	1355 (93.8)	801 (98.2)	554 (88.1)	<0.001**
Relying on help from families and friends	1402 (97.0)	808 (99.0)	594 (94.4)	<0.001**
Reduce number of meals per day and reliance on inexpensive meals	285 (19.7)	125 (15.2)	160 (25.4)	<0.001**

**means significant at 5%

Source: Field survey, 2017

Determinants for adopting coping strategies after floods in both geo-ecological zones

As shown on Table 7, the variables that were significant in influencing the choice of coping strategies during floods were gender, household size, income, household ownership, perceived severity, geo-ecological zone and social network. The negative sign of the coefficient of gender means that male respondents were less likely to sell assets as coping strategy than their female counterparts. Household owners were less likely to sell assets compared to non-house owners. The probability of selling assets decreased with increase in household size. Wealthier households were less likely to sell assets compared to poorer households. Household's ability to sell assets as coping strategy increased with not belonging to a social network. Sudano-sahelian respondents were more likely to sell assets compared to western highlanders.[28–30]

Table 7 Determinants of households' informal coping strategies during floods

Variable	Coefficient	Standard error	p-value
Age	0.001	0.001	0.186
Gender	-0.052	0.022	0.017**
Occupation	0.01	0.017	0.534
Education	-0.25	0.017	0.145
Household size	-0.016	0.004	<0.001**
House ownership	-0.095	0.025	<0.001**
Monthly income	-0.001	0.001	0.004**
Social network	-0.210	0.121	0.044**
Perceived severity	-0.206	0.026	<0.001**
Access to loan	-0.078	0.061	0.231
Geo-ecological zone	-0.234	0.023	<0.001**
Constant	1.563	0.144	<0.001**

*means significant at 5%

Source: Field survey, 2017

The effects of employing informal coping strategy for floods on household welfare

Table 8 presents the estimated results of the welfare model. The age, gender, house ownership, and access to loans were significant determinants of welfare. The negative sign of the coefficient of age means that older respondents were poorer than their younger counterparts. This is normal, as younger people have the tendency to struggle to recover after floods than older ones. Males were significantly better off than their female counterparts. Household welfare increased with ownership of a house. Household welfare increased with increase access to loan from financial institutions. Employing informal coping strategy for floods had a negative effect on household welfare although this effect did not reach statistically significant levels (p=0.965). This is likely due to the fact that sharing reduces assets that could have been invested to enhance welfare, especially for donating households and individuals.

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Table 8 Factors influencing household welfare with employing informal coping strategy to contain floods

Variable	Coefficient	Standard error	p-value
Age	-12.26	4.82	0.011**
Gender	350.21	14.51	0.013**
Occupation	203.24	10.89	0.062
House ownership	633.14	15.92	<0.001**
Education	29.75	1.23	0.789
Social network	-184.32	7.98	0.815
Perceived severity	33.35	1.89	0.856
Access to loan	1184.21	65.32	0.003**
Geo-ecological zone	-151.32	12.36	0.321
Adoption of coping strategy	-9.521	1.78	0.956
Constant	2847.2	12.36	0.003

∗ means significant at 5%

Source: Field survey, 2017

Conclusions

In this article we first set out to assess how social networks, other endogenous, community based strategies and socio-demographic factors attenuate the complex relationship between stressful life experiences in flood experienced households and the adoption of coping strategies. We also sought to explore coping strategies used by households in response to flood hazards across the selected geo-ecological zones of Cameroon. And we finally measured the extent to which the coping strategies of choice by households affect their well-being in different geo-ecological zones. This study has ascertained that endogenous mechanisms such as social networks broaden amongst households experiencing similar disaster over time. This is a pointer to the argument that social, cultural and religious affiliations remain very strong predictors of intra-community support systems, especially in Sub-Saharan Africa where formal (state and market based) shock absorption mechanisms are weak. Our findings have equally established that there is a spatially ubiquitous relationship between experiences of flood disaster and adoption of coping strategies. This finding is specifically significant within the geo-context of increasing concerns about climate variability which exacerbates flood disasters. More important to this study is the finding that community based strategies constitute key coping strategies for flood-affected households in Cameroon, irrespective of geo-ecological zone. This submits to the school of thought that context-specific policies aimed at boosting the adoption of coping strategies to floods should be designed based on local prerequisites and orientations, and should include community based strategies which locals consider crucial for coping. Further research is however needed to ground this contention.

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Conflicts of interest

The authors declare no conflict of interest.

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