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Enhancing local livelihoods resilience and food security in the face of frequent flooding in Africa: A disaster management perspective

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Climate change and climate variability are causing frequent flooding in Northern Cameroon with dire consequences for food security and agrarian livelihoods. With projected increases in temperature and rainfall, there is heightened risk for livelihood assets and food security in the region. This article undertakes three tasks. First, it applies and adapts the Sustainable Livelihood conceptual framework to the Northern Cameroon case. Second, evaluating the 2012 floods, considered the worst affecting Northern Cameroon, and lastly, this research investigates the effects of frequent flooding on livelihood assets and food security focusing on two case study sites. Findings indicate that floods usually cause considerable damage to critical infrastructure with dire ramifications for food Security and livelihood assets. Finally, the article draws upon the empirical findings relating to post-2012 flood in Cameroon to facilitate further enhancements to the Sustainable Livelihood framework. The authors argue that there is considerable 'value-added' if the framework accommodates a more explicit disaster management perspective. By integrating an explicit disaster management perspective, further insights are in turn possible into the future role of transforming structures and processes that influence livelihood strategies and outcomes in a food-insecure Cameroon confronted with every more frequent flooding.

Key words: Frequent flooding, climate variability, sustainable livelihoods, disaster management, North Cameroon.

INTRODUCTION

The number of people affected by natural disasters worldwide is on the increase, with climate-driven disasters especially floods being the most disastrous,

widespread and frequent (Guha-Sapir et al., 2016). Scientists have asserted that anthropogenic climate change (CC) is causing climate variability (CV). Climate

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projections, for example, have revealed that the number of days of extremely heavy rainfall has risen by 1 to 2% each decade in the world's driest regions, and that over the next decades, increasing rainfall will lead to more flooding (IPCC, 2014). Higher temperature and changing precipitation levels have implications for human security, and contemporary research on the impact of CV on agriculture in developing countries shows a great threat to Food Security (FS) in many African agrarian economies (Molua, 2012; IPCC, 2014; FAO, 2016a).

In some respects, Cameroon seems to be compatible with these wider African findings. The agricultural sector is the cornerstone of livelihoods, employing 70 to 80% of the country's labour force (Epule and Bryant, 2016). Around 70 to 75% of the sector composes of small-scale peasant farmers that produce about 80% of the country's food crops (Yengoh and Ardo, 2014). In recent decades, food production has not met the rising demand (Yengoh and Ardo, 2014; Epule and Bryant, 2016) and the situation is exacerbated by the omnipresence of CV, which is reinforcing seasonal floods (IPCC, 2014) that seriously affect agricultural production (CERF, 2012).

Flooding has become a major issue in Cameroon. Variations in rainfall patterns, increased population densities in flood prone areas, poor urbanisation, ill-conceived waste disposal practices and weak institutional flood management exacerbate flood frequency and intensity in Cameroon (IPCC, 2014; Balgah et al., 2015; Bang, 2014, 2017; Fogwe and Asue, 2016). This has socioeconomic and environmental consequences including implications for access to adequate and nutritive food. In the arid Northern Cameroon that is dependent on rain fed agriculture, frequent floods have caused increased household-level FS risks (Molua, 2012; Relief Web, 2012; UNICEF, 2012; World Bank, 2013).

To mitigate risks, adequate adaptation measures are required, which, as this article argues, has a stronger focus on the links with disaster management (DM). Despite efforts to understand farmers' responses to CV and CC, research on the likely impact of CV, especially flooding on livelihoods and FS in Northern Cameroon remains limited (Molua, 2012). Moreover, there has been little work regarding the application of conceptual models to Cameroon in general with few drawing conceptual lessons that can inform future understandings of livelihood outcomes. Since frequent flooding is addressed through DM techniques, it is opportune to explore how approaches on FS and livelihoods may benefit from stronger interaction with DM perspectives. The authors argue that this represents a valuable additional contribution to knowledge, particularly if a greater prioritisation of flood management accompanies viable adaptation strategies so that FS improves in practice.

This article undertakes three tasks. First, it applies the Sustainable Livelihood (SL) conceptual framework (Ashley

and Carney, 1999) to the case of Cameroon. Second, it evaluates the 2012 floods, considered the worst affecting Northern Cameroon and third, using the 2012 floods, this research investigates the effects of frequent flooding on livelihood assets and FS by focusing on two case study sites in the region. Findings indicate that floods usually cause considerable damage to critical infrastructure with dire ramifications for FS and livelihood assets. Furthermore, the article draws upon empirical findings relating to the 2012 floods to facilitate further enhancements to the SL framework. The authors argue that there is considerable 'value-added' if the framework accommodates a stronger DM perspective. There is after all, increasing work on Cameroon DM to draw upon (Bang, 2013, 2014, 2016; Miles, Gordon and Bang, 2017; Bang et al., 2017). By integrating an explicit DM perspective, useful insights are possible on future transforming structures and processes that influence livelihood strategies and outcomes in a food-insecure Cameroon confronted with more frequent flooding.

CONCEPTUAL FRAMEWORK

Climate variability and food security

FS remains centre stage in policy discourses especially after the 2007-2008 global food crises (Kakota et al., 2013). CV is seriously affecting agricultural production with continuing threats to rural and farmers' livelihoods in the global South (FAO, 2016a) where subsistence farming is widespread (Nyariki et al., 2002).

There have been many conceptualisations of 'FS' since the concept originated in the mid-1970s (Sen, 1981; Maxwell and Smith, 1992; Allen, 2013). The Food and Agricultural Organisation (FAO) of the United Nations defines FS as:

"a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (FAO, 2013, p. 50).

Key dimensions of FS are availability, access, utilisation and stability (Ericksen, 2008; FAO/IFAD/WFP, 2013). In this article, households are considered food insecure when they lack food availability, have inadequate access to food production and nutritious food, unsafe and unstable supply and distribution of food (Ericksen, 2008; Kakota et al., 2013). Food availability is considered from the perspective of own production critical to ensuring household FS in cases of temporary shortfall in food availability and consumption (transitory food insecurity) or consistent food shortages-chronic food insecurity (Nyariki

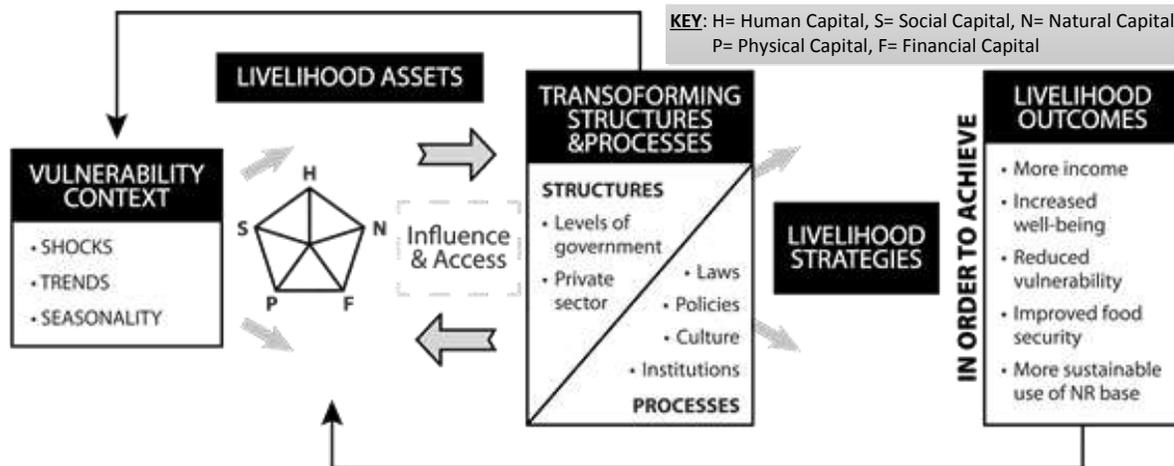


Figure 1. The sustainable livelihood framework.
Source: Ashley and Carney (1999).

and Wiggins, 1997).

Contemporary FS in Africa depends on a food system that is increasingly shaped by a changing climate system. The availability, production, utilization and accessibility of food are climate dependent (Molua, 2012; IPCC, 2014). Africa relies mainly on staple foods to the neglect of foods rich in nutrients (FAO/IFAD/WFP, 2013). The prevalence of severe food energy deficiency is life threatening and children are the most vulnerable demographic group. In the Sahel, some 6.2 million people are severely food insecure (FAO, 2016b).

Continued food insecurity and reduced agricultural yields will only further exacerbate the problem.

Sustainable livelihoods

Livelihood assets are vulnerable to CV, with dire implications for FS and SL - a concept that was designed to help understand and analyze poor people's livelihoods (Ashley and Carney, 1999 (Figure 1)). The SL concept combines the vulnerabilities of individual/family survival strategies. These comprise, mainly, people's assets and activities that provide them an adequate standard of living, including other goals such as risk reduction, and the factors that facilitate or inhibit different people from gaining access to assets and activities (Ellis, 2000). The framework starts with the vulnerability context in which people live, and the livelihood assets (human, social, natural, physical and financial capital) they possess. It then looks at how transforming structures and processes generate livelihood strategies that lead to livelihood outcomes (Figure 2) (Ashley and Carney, 1999).

The original framework identified numerous gaps and challenges to be addressed such as, understanding sustainability and the relationship to poverty, and importantly for this article, the need to acknowledge 'uneven emphasis or neglect' (Ashley and Carney, 1999, p. 33) of specific aspects that receive insufficient attention. DM may be one of these. Yet, one strength of the framework is that it stresses building on 'shared principles' and avoids conceptual 'hard selling' (Ashley and Carney 1999, p. 32), providing a gateway to incorporate a stronger DM perspective within its auspices. We would argue, based on the findings of this research, that the impact of frequent flooding in Northern Cameroon does affect the various livelihood assets, requiring alternative livelihood strategies in order to achieve the desired livelihood outcome, one being improved FS, but also one that incorporates a stronger awareness of DM.

But what do we mean by this DM perspective? In brief, it includes three aspects: first, the existence of effective DM bodies inside government and within the respective region that can act as transforming structures. Second, effective DM planning and processes, such as emergency planning and resourcing that can transform situations on the ground. Finally, a stronger appreciation of disaster risk reduction (DRR) measures, particularly those associated with flood management that will ensure practical measures to reduce vulnerabilities and are not simply restricted to immediate disaster response. This more robust DM perspective is applied in relation to the SL framework in weak (unsustainable) (Figure 2) and strong (sustainable) (Figure 7) forms.

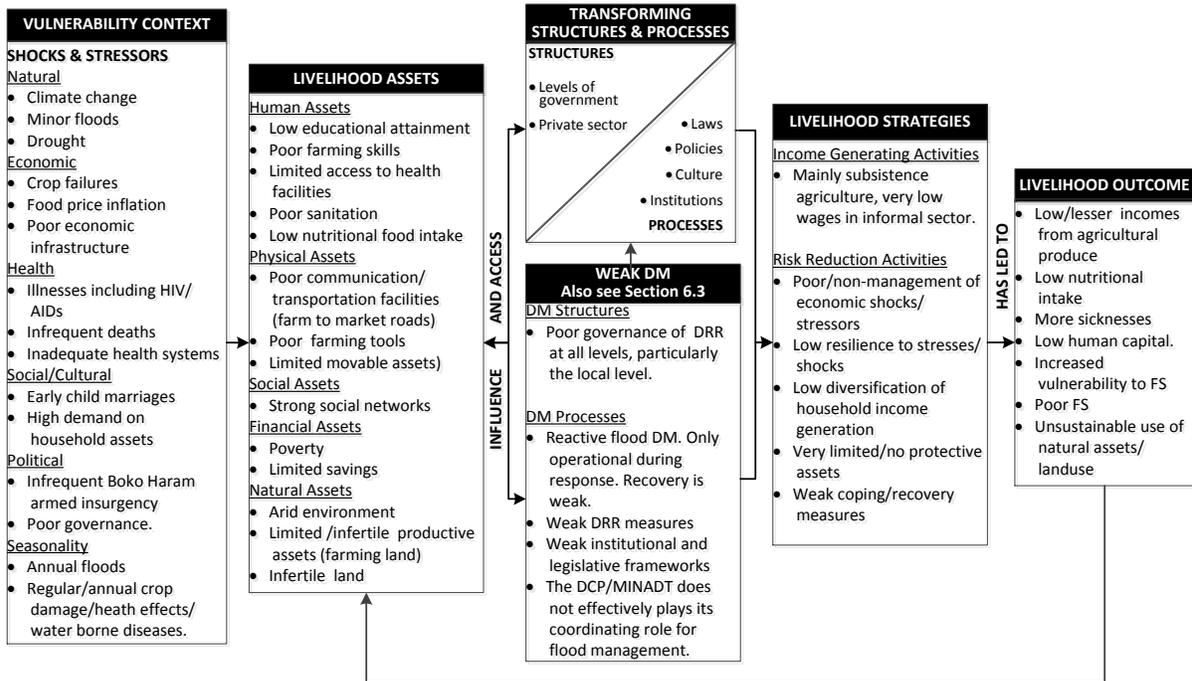


Figure 2. Unsustainable livelihood framework with weak disaster management. Source: Authors.

Enhancing food security: Role for adaptation in the sustainable livelihood framework

Within the SL framework, there is an emphasis on the role of adaptation as part of transforming structures and processes and in shaping livelihood strategies (Figure 1), and particularly since adaptation may mitigate the impact of climate shocks on FS. Adaptation is the process of adjustment to actual or expected climate and its effects (IPCC, 2014). Adaptive capacity increases with declining vulnerability and declines as vulnerability increases (Cutter et al., 2008). Moreover, DM also includes a strong emphasis on adaptation techniques particularly in developing countries like Cameroon (Bang, 2016).

Livelihood diversification, for example, is a complementary adaptation strategy for addressing food insecurity, livelihood collapse and poverty (Ellis and Allison, 2004). It represents ‘the processes by which households construct a diverse portfolio of activities and social support capabilities for survival and in order to improve their standard of living’ (Ellis, 2000). Traditionally it involves farm and off-farm activities including factors that induce people to engage in multiple livelihoods (Khatun and Roy, 2012). Common adaptation methods in developing countries are: the use of new crop and livestock species more suitable for drier conditions, changing cropping patterns, irrigation, trees planted for

shelter, crop diversification, mixed crop/livestock farming systems, adjusting sowing dates, adopting higher-yielding and heat resistant cultivars, the selection and breeding of new hybrids, and increased use of water and soil conservation techniques. Others include policies, financing, and institutional arrangements and land management options that aim at conserving ecosystem services (Tingem et al., 2008; Njondgeb, 2013; Njeru, 2013; Epule and Bryant, 2016). Yet, the extent to which households diversify their livelihoods depends on a variety of factors that include skills, educational attainment level, physical assets, experience, family size and access to credit (Khatun and Roy, 2012). Without adaptation, CV will pose considerable problems for livelihoods and FS in Cameroon (Tingem et al., 2008).

Coping strategies also help households maintain consumption when confronted by shocks. These include using saving and food stocks; sales of personal assets, gifts from friends/relatives or community assistance, government/NGO support and social capital/networks (Ellis, 2000; Khatun and Roy, 2012; Abid et al., 2015).

Climate variability: Implications for Cameroon

Cameroon is already experiencing diverse CC impacts. Since 1930, mean annual temperatures have been

increasing by an average of 0.15°C per decade, with dramatic rises predicted by 2100. Temperature rise is expected to increase northwards, reaching 2.1 to 4.5°C in the Northern Sudano-Sahelian region (Molua and Lambi, 2007; IPCC, 2014). Climate simulations predict the average annual rainfall could increase by as much as 35% between 2010 and 2050 (Mc Sweeney et al., 2012).

Future climate extreme events will probably be the most challenging for farmers. The onset and retreat dates for future rainy season are expected in most cases to be later by about 5 days than in the present climate, affecting the sowing season (Guenang and Kamga, 2012). Most future climate scenarios show a general tendency towards diminishing future maize and sorghum yields in all agricultural regions of Cameroon (Tingem et al., 2008).

The potential ramifications of CV will be to exacerbate poverty since 40% of Cameroon's population (who live below the poverty line) are engaged in subsistence agriculture (World Bank, 2016). Therefore, there is urgency to introduce adaptation and other strategies to mitigate the impact of CV on the agricultural sector (IPCC, 2014). With the potential detrimental effects to agricultural productivity, there are calls for Cameroon to plan for climate contingencies (Ngondjeb, 2013). Indeed, this article highlights that there is a particular need to focus on improved FS as part of any climate contingencies.

Food security in Northern Cameroon

Northern Cameroon is characterised by climatic variations, irregular rainfall and poor soil quality with food production that barely meets the needs of the population. The threat to FS is even greater because food production is mainly in the hands of smallholder farmers with farming practices characterised by small farm size, low capital input, basic tools, limited control of diseases and plant pests, low yields and high labour inputs (Yengoh and Ardo, 2014). Implementation of adaptive and coping strategies has - so far - been rather weak and limited, exacerbated by the high population density, the highest incidence of poverty in the country, and frequent flooding. Moreover, food production, availability, accessibility and supply are vulnerable to climate-related shocks and stressors such as desertification and intense rains - resulting in frequent flooding, which have caused acute food shortages in recent years (Molua and Lambi, 2007; Gergely, 2009; MINDADER, 2014; FAO, 2014, 2016a; WFP, 2016a).

Northern Cameroon is highly dependent on rain-fed agriculture and livestock herding due to its location at the southern edge of the Sahara desert. The region produces a variety of food crops (sorghum, millet, and maize,

cowpea, okra, cereals). Cotton is produced and marketed under the auspices of an enterprise created by the Government in 1974 to produce and market cotton in Northern Cameroon known as SODECOTON (Société de Développement du Coton), and is the main cash crop and income source for the majority of the population (Gergely, 2009; MINADER, 2014).

According to UNICEF (2013), about 15% of the population suffer from food insecurity, and acute malnutrition is highest in the region (5.5% in the North and 6.3% in the Far-North), affecting about 10% of the children (Table 1) (UNICEF, 2012). Because of shocks, stresses, insecurity and displacement, the overall FS situation in the country sharply deteriorated in 2015 and 2016 (2.6 million people being food insecure) with the Far North Region most affected (WFP, 2017).

Similarly, there was increase in malnutrition rates, especially in the Far North, compared to 2013 and 2014 (WFP, 2017). The main causes of malnutrition are inadequate food and diseases, poverty, poor/detrimental health and poor resources/practices, including lack of adequate health information/education (FAO, 2016a).

Other factors that compound the FS problem are locust infestations, elephant destruction, soil/land degradation, overpopulation, conflict, population movement, inadequate labour and poor wages (Gergely, 2009). The civil war in Central African Republic and the Boko Haram insurgency in Nigeria have caused the influx of refugees into North Cameroon. As of February 2016, there was an estimated 169,970 internally displaced persons including some 30,600 persons displaced by flooding and other natural disasters, rendering over 5 million people food insecure in the Lake Chad basin. The situation is worsened by epidemics such as cholera, measles and meningitis (FAO, 2016a, b; WFP, 2016a, b).

These socio-economic challenges pose a serious threat to livelihoods including FS leading to livelihood challenges in the region. Yet, Cameroon, a place already prone to frequent natural hazards (Bang, 2016; Miles, Gordon and Bang, 2017) has also been seeing more frequent and severe flash flooding over the past two decades, transforming from essentially representing a nuisance value to becoming catastrophic flooding. Between 2000 and 2015, floods, exacerbated by poor drainage systems and inadequate waste disposal, affected more than 373,176 people in Cameroon, with climatic variations in Northern Cameroon attributed as the reason for more frequent flooding during the last decade (Guha-Sapir et al., 2016).

Northern Cameroon, though located in an arid environment, has been experiencing recurring devastating annual flash floods in the last decade (Bang et al., 2017). The 1999 and 2012 floods compromised the Lagdo and Maga Dams - forcing the release of water from the reservoir and exacerbating the flooding downstream.

Table 1. Estimated population affected from the nutritional crisis in the north and far north regions

Population Demographics	Total
Total Population	5,891,785
Children (Under 5)	1,178,357
Children (6 to 23 months)	350,089
Pregnant women	368,186
Number of Internally Displaced Persons due to flooding	90,203
Number of primary schools affected (11 in North and 159 in Far North Regions)	170
Number of school children affected	61,646

Source: UNICEF, 2012.

According to Cameroon's Department of Civil Protection (DCP), the worst flooding in Northern Cameroon for over 60 years occurred in 2012 (Relief Web, 2012; UNICEF, 2012). The 2012 floods are analysed in some detail through two case studies that tease out how flood affects livelihoods and food insecurity.

In essence, poor DM of floods in the region heightens an already dire situation and thus a more elaborate appreciation of DM perspectives is valuable, not least since flooding has made livelihoods in the region unsustainable. This situation is represented in Figure 2, which is the modified SL framework variant incorporating weak DM addressing what may cause livelihoods in the region to be unsustainable. Left unchecked the peasant dominated agricultural sector of Northern Cameroon could be completely devastated. Institutional support for agricultural production is imperative and urgent in order to mitigate the risks posed to food insecurity. So far, resilience has been mainly through social networks and humanitarian assistance, which is temporary and has not been that effective.

METHODOLOGY

Case study strategy

The trends in FS, as in poverty, may not be fully evident at a national level. This implies the need for regional/local analyses to complement country level investigations. The main aim of this study is to assess the impact of frequent flooding on livelihoods and FS in two study areas in Northern Cameroon. The article utilises case study research that explores a contemporary phenomenon within its natural setting in one or a few sites. It draws upon multiple sources of data - primary interviews (see below), secondary and empirical data, including personal observation, relevant knowledge/experience and inferences that were also detailed and contextualised (Yin, 2003; Stake, 2000; Bhattacharjee, 2012).

Eight interviews were specifically conducted with mid/senior level disaster managers in Cameroon over four weeks in February/March, 2017 - the key research theme for enquiry focused on institutional frameworks and arrangements for flood management. There was intensive search for documentary evidence of challenges to

livelihood assets caused by repeated flooding with the aim to analyse differences and similarities between the case studies using qualitative methods. This requires a logical chain of evidence, and maintaining theoretical coherence by, for instance, identifying patterns and themes, establishing plausibility, counting, clustering, and making metaphors (Miles and Huberman, 1994; Bryman, 2004; Bhattacharjee, 2012). The ultimate aim was to establish the link between CV, repeated flooding, and relates its effect on livelihood assets and consequently FS.

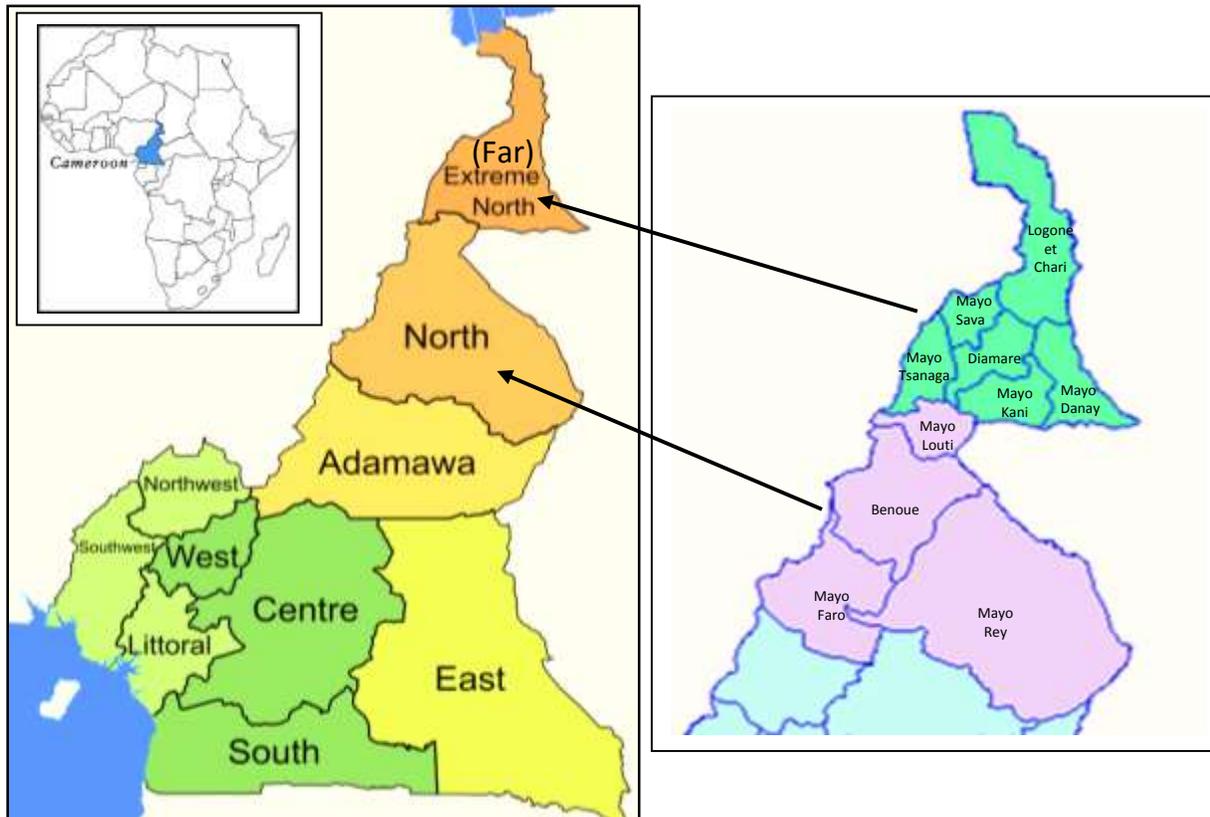
Case study area (Northern Cameroon)

The two study areas are Garoua and Maga in the North and Far North Regions of Cameroon respectively (Figure 3), that collectively represent one of the most densely populated areas in the country (64.8/km²) (Geohive, 2016). Accordingly, the study sites were selected for the following reasons: they were the most seriously affected areas during the 2012 August/September floods; both sites have been experiencing frequent annual flooding during the rainy season and both sites have Dams within their vicinity that greatly influence flash floods. Furthermore, both sites have an agrarian economy-one site is urban and the other rural, thereby enabling findings to cover the effects of flooding in both urban and rural areas, with nonetheless, a similar cultural setting.

In Northern Cameroon, the agricultural cycle begins with the first rains (March-June) and last three to six months. The topography of the region influences the drainage system, which is a key determinant of agricultural activities. Dams and dykes - a vital component of Cameroon's critical infrastructure - were built close to the main rivers for irrigation purposes and to generate electricity for homes and businesses (including agricultural factories) across Northern Cameroon and provide the energy needed to power electric pumps for irrigation. The power is also important for processing the cash and other crops produced in the region. The hydro infrastructures, however, are vulnerable to extreme weather shocks such as floods. The Dams are often damaged during flooding, causing power outages. These effects are set to rise as CC increases the frequency and intensity of extreme weather events (Cervigni et al., 2015).

The 2012 August/September flooding of Garoua town and environs

Garoua, the capital of the North Region, is a port city on the Benue River and the biggest town in Northern Cameroon (population of



Divisions in the North & Far North Regions

Figure 3. Cameroon map showing the ten regions and administrative divisions of the north and far north regions.

436,899). It has an international airport, several textile-processing facilities and host to SODECOTON, which produces cotton, the main cash crop. Cotton contributes nearly a quarter of Cameroon's agricultural exports and about 90% of farmers in the region grow it (Gergely, 2009).

River Benue hosts the Lagdo Dam - a 27 km earth Dam located 80 km from Garoua - with a reservoir capacity of 620 million cubic meters (Figure 4). The Benue River has an extended flood plain that is very fertile for farming and has attracted a high population density including many immigrants (Neba et al., 2010).

In August 2012, heavy rainfall in North Cameroon caused the Lagdo Dam to exceed its high water level and River Benue inundated residential, agricultural and industrial areas in Garoua town and its four administrative divisions, and further downstream in Nigeria (CERF, 2012; Reliefweb, 2012; UNICEF, 2012). The flood affected 118 villages and was the worst in Cameroon for more than 60 years.

The 2012 August/September flooding of Maga village and environs

Maga is a poor, rural settlement in the Far North region (Figure 5), which is seriously deficient in roads, drinking water, sanitation, and

medical and education facilities (magacam.com/about-maga.html). The River Logone and the Maga Dam drain the region. Maga Dam is used for fishing and provides irrigation water for extensive rice fields. Rice is the second most important cash crop produced on a large scale in the Extreme North Region. About 22,000 farmers produce 102,680 tonnes of paddy rice on 13,000 hectares of land; and a 70 km embankment was constructed along the Logone River to protect widespread rice fields from damage during flooding (Njomaha and Piro, 2004). Local food crops are sorghum, millet, onions, gumbo, beans, onions, lettuce, tomatoes, cucumber, lemons, bananas, sweet corn and sugar cane. Overbank flooding of the River Logone is common after heavy rains/storms (World Bank, 2013). Due to the level topography around Maga, the flood usually spreads over a very vast area exceeding 3,000 km², inundating the extensive rice farms (Neba et al., 2010).

Heavy rainfall, from mid-August 2012, led to widespread flooding in many areas of the Far North Region. Flooding was severe in Maga and neighbouring settlements (Doreissou, Begué, Palam, Dougui, Pouss and Tekele) following the Maga Dam's rupture (Figure 5). Agricultural fields and communities near the banks of the Chari/Logone River were inundated (World Bank, 2013). The flooding was the worst natural calamity to hit the Far North Region for the past forty years (Bang et al., 2017).

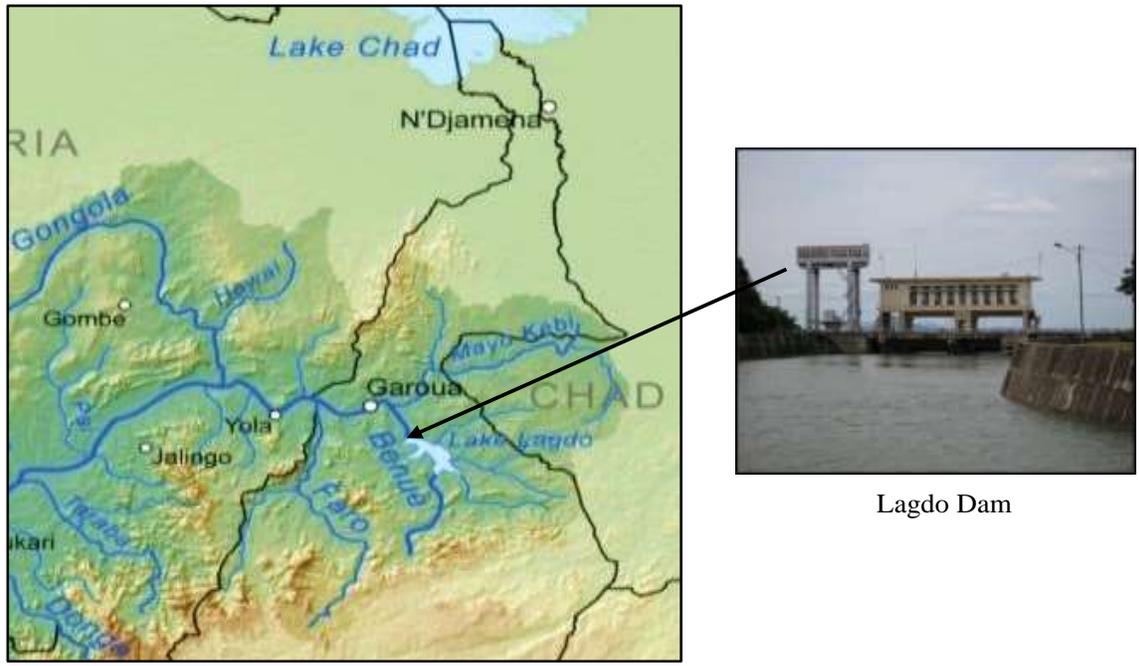


Figure 4. Map showing the Benue drainage basin including the Lagdo Dam along River Benue in North Cameroon.

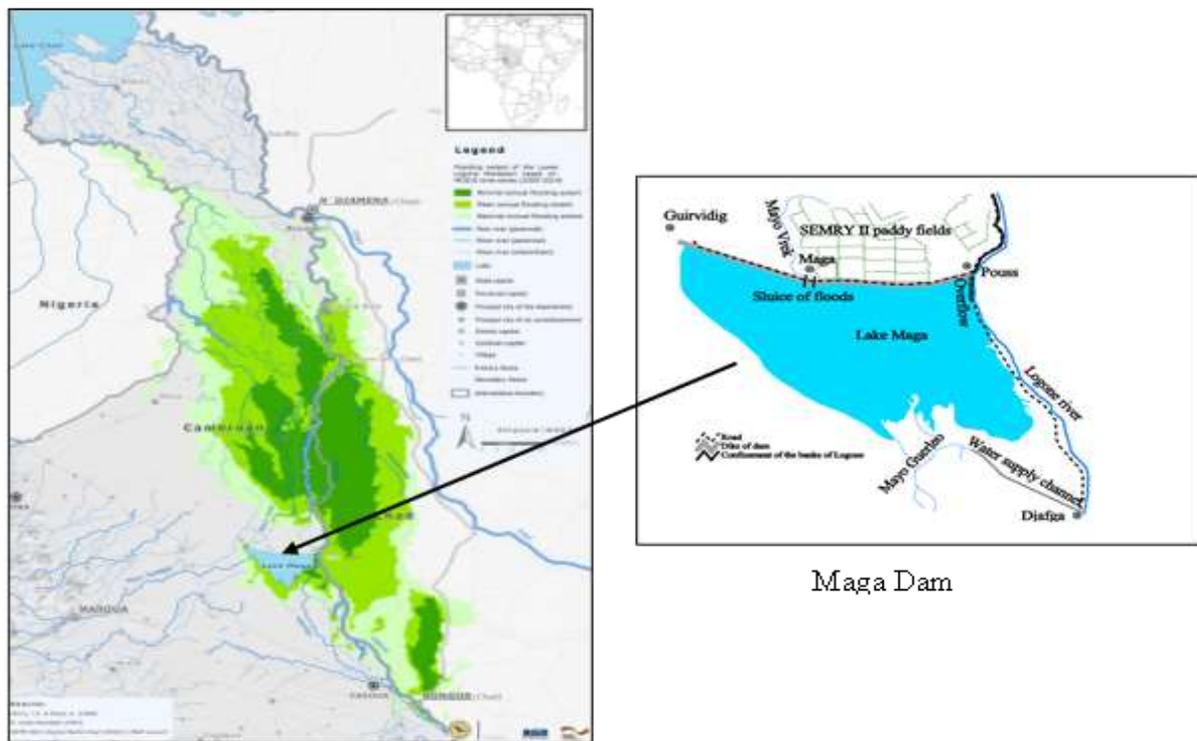


Figure 5. Yaere flood plain of River Logone showing Lake Maga and minimal, mean, and maximal inundated areas for the period 2000-2014. Sources: Francois et al. (2010) and Vassalo and Wilczok (2016).



Figure 6. Displaced flood victims sheltering in schools and flooded areas in the North Region during the August/September 2012 Floods. Sources: UNICEF/2012/Iker (1st two photos), Thomson Reuters Foundation and Cameroon Red Cross respectively (3rd and 4th photos).

FINDINGS

Impact of frequent flooding on livelihood assets and food security

Findings - taken from a detailed analysis of the literature review, case analyses, and interviews, reveal that the flooding had notable impact upon the various livelihood assets (Figure 6). According to the interviewees, the 2012 floods caused considerable damage to livelihood assets in Northern Cameroon including crops and livestock worth billions of FCFA francs (also CERF 2012; Relief Web, 2012). The 2012 flooding seriously affected natural capital in both study areas. Since the floods hit during the peak of the farming season, food, and cash crops, food stocks and livestock assets were completely lost. This caused severe harvest shortfalls and shortages of food supply in the region (Gergely, 2009; CERF, 2012; Relief Web, 2012). According to SODECOTON, 45,000 tonnes of cotton, worth 900 million FCFA, the main cash crop of the region, was ruined. SEMRY also estimated that 450 million FCFA worth of rice was also destroyed (*Economist Intelligence Unit News, edition of 27 September 2012*).

Physical capital of the region also suffered serious damages. About 12,000 homes - as well as critical infrastructure - were damaged in the North and Far North regions. In the North Region, the flooding weakened the Lagdo Dam significantly (World Bank, 2013), and diminished its operational effectiveness causing consistent power outages. The power outages led to inadequate water supply to irrigate fields, delaying factory processing and production of crops and other agricultural services in the region. To prevent Dam failure, floodwaters were released, exacerbating flooding downstream (UNICEF, 2012). In the Far North Region, the Maga Dam ruptured, flooding neighbouring areas (Figure 7). Floodwaters damaged roads and bridges, and disrupted local and international transportation, as well as

bringing down power lines and causing power outages to thousands of homes (Ngalame, 2012; *Cameroon Tribune, edition of 16 September 2012*). Infrastructural and agricultural damage was expected to come to billions of FCFA (*CNN news, edition of 17 September 2012*).

According to the interviewees, human capital – a key livelihood asset identified in the SL framework was seriously affected. Food insecurity of the population already reliant on staple foods of very low nutritious value, and suffering malnutrition levels above the national average (UNICEF, 2012; Ponka et al., 2015, p. 183) worsened due to flooding induced food shortages. The flooding caused more than thirty fatalities, displaced about 60,000 people (some sought shelter in schools that were not flooded (Figure 6) and affected more than 120,000 people (Relief Web, 2012; CERF 2012; UNICEF, 2012; *Cameroon Web regional news, edition of 22 December 2014*). The damage to other school premises affected education delivery, delaying the reopening of schools in the region for the 2012/2013 academic year (*Cameroon Tribune, edition of 16 September 2012*; Relief Web, 2012; UNICEF, 2012).

In addition, the flooding increased health risk for diseases, with 3,000 people hospitalised due to flood related illnesses (*CNN News, edition of 17 September 2012*). It caused a cholera epidemic and measles outbreak that threatened the health of the affected population (CERF, 2012; Gergely, 2009; Relief Web, 2012).

Flood damage to crops/food stocks has dire consequences for financial capital. High poverty levels in the region are exacerbated by further agricultural losses, and changes in land use due to flooding. With ruined farms/food stocks and reduced crop yields, small-scale farmers have very limited food to eat and no excess to food stocks able to generate extra income. The population also regularly use their limited resources to cope with the impacts of flooding, exhausting their financial abilities, constraining their capacities to

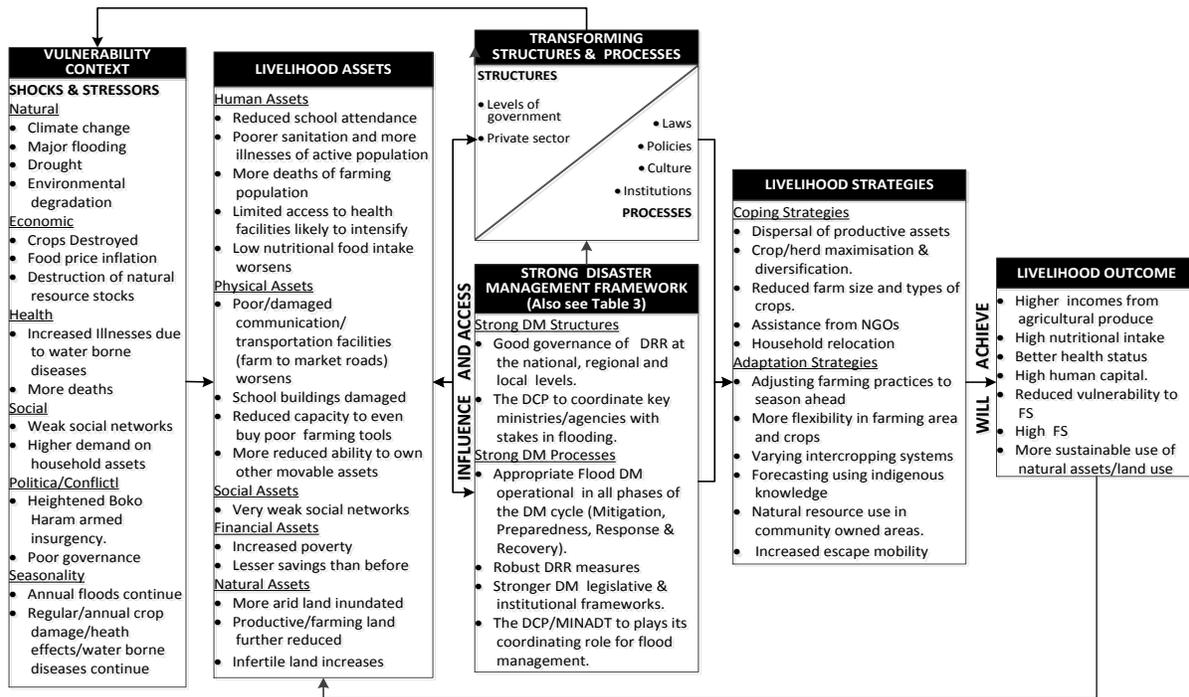


Figure 7. Proposed Disaster Management with Sustainable Livelihoods (DMSL) framework.

implement other livelihood strategies, and deepening poverty at individual and household levels.

Damages to financial and human capital had ramifications for social capital. There are examples of coping measures that enhance FS - such as using family networks and assistance from relatives - that represents a common form of African community resilience. These networks, are however, seriously weakened during floods. The death of family heads (income generators) and displacement of people weakened the social networks in Northern Cameroon, making the population more vulnerable to flooding impacts. Constrained financial resources, arising from agricultural losses, also affect social capital since there is little free cash for personal use. In such circumstances, people have limited abilities to help each other.

Equally, the flood problem is made worse by the high poverty in the region. The population have limited financial resources to engage in alternative livelihoods and to acquire nutritious food when they persistently suffer agricultural loss. It also implies that where there is high vulnerability, the frequency of disasters such as flooding further constrains the already limited capacity of farmers to diversify in order to facilitate to developmental change.

Analysis reveals remarkable similarities, trends and impacts on livelihood assets in both study regions.

Findings are also similar to limited studies covering other parts of the country that showed that destruction of homes, crops, livestock loss from flash floods causes production and income loss (Molua, 2012; Balgah et al., 2015; Bang et al., 2017). This adds credence to the generality of the results. Considering the case studies provide a snapshot of the impact of flooding for a few months in one year, the cumulative impact of frequent flooding for several years would have dire ramification for livelihood assets and FS because it reduces the ability of smallholder farmers to respond to and recover from shocks. This also has wide-ranging implications for regional economic development considering the main export, cash and staple crops are highly vulnerable to flooding.

Assistance to food security

Frequent flooding induced devastation often-precipitate requests for donor-provided food aid to mitigate the ravages of hunger, malnutrition and food shortages. In the context of the SL framework, there is an important role for transforming structures and processes, such as governmental agencies and DM bodies, to administer this food aid (Figure 2).

No consistent national strategies exist to enhance FS in

the region, and thus transforming structures and processes are weak. According to the interviewees, those that exist are largely associated with DM functions and strong corroboration of the need to incorporate a durable DM perspective into the SL framework. Institutional assistance for livelihood challenges and FS has been mainly through post-crises/disaster relief without adequate proactive measures. Interviewed DM respondents said the government remained reactive when providing food aid and financial assistance to flood victims. Nevertheless, they highlighted that FS is not guaranteed. Food aid remains temporary and relief assistance is vulnerable to corruption and embezzlement so many disaster victims receive only a proportion of assistance or even not at all. This lapse in DM has made livelihoods in the region unsustainable (Figure 2).

Of course, one of the main ways to enhance livelihood assets and address food insecurity in Northern Cameroon is through international assistance (see Molua and Lambi, 2007; FAO, 2016a). Post 2012-flooding assistance arrived from many sources including UNHCR, WFP, UNICEF, WHO, UNDP, the governments of Morocco, Japan and NGOs such as PLAN and the Red Cross (*Cameroon Tribune, edition of 26 October 2014*). After the 2012 floods, the WFP responded in 2013 to food insecurity and malnutrition concerns in northern Cameroon by improving the grain storage capacity of the communities and providing school meals to 55,000 pupils annually (WFP, 2016a). By March 2016, 30,000 children under five had benefited from malnutrition prevention activities - illustrating that adequate post-disaster relief can improve livelihoods (WFP, 2016b). This is also in line with the contentions of the new suggested Disaster Management with Sustainable Livelihood (DMSL) framework (Figure 7). In the same token, the Food and Agricultural Organisation of the United Nations have been improving FS in Northern Cameroon by boosting cereal production through the provision of improved seeds, tools and training (FAO, 2016a). Yet, these efforts have been largely transient and temporal and often undermined by the increased frequency of flooding. It is increasingly important to recognise that domestic flood management and protection measures have to accompany international assistance if they are to enhance livelihood assets and FS. Aid measures alone have not been nor will be sufficient to sustain livelihood assets and enhance FS (Figure 7).

In developing countries, FS or hunger is mainly due to poverty (FAO, 2016a, b). Intermittent attempts made through externally funded poverty reduction projects have had very limited or no success. Due to the high poverty level and over dependence on agriculture for livelihoods, frequent damage to agricultural produce risks keeping the populace trapped in a vicious cycle of hunger and poverty for several decades. However, adaptation strategies

and/or coping measures, supported by a viable DM system are viable options to reduce smallholder farmer's risk to poverty. However, these strategies are hard to implement since poverty and vulnerability are highly correlated with over-dependence on subsistence agriculture (Ellis and Allison, 2004; Khatun and Roy, 2012).

Adaptation to climate shocks and food insecurity in Northern Cameroon

Adaptation is an important livelihood strategy. Faced with the effects of climate shocks on agriculture, farmers in Northern Cameroon have made efforts to mitigate risks to food production, food availability and food accessibility. Some studies in Northern Cameroon reveal that communities are trying to enhance FS at the local levels by adjusting their farming practices to the seasons ahead, by increasing flexibility in the choice of farming areas and crops, by varying inter-cropping systems and through diversified socioeconomic changes. The main strategies include the use of indigenous knowledge or traditional ways of forecasting (Tingem and Rivington, 2009); the use of natural resources, including food in community owned or private lands/forest (Tingem et al., 2008); crop management, water management, and soil management techniques, including farming operations and socio-cultural activities (Molua, 2012; Ngondjeb, 2013). However, around 39% of the farming population do not employ adaptation techniques (Ngondjeb, 2013). Pastoralists in Northern Cameroon also developed survival strategies to mitigate the impact of rangeland degradation (for example flooding of the Yaere flood plain in the Far North Region) to their cattle. Herd maximisation and diversification, and increased/escape mobility to search for water availability are common coping methods used by herders in the region (Pamo et al., 2005). Table 2 shows the main adaptation and/or coping strategies employed by small-scale farmers in Northern Cameroon.

Research findings also reveal that attempts to adapt to the effects of Climate shocks to agriculture in the region have several limitations. Ngondjeb (2013) identified five main constraints to adaptation in the region and quantified them in percentages as follows: Lack of Information (13%), lack of money (22 %), shortage of labour (16%), land tenure (43 percent) and poor potential of irrigation (6%). It is notable that since adaptation is expensive, most of these constraints are linked to poverty.

Limited finances prevent small scale farmers from acquiring the necessary resources needed to facilitate adaptation (Ngondjeb, 2013), and to recover and bounce back following climate shocks like flooding. Epule and

Table 2. Adaptation and coping strategies for enhanced FS in Northern Cameroon due to CC and CV.

	Main Strategies	Adaptation/Coping choices
Farming	Indigenous and traditional knowledge	Interpreting natural events and phenomenon. Seasonal cropping calendars, crop choices influenced by traditional forecasting; e.g. heights of ant nests informed forecasting of rainfall and rainy season
	Crop management	Use of different crop varieties, mixed-cropping, mono-cropping, and plant protection, e.g. staking, shading & shelter, Seed treatment, application of pesticides, drought tolerant varieties
	Land and Soil management	Altering locations of planted crops, applying soil amendments, e.g. farmyard manure, pesticides, fertilisers, changing farm sites, soil conservation, tree planting.
	Water Management	Rainwater harvesting, manual watering, increased irrigation, water conservation practices.
	Farming Operations	Adapting sowing techniques, early/late crop harvesting, planting early maturing short-duration varieties; adjusting sowing time and sequence; storage prompt marketing, seasonal plant spacing and row orientation.
	Socio-cultural activities	Traditional ceremonies, religious prayers, migration
	No adaptation strategies	Substantial proportions of farmers (39% do not employ adaptation techniques.
Herding	Herd Maximisation and Diversification	Using different livestock species in different ecological niches where they can graze certain plant species.
	Increased mobility and Escape mobility	Increasing mobility of dispersed forage resources at times of rarity. Escape mobility involves long distance migration to escape combined effects of range degradation and decreased rainfall.
Others	Natural resource use	Use of natural resources, in community owned or private lands/forests, including food and other livelihood assets to strengthen adaptation at the local level

Source: Authors, culled from Ngondjeb (2013); Molua (2006; 2012); Tingem et al. (2009) and Pamo et al. (2005).

Bryant (2015) assessed the responsiveness of Cameroon's maize production to climate and land use change, and suggested that adaptation strategies highlight the level of forest area change. However, this poses problems because land use in Northern Cameroon is under pressure due to the influx of refugees, which has limited available cultivable farm sizes. Lack of measures to sensitise and educate the population, coupled with the very high illiteracy rate of the region prevents the inhabitants from learning adaptation measures that could improve their livelihood assets. Therefore, the findings reveal the need for a strategic approach to adaptation to food insecurity and a robust flood management that can facilitate the process.

Flood management in Cameroon

Existing institutional and legislative arrangements, which correspond to transforming structures and processes in the SL framework (Figure 2); have not so far mitigated

the ramifications of frequent flooding for livelihood assets including FS, thus limiting adaptation measures. The Sendai Framework for Disaster Risk Reduction (DRR) urges governments to invest in DRR for resilience (UNISDR, 2015). Flood management in Cameroon, designated to the Department of Civil Protection (DCP) in Cameroon's Ministry of Territorial Administration and Decentralisation, suffers from notable deficiencies hindering effective flood management; most notably the weak inclusion of DRR into legislation (Bang, 2014; 2016). Interviewed disaster managers highlighted that, despite frequent flash flooding, no adequate plans exist to strengthen the capacity of local community structures to cope, resist and recover from floods, with no dedicated budgetary provisions to manage flood hazards. This statement corroborates earlier research by Bang (2014) that found that organisational structures do not provide funding mechanisms to mitigate and prepare for natural hazards. Interviewed respondents also acknowledged that the legislative framework does not prioritise flood hazards, despite governmental recognition that floods

represent the most frequent natural hazards in the country and affects the greatest number of people. All disaster managers agreed that institutional arrangements have a narrow focus on flood response rather than risk reduction.

Referring specifically to North Cameroon, interviewed disaster managers emphasised the necessity to incorporate further structural mitigation measures into legislative and administrative frameworks since hydrological structures in the region exacerbate flooding. The research also found that, although the administrative architecture for natural DM exists at the national, regional and local levels where a crisis committee can be created to manage flood events, the devolution of resources for crisis management to local structures is limited (Bang, 2016). Another concern expressed by respondents is weak institutional coordination and cooperation since multiple government ministries have varied and sometimes conflicting interests in flood management. For example, while the Ministry of Environment and Forests prioritises environmental conservation, the Ministry of Mines, Water and Energy focuses on water resources management, and the Ministry of Agriculture is concerned about impacts of flooding on agricultural production and FS (Sighomnou, 2005). So far, diverging interests have not been properly coordinated and translated into practical measures to mitigate the impact of flooding on livelihoods and FS.

Given these aforementioned limitations in DM, we argued for the inclusion of a more robust DM perspective in order to improve the livelihoods of the inhabitants (Table 3) facing uncertain and vulnerable environmental conditions.

Moreover, we argue that a more robust, explicit DM perspective that has the ability to improve the livelihood assets and strategies, especially after intense shocks/stressors, and leading to better livelihood outcome should be incorporated into the SLF, representing what we identify as the proposed Disaster Management with Sustainable Livelihood (DMSL) framework (Figure 7).

Conclusion

Findings reveal the threat pose by CC and CV to livelihoods and FS is real in Northern Cameroon, and emanating directly from increases in the frequency and severity of climate shocks. As the 2012 floods have shown, too much water even in arid Northern Cameroon demonstrates that, rather than being a salvation, flooding can be a limitation on enhancing FS.

Resilience to sustainable livelihoods and FS are extremely low in Northern Cameroon for several reasons, and look to remain so. Extreme poverty in the region restricts livelihood activity mainly to subsistence

agriculture. When floods strike frequently, the regular damaging of crops and killing of livestock, ensures the local populations suffer persistent food insecurity. With continuous damage to livelihood assets and agricultural produce, there is a risk that the population may be trapped in a vicious cycle of poverty and food insecurity. Therefore, FS policies should be central to poverty reduction efforts if the population is to avoid permanent entrapment in poverty.

The article also shows that with CC forecasts predicting even worst weather shocks with increasing temperatures, the effects on livelihood assets and FS in Northern Cameroon will be dire. Notable also, is that although floods are often short-lived, their cumulative effects can cause long-term damage to livelihood assets. This also poses a high risk of permanent socio-economic damage in the region, which might continue to aggravate poverty, and food insecurity.

As the findings in both study sites show, FS problem is made worse due to Northern Cameroon already suffering from substantial reliance on staple foods, and registering the highest prevalence rate of chronic/acute malnutrition in the country (Ponka et al., 2015, p. 183). With frequent flooding likely to cause more food shortages, this will inevitably compound water borne related health diseases including malnutrition. Diversification should - in theory - be the answer. Nevertheless, this is limited because some crops are more resilient in arid environments resulting in narrower variety of food sources, hence lesser food nutrients (Azam-Ali, 2007). Yet, floods damage the few nutritious crops and poverty limits access and utilisation of a balanced nutritious diet. Already, government's reactive post-flooding assistance is diverting funds that could be used to improve the transforming structures and processes, particularly DM. To increase sustainable food production and enhance FS, viable adaptation and/or coping strategies are needed, with strong, transformative institutional support (Figure 7).

During flooding, fatalities, including the prevalence of diseases coupled with limited access to healthcare, education, and clean water have a serious toll on social and human capital. This diminishes the quantity/quality of human capital available for agricultural activities. The large number of affected/displaced people during flood events distorts social networks, a useful resource that local communities utilise for assistance. Equally, floodwaters damage physical capital - roads and bridges disrupting transportation and communication, degrading the regional economy and diverting funds that could be used to enhance FS to repair work.

Influx of refugees into Northern Cameroon has increased the population density of the fertile flood plains in the region, which has not been matched with food supply. With dwindling crop yields and food/livestock

Table 3. How disaster management can positively affect livelihood strategies/outcome.

Disaster Management		Effects on Livelihood Strategies (including Adaptation/Coping Choices)	Livelihoods Outcome
Key DM Phases	Key Activities		
Mitigation (Robust DRR measures)	Early warning systems (EWS) for floods/hazards	Scientific EWS enhances traditional forecasting and understanding of seasonal cropping calendars, crop mixes and choices.	Higher agricultural produce leads to higher incomes, greater nutritional intake and/or better standards of living.
		Facilitate increased mobility and escape mobility for herders when severe weather predicted.	Higher incomes from livestock production can translate into better nutrition, increased household physical/natural/economic assets.
	Maintenance of Hydraulic infrastructures	Dam repairs prevent Dam breakage and downstream flooding.	Farming, agricultural produce and human resources and assets will be preserved and flourish.
	Legislative Framework	Land use management and building codes to guide hazard/flood prone areas.	Reduce vulnerability to natural shocks, with greater preservation of assets (physical, natural, financial)
Preparation	Education & Information Dissemination	Raise knowledge awareness of local communities on regional vulnerabilities and safety protective measures.	Lead to less effects, damages, or losses during shocks/natural hazards, thereby enhancing chances of livelihood survival post-hazards.
	Training/Simulation Exercises	Frequent evacuation drills for flash floods involving population & emergency services saving lives	Increase propensity to save lives and livestock (vital livelihood resources).
Response	Evacuation-Coordination of relief agencies	Swift evacuation of flooded/ risk areas saves lives of people/ livestock.	Preservation of human resources provides numerous economic and social benefits.
	Relief Aid-provision and coordination of relief aid/assistance	Ensure contingency planning in place (including budget) to provide relief aid to affected populations in case of natural shocks/stresses	Relief assistance provides financial/material aid to buffer against shocks/stresses to short-term sustainable livelihoods.
Recovery	The DCP in MINATD to coordinate inter-agency & inter-ministerial recovery efforts after disasters	Appropriate cooperation and collaboration of key stakeholders managing flood protection like respective ministries. Enhance stakeholder cooperation with local communities.	Enhances livelihood resilience at community and household levels to minimise any long-term damage to livelihoods assets.

Source: Authors.

availability caused by recurrent floods, food insecurity is bound to increase. These challenges have had very limited and inconsistent response.

FS, to a certain extent, rests on government assistance albeit with food policy failures (World Bank, 2013). Government has not instituted DRR measures that will mitigate the impact of flooding to livelihoods on a long-term basis. Poor, mainly reactive DM strategies, lack of credit facilities, a poor asset base, lack of awareness and knowledge, low educational attainment and limited skills

in non-farm sector, lack of rural infrastructure and over dependence on agriculture as primary source of livelihood tend to compound food insecurity in the region. The government and many NGOs provide relief assistance during crisis, which is insufficient and has not been able to sustain the food needs of the region.

We argue that the FS challenge hinges on livelihood assets. As such, the government needs policies and strategies that enhance livelihood assets and facilitate crop production. Adaptation and coping measures should

be a proactive as well as a reactive strategy that should provide cushioning for households security. As such, public investment in both structural and non-structural measures should be increased and hereby a stronger DM perspective is required. Considering that floods pose a serious risk to Dam infrastructure, continued investment in Dam resilience will also enhance livelihoods and FS.

This article's findings highlight, not only the relevance of mainstreaming resilience into livelihood assets and FS, but also that flood management must become an integral, increased priority, especially when confronting recurrent shocks as we have argued in DMSL framework. This is relevant for SL considerations (Figure 7) for future generations given the damning effects of CV.

Since CC and CV is an unavoidable future for all, it should not be a permanent limitation for Northern Cameroon to achieve its full livelihood/FS potential. This worrying situation can be better handled if the government adopts a strategic approach that specifically incorporates a stronger proactive DM perspective.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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