Natural Disasters, Vulnerability and Livelihood Security in Rural Cameroon

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Abstract

Increasing occurrence of natural disasters is having immense impacts on livelihood security especially in developing countries. While it is generally accepted that these impacts will be stronger in developing countries, empirical evidence is scarce. The objective of this paper is to empirically compare the livelihood security status of victims and non-victims of the 1986 natural disaster in rural Cameroon. A structured questionnaire was used to collect data from 296 victims and non-victims from three disaster affected villages and three resettlement camps in North West Cameroon. Livelihood security was estimated at household level based on the World Bank’s per capita income value of US $ 1.25. The impact of a possible shock requiring 10% of household assets to accommodate it was simulated to assess the vulnerability of households to future livelihood insecurity. The results revealed that victims were not essentially different from non-victims from a livelihood security perspective, even if less non-victims (94%) were livelihood insecure compared to victims (97%). Combining income and assets, 90% of non-victims were found to become insecure in case of a simulated shock, up from 44%, compared to almost 94% of victims, up from 49%. The research concludes with the need for livelihood security programs to be directed to all households in the Lake Nyos area, irrespective of their type.

Key Words: Natural Disasters, Vulnerability, Livelihood Security, Sustainable Development, Rural Cameroon.

1. Introduction

The alarming upsurge of natural and manmade disasters in the last three decades or so has negatively impacted global livelihood security. Between 2000 and 2005 alone, almost 250 million livelihoods per annum were rendered insecure as a result of natural disasters around the world (Feron, 2012). At current rates, an estimated global economic loss US $ 314 billion will result from natural disasters annually (UNISDR, 2015). Natural disasters therefore create poverty traps by rendering non-poor households poor, or by pushing the poor deeper into poverty (Carter & Barrett, 2006). In other words, natural disasters often
either increase vulnerability of victims to poverty, or directly perpetuate poverty and reduce livelihood security. The impacts are, and will continue to be stronger in developing countries where state and market failures for disaster management are very frequent and where social degradation resulting from manmade disasters such as riots, wars, ethnic conflicts and terrorism have become the order of the day. The hypothesis that the basis of sustainable development and livelihood security will be increasingly determined by the extent to which disaster risks are minimized is therefore justified (UNISDR, 2015).

Livelihood security has been a fundamental component underpinning the scientific discourse on sustainable development and influencing development policy for over a half of a century (Frankenberger and McCaston 1999, Lindenberg 2002). The nexus between livelihood security and sustainable development was traditionally embedded in the food (in)security dialogue, which quickly became synonymous and was used interchangeably with the livelihood security concept in the early days of its conceptualization (Frankenberger 1992). In other words, being food secure meant being livelihood secure, to the extent that this was applicable in developing countries.

The African food crises in the mid 1980s gave a new impetus to livelihood security – food security – sustainable development dialogue. It became clear that food security did not immediately translate neither to livelihood security nor sustainable development (Frankenberger and McCaston 1999). Other entitlements were crucial for livelihood security (Sen 1983). Crucially, livelihood security had to be declared on the basis of its sustainability. A Livelihood was conceptualized as sustainable only if it was able to cope with and recover from shocks and stress, maintain or enhance its capabilities and assets, while not undermining the natural resource base of the area (Scoones, 1998). Sustainability emerged from complex relationships between a number of factors such as the vulnerability context and its interaction with livelihood assets, leading to certain outcomes which were mediated by institutional processes, livelihood strategies and stability of the resource base (Chambers, 1989).

The impact of natural disasters on livelihood security became an issue for concern. This was even more important for developing countries where the greatest chunk of the world’s poor live, and where livelihoods are expected to be rendered insecure by the negative effects of increasing natural disasters, linked to but not limited to climate variability (Guha Sapir et al. 2011). It is generally agreed that climate variability and emanating natural disasters thereof affect livelihood security especially in developing countries where states and risk markets are not vibrant (Holzmann et al 2003, Guha Sapir et al. 2011, IPCC 2014,GAR 2015 ).

The rise in disasters in Africa in recent years have caused great economic losses, socio-political instability and increasing poverty and livelihood insecurity amongst affected households. Over 60 percent of the total victims (killed and affected) of natural disasters in 2005 were found in Africa (ISDR, 2010, Balgah and Buchenrieder, 2011). The African continent is witnessing an increase in natural disasters. The effects of these disasters are exceptionally high in Sub-Saharan Africa, where the poor are concentrated (Holzmann et al 2003, Guha-Sapir et al. 2011).

Cameroon’s geologic and tectonic history makes her one of the most exposed countries to natural disasters in Sub-Saharan Africa (Bang 2008). On August 21st 1986 in the North West Region of Cameroon a natural gas eruption took place at Lake Nyos, emitting large amounts of carbon dioxide and minimal amounts of hydrogen sulphide that suffocated and killed about 2,000 inhabitants and almost all livestock in three villages (Nyos, Cha and Subum) located within a diameter of about 25km around the lake (Sigvaldon, 1989). Significant efforts have been made by scientists to determine the exact cause of the disaster, assess the impact of the disaster and the recovery process of the victims (Shanklin 1988, Halbwachs et al. 2004, Bang 2008, Balgah and Buchenrieder, 2011& 2012). However, not sufficient efforts have been placed on analyzing the impact of the disaster on livelihood Security. This paper therefore examines the impacts of the disaster on livelihood security of victims.

A comparative analysis with non-victims is also undertaken.
2. Literature Review

2.1. Natural Disasters, Livelihood Security and Sustainable Development

Disasters can be considered to be a serious disruption of the functioning of a society, causing widespread human, material or environmental losses which exceed the ability of the affected society to cope using its own resources, necessitating a request on a national or international level for external assistance (Holzmann, 2001, CRED, 2010). Disasters have potentially derailed socio-economic as well as development progress, putting millions of people into dire poverty or make the poor people even poorer in most disaster areas. A contemporary example is the 2011 droughts in the horn of Africa. One of the major impacts of disasters is their potential to render livelihoods of victims insecure. According to the Hyogo Framework for Action (2005), disasters affect over 200 million people annually, causing significant loss of lives, forced migration, and disruption of livelihoods and institutions.

Though these disaster impacts are widely felt, they often disproportionately fall on poor countries, hitting hard on the poor and marginalized people within such countries. Thus the effects of disasters are not simply a humanitarian problem, but also a major challenge to achieving the Millennium Development Goals (Karen et al. 2013). For instance after the 2010 earthquake in Haiti, poor households’ cash stocks were completely obliterated following the disaster. With little to no access to formal financial institutions, households were forced to rely on informal saving strategies which in a multi-hazard context (like the case of Haiti) provide little to livelihood security. These households were left with little choice but to borrow; however, not sufficiently enough to restock their businesses, earn a profit, or sustain their current livelihoods or consumption needs. Therefore while wealthy households were able to recover, the poor continued to further deplete their assets, take on debt, and spiral down into a poverty trap (Feinsten International Center, 2013).

Disasters can lead to severe destruction of physical, human, financial, natural, and social capital, inevitably resulting in economic stagnation and the deterioration of livelihoods as well as overall development. The loss of physical capital is often exacerbated in poor and developing countries due to the use of less durable building materials, poor legal enforcement of regulations (i.e., building codes), and weaker prevention systems (Cavallo and Noy, 2009). Human capital can take even a greater toll through the loss of life, injury, disease, and emigration. An example is the case of the March 2013 floods in Kenya which affected mostly the poor, killing 62 Kenyans and displaced at least 89,515 from at least 1,198 households (Sheikh, 2013). Financial capital is also severely affected by disasters. For instance, savings, insurance, and access to credit are all potentially lost or reduced as a result of disasters. Households lose access to informal financial strategies, such as borrowing from a neighbor or reciprocal insurance. Savings with informal savings groups can be washed away or destroyed, or lost in the process of people fleeing from their villages. The effects of disasters can have long-term consequences on natural capital as for instance the effects of floods, tsunamis, gas eruptions and cyclones which often make large tracts of crop land unusable for several seasons. An example was the abandonment of the fertile lands in the three affected villages of the Lake Nyos area after the 1986 Lake Nyos disaster (Sigvaldon, 1989). The effect of disasters on social capital is more ambiguous, as in some cases, traumatic experiences can sometimes alter norms in a positive direction with respect to collective action in the post-disaster situation. Therefore, disasters can be seen to have a very strong and mostly negative impact on livelihood assets, leading to outcomes of increased vulnerability, reduced food security, deterioration of development plans and increase poverty (Feinsten International Center, 2013).

Though there is little dissent in the literature about the overwhelming consequences of disasters on communities and their livelihoods, a number of conceptual frameworks on sustainable livelihoods have been well developed and tested by many organizations particularly the Department for International Development, CARE, Oxfam and United Nations Development Program to mitigate against the negative
impacts of natural disasters on individual, household and community livelihoods (Scoones, 1998, Diana et al. 1999). These livelihood approaches emphasize understanding of the context within which people live, the assets available for them, the livelihood strategies they follow in the face of existing policies and institutions, and livelihood outcomes they intend to achieve (Adugna and Wagayehu, 2008). Thus the key question to be addressed in any analysis of livelihood following a disaster is given a particular context (policy setting, politics, history, agro ecology and socio-economic conditions), what combination of livelihood resources (different types of ‘capital’) will result in the ability to follow what combination of livelihood strategies (agricultural diversification/ extensification, livelihood diversification and migration) with what outcomes (poverty, reduced vulnerability, reduced development)? (Scoones, 1998).

While more developed countries usually are able to cope with the impacts of natural disasters, large proportions of population are severely affected in developing countries thus affecting the countries’ resources and ability to finance important social and economic programs. More so, developing countries frequently face post-event liquidity crises in financing or coping with relief and reconstruction after disasters, thus leading to serious effects on their long-term development plans. For instance after the 2001 earthquake in the state of Gujarat, India, funds for recovery from the central government and other sources fell far short and actual funding only covered about 30% of the state government post-disaster reconstruction needs (Anthony et al. 2009). Hence such lack of financial robustness can also imply huge negative fiscal effects due to natural disaster events. As a result of these, most developing countries usually respond by diverting from their budgets or already disbursed development loans, as well as by relying on aids from the international community which are often insufficient, associated with longer time lags and hardly provide incentive for risk reduction (ibid). Thus, proper risk management to evade disasters and disaster appropriate response mechanisms when disasters strikes are therefore needed for the better management of resources and development in disaster areas especially in developing countries.

2.2. The Concept of Vulnerability Re-Visited

Vulnerability is a broad concept, explaining not only income vulnerability but also those related to health, social exclusion and violence, all of which can have dramatic effects on household livelihoods and community, regional as well as country development plans (Alwang et al, 2001).

Vulnerability can be defined as the probability of an individual, household, region or country to be affected negatively by future events which are in themselves determined by the assets of the household, the correlation, frequency and timing of the shocks and the risk management instruments applied (Holzmann, 2001, Karin et al. 2001). In the development literature, vulnerability can be captured based on expected loss in utility, as expected poverty, assets based measures and as expected exposure to risks (Schechter, 2006). Vulnerability as expected loss in utility is defined as the difference between the utility derived from some level of certainty-equivalent consumption at times t and t+1. As expected poverty, vulnerability is defined as the probability that a household will fall in to poverty in the future. Using asset-based measures, it is defined as the probability of falling below some benchmark level of current consumption as a result of loss or degradation of assets. As exposure to risk, vulnerability is looked upon as probability of having an ex post welfare loss as a result of a negative shock (Alwang et al. 2001, Schechter, 2006, Raghav and Katsushi, 2008). In this study, vulnerability of households to future shocks is used as a proxy for livelihood insecurity. Household income and the total value of the selected household assets were used as a proxy for measuring future livelihood insecurity, in the case of effects from a simulated shock. The reason for using household assets is that shock affected households are very likely to draw on their assets in the process of recovery. Poorer households with fewer assets and entitlements are usually more exposed to the probability that shocks will make them poorer and thus livelihood insecure (Karin et al. 2001). Also, livelihood insecurity as a result of income and household assets is considered to present a better condition for analysis. Therefore, if the relative welfare loss of the household is large enough to push households into poverty or deeper in to a vicious cycle of poverty, these households are considered to be vulnerable to future shocks, and insecure livelihoods (Karin et al. 2001, Schechter, 2006, Armando, 2007).
Although there exist dissent literature in this domain, empirically documented evidence especially from developing countries currently lags behind that of developing countries. This paper contributes in this direction, by empirically examining the impacts of natural disasters on livelihood security for victims in northwest Cameroon.

The paper will proceed as follows. The next section will present the materials and methods implored in the empirical study, while the results will be presented and discussed in section 4. Section 5 will conclude the paper.

3. Materials and Methods

3.1. Methodology and Sampling Approaches

Following a cross sectional survey approach, data was collected from victims and non-victims of the 1986 lake Nyos disaster using a standardized questionnaire. The sampling unit was the household. Data was collected from households in the three villages affected by the 1986 Lake Nyos disaster, that is, Cha, Nyos and Subum villages; and three of the seven resettlement camps that were closest to the disaster villages (Kimbi, Buabua and Kumfutu). It should be mentioned here that after the disaster, victims were displaced into seven resettlement camps considered to be safe havens. While all the affected villages were included in the survey, only three of the seven resettlement camps closest to the affected villages were sampled. This purposive sampling approach has a number of advantages. Firstly, it will allow for comparative analysis of households in camps and affected villages, on the basis of livelihood security. Secondly, it is assumed that the villages are more or less exposed to similar extraneous factors, thereby reducing any forms of bias that cannot be captured by the research. Thirdly, it would be easier for the researchers to collect data in adjacent villages, taking into consideration transportation and communication difficulties evident in the area. A total of 296 households (133 victimized, 163 non-victimized) were sampled as follows: Nyos (39), Cha (57), Subum (37), (Kimbi (41), Buabua (68) and Kumfutu (54). The sampling frame was the list of households previously interviewed in 2009/10 (see Balgah and Buchenrieder 2010). This sampling frame permitted the construction of a panel data set that will facilitate subsequent comparative analysis over time in the region.

3.2. Data Collection

Data was collected using a structured questionnaire based on Zeller et al (2003) which was modified to capture new variables of interest. Data collection undertaken by trained enumerators took place from January 26th to February 1st 2014. Interview as well as filling in the questionnaire was done solely by the enumerators irrespective of whether the household head could read and write, since they had been trained for three days to administer the questionnaires. Interview and data recording was done at the homesteads of the interviewees. This was complemented by observations, key informant interviews and focus group discussions. Qualitative data collection exercises were organized at the convenience of each target group.

3.3. Data Analysis

Data was entered and analyzed in SPSS (Statistical Package for Social Sciences), version 17.0. At 95% confidence interval (α = 0.05), both descriptive and statistical analyses were performed. A comparative analysis was done between victims and non-victims to identify any differences or similarities in livelihood security. The current poverty state of both socio-economic groups (victims and non-victims of the Lake Nyos disaster) was used as a proxy for livelihood security in these areas. To achieve this, the paper employs the internationally accepted poverty per capita threshold of US$1.25 (PPP) per day (World Bank Report 2013). Using the BEAC’s (Bank of Central African States) exchange rates for 2014, US$1 = FAFC 472.2, thus US$1.25 = 1.25 x 472.2 = FAFC 590.25.
The household per capita daily income was calculated following Fambon and Menjo (2002) and Schechter (2006) as follows:

$$\text{Per capita income} = \frac{\text{HHI}}{\text{HH size} \times N \text{ days}}$$

(1)

Where

- HHI = Household monthly income
- HH size = Household size
- N = Mean number of days per month

Note: \[ N = \frac{365 \text{ days}}{12 \text{ months}} = 30.4 \]

Therefore if:

- If the per capita income < FAFC 590.25, then the household is living below the poverty line and is considered from a per capita income perspective to be livelihood insecure. On the other hand, Households with a per capita income > FAFC 590.25 (living above the poverty line) are considered from a per capita income perspective to be livelihood secured. In addition, a simulation analysis was performed to assess the proportion of households who will remain secure in case of a hypothesized shock.

4. Results and Discussions

4.1. Comparative Socioeconomic Analysis

Table I below presents a descriptive statistics on the sample population. The mean age of the population was almost 47 years, about 7 years less than the life expectancy ratio in Cameroon (World Bank Report 2013). According to gender, slightly above 31% of the households were headed by women. Of these, close to 62% of them are victimized households.

Table I: Comparative Socioeconomic analysis of victims and non-victims in the sample

<table>
<thead>
<tr>
<th></th>
<th>Sample Mean</th>
<th>Sample Deviation</th>
<th>Std. Deviation</th>
<th>Victims</th>
<th>Non-Victims</th>
<th>P-value</th>
<th>Standard values for Cameroon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age of HHH</td>
<td>46.74</td>
<td>14.082</td>
<td>49.58</td>
<td>41.22</td>
<td>0.000</td>
<td></td>
<td><strong>54</strong></td>
</tr>
<tr>
<td>Average income</td>
<td>28,790</td>
<td>26,150</td>
<td>29,360</td>
<td>27,670</td>
<td>0.598</td>
<td></td>
<td><strong>28.431</strong></td>
</tr>
<tr>
<td>Household size</td>
<td>7.29</td>
<td>4.780</td>
<td>7.89</td>
<td>6.13</td>
<td>0.002</td>
<td></td>
<td><strong>6</strong></td>
</tr>
<tr>
<td>Literacy rate</td>
<td>37.3%</td>
<td>NA</td>
<td>44.1%</td>
<td>33.8%</td>
<td>0.081</td>
<td></td>
<td><strong>68%</strong></td>
</tr>
<tr>
<td>Gender</td>
<td>31.1%</td>
<td>NA</td>
<td>39.4%</td>
<td>60.6%</td>
<td>0.199</td>
<td></td>
<td>NA</td>
</tr>
</tbody>
</table>

Notes:
1. The Cameroon standard values were gotten from World Bank Report on Cameroon Statistics (2013)
2. Household income has been rounded up to the nearest franc CFA.
3. HHH = Household head
4. NA = Not applicable

Results also show that a higher proportion of the victimized household heads (almost 45%) could read and write compared to only about 34% of the non-victimized household heads. This can be attributed to the fact
that since the 1986 Lake Nyos disaster, support from the government and development organizations has probably been somewhat biased in favor of the victims, providing them with more opportunities to be educated than the non-victims. Also, they may have been having informal educative trainings through community based disaster management institutions such as BUKILSDA (Bua-bua Kimbi Lake Nyos Survivors Development Association); especially on the importance of education, sanitation and particularly sustainable agriculture which forms the backbone of their economy. This result seems to support previous conjectures (see for instance Balgah and Buchenrieder 2012) that informal response mechanisms can be crucial in dealing with natural disasters.

Human capital was assessed based on the household head’s literacy rate, educational attainment and the size of the household. Though the literacy rate was generally lower for all the villages than the national average of 68% (World Bank Report, 2013), a significantly higher proportion of household heads in Kimbi could read and write (61%) compared to only about 7% in Cha ($X^2 = 0.000$). In general, the literacy rate in the resettlement camps are significantly higher than those in the disaster villages (73% and 23% respectively) (figure 1).

This higher literacy rate in the resettlements can be attributed to the fact that they are located close to more developed and advanced villages like Fonfuka, Nkambe and Wum. The interaction between household heads in these villages are very high especially for business purposes. As a result of these, household heads are more likely to learn how to read and write so as to facilitate their business transactions. In addition to this, since the occurrence of the disaster in 1986, government intervention at the level of creation of schools has been concentrated in the resettlement camps until of late where some of the disaster villages have now been given schools. This must be understood as part of the decision of the government to discourage or prohibit illegal return to the disaster villages (Sigvaldon, 1989, Bang, 2008, Balgah and Buchenrieder, 2011a). This may also constitute some of the reasons for instance why a higher proportion of household heads in the resettlement camps (slightly above 20%) have completed primary education compared to about 15% in the disaster villages (table II).
In the Lake Nyos area, almost 86% of the household heads are self-employed in agriculture, 10% employed in non-farm enterprises, with only a small proportion belonging to the casual waged employed category and not being able to work either because they are too young, too old or are handicapped (2% each). Close to 70% of those self-employed in agriculture are victimized households.

The mean household size is 7 for the overall population, 8 for victimized households and 6 for non-victimized households (P = 0.002). This significantly higher household size for the victims can be seen as a means to ensure survival of at least one individual if another Lake Nyos disaster was to occur. This could be seen as a direct impact of the experience of the victims during the 1986 disaster. This is in line with the findings of Balgah and Buchenrieder (2014) who suggest that higher household size of victims is probably an attempt to safeguard their lineage, in case of another disaster.

Social capital was assessed based on the number of networks to which the household head has membership. Results show that more than 80% of the sample population belonged to at least one group or network, with a higher proportion being victimized households (about 65%). The mean number of groups for the victimized household is 2 while that for the non-victimized household is 3 (P = 0.465). This insignificant difference therefore suggests that belonging to a group or network does not distinguish or affects the livelihood security of the households in this area especially comparing that of victims and non-victims. However, membership in networks seems to be an important risk management strategy for both victims and non-victims, supporting the findings of Balgah et al (2012) that households usually employ informal mechanisms in managing covariate and idiosyncratic shocks.

Physical capital was assessed using some selected household assets such as available livestock and household equipment. A Levene’s Test for Equality of Variances showed that the mean value for the physical asset for the non-victims is close to FCFA 536,100 while that for the victims is almost FCFA 436,200 (P = 0.326) a difference of about FCFA 100,000. These two values suggest that the non-victims are more likely to survive another shock if recovery is highly positively correlated with access to natural capital. Though not significant, the difference of close to FCFA 100,000 in assets value owned by the non-victims (about 3.4 times the average victimized monthly salary) may be very useful in determining the social status of each household. This can be shown for instance in the amount spent on clothing and footwear by both victims and non-victims. On average, the non-victimized households spend a significantly higher amount of about FCFA 28,300 compared to only FCFA 20,800 spent by victims on clothing and

<table>
<thead>
<tr>
<th>Table II: Household head’s educational attainment by individual villages</th>
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<tr>
<td></td>
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<tr>
<td>------------------</td>
</tr>
<tr>
<td>Bua-bua</td>
</tr>
<tr>
<td>Kumfutu</td>
</tr>
<tr>
<td>Kimbi</td>
</tr>
<tr>
<td>Cha</td>
</tr>
<tr>
<td>Nyos</td>
</tr>
<tr>
<td>Subum</td>
</tr>
</tbody>
</table>

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footwear (P = 0.023). This therefore suggests that the more physical capital a household possesses, the more likely it is able to acquire better social needs.

Financial capital was assessed using only the estimated monthly income of the household. Results show that the estimated mean total monthly income for the entire population is close to FCFA 28,800. While that for the victimized household is FCFA 29,400, the value for the non-victimizes households is FCFA 27,700 (P = 0.598). This therefore suggests that both household types are more or less equal in terms of average household monthly income. The household monthly income was further used to determine the proportion of people who fall below the poverty line, those who lie at the poverty line and those who fall above the poverty line. This was used as a proxy for livelihood security in the Lake Nyos area. Two poverty threshold values are commonly used by researchers for this purpose: US$1 (PPP) per day and US$1.25 (PPP) per day (World Bank Report, 2013).

As mentioned already, this study employs the calculated per capita daily income FCFA 590.25 (US$1.25) as a bench mark for livelihood security. Therefore if per capita income < FCFA 590.25, then the household is considered from a per capita income perspective to be livelihood insecure. Households with per capita = FCFA 590.25 are considered to be having neither secure nor insecure livelihoods. Per capita incomes > FCFA 590.25, indicate livelihood secure households. The results of the analyses are presented below.

4.2. Livelihood Security in the Lake Nyos Area

4.2.1. Comparative analysis of Livelihood Security between Victims and Non-victims

Figure 2 below presents the livelihood situation as a percentage of victimized and non-victimizes households in the study area who are living below the poverty line. The results reveal that the percentage of people with insecure livelihood is slightly higher for the victims than the non-victims (97% and 94% respectively) though the difference is not statistically significant. Nevertheless, this difference may be attributed to the fact that most of the inhabitants in this area (close to 86%) rely on subsistence agriculture for their livelihoods. Recall that the average household size of victimizes households was significantly higher than those of the non-victimizes households (8 and 6 respectively). In fact, a correlation analysis done to test if household livelihood security is related with the size of the household was strong (Cramer’s V value of 0.463, P = 0.000). It therefore seems logical for us to conclude that the difference in livelihood security between victims and non-victims is at least partially explained by the higher household size of the former, compared to the latter. Larger household sizes provide more farm labor, which is a key resource in smallholder agriculture (Barret, 2005).

Fig.2: Livelihood security dynamics amongst victimized and non-victimizes households
4.2.2. Household Vulnerability to Future Livelihood Insecurity

In this study, vulnerability was used as a proxy for future livelihood insecurity. The same procedure that was used by Schechter (2006) in calculating the per capita income of each household was used here, the main difference being that household income and total value of selected household assets were used and not just income alone. For a household at time $t$, let $C_t$ represent per capita income at time $t$ and $PL$ the poverty line.

Then in this case, vulnerability ($V$) is defined as the probability that the expected per capita income of the household is below the selected poverty line of US$1.25 (PPP) per day. Thus

$$V = \Pr (C_{t+1} < PL) \quad (2)$$

Based on these measures, that is, the household income and total value of selected assets, it was observed that more than 53% of the inhabitants in the study area presently have secured livelihoods while close to 47% have insecure livelihoods.

To estimate future livelihood (in) security, assume a simulated shock was to occur, that will require a minimum of 10% of current household income and assets combined.

Balagah and Buchenreider (2011a) for instance found that households in the lake Nyos area lost about FCFA 106000 in livestock assets, representing about 24% of the mean household income and assets combined. Leaning on these results we therefore hold that, the 10% loss level used in our simulation is very fair. Our simulation further assumes that initial external support to victims immediately after the shock is zero.

Table III below presents the simulated livelihood situation by individual villages. As expected, more households will be insecure in case a shock occurred that could require an average of 10% of household income and assets to manage it. For instance, the percentage of households having secured livelihoods in Bua-bua will drop from about 61% to slightly less than 5% under such conditions. On the other hand, those with insecure livelihoods will increase from 38% to nearly 96%. Livelihood insecurity will increase to above 90% for all the individual villages. This suggests tha all households in the research area, irrespective of whether they are in the affected villages or resettlement camps are strongly exposed to insecure livelihoods in the future, especially in the situation of a new shock.

Table III: Livelihood insecurity in the six research villages.

<table>
<thead>
<tr>
<th>Village</th>
<th>Livelihood Insecurity Status</th>
<th>Secured Livelihood</th>
<th>Insecure Livelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before Shock</td>
<td>After Shock</td>
<td>Before Shock</td>
</tr>
<tr>
<td>Bua-bua</td>
<td>60.7%</td>
<td>4.4%</td>
<td>38.3%</td>
</tr>
<tr>
<td>Kimbi</td>
<td>48.8%</td>
<td>9.8%</td>
<td>51.2%</td>
</tr>
<tr>
<td>Kumfutu</td>
<td>56.1%</td>
<td>7%</td>
<td>43.9%</td>
</tr>
<tr>
<td>Cha</td>
<td>37.9%</td>
<td>6.9%</td>
<td>62.1%</td>
</tr>
<tr>
<td>Nyos</td>
<td>64.1%</td>
<td>12.8%</td>
<td>35.9%</td>
</tr>
<tr>
<td>Subum</td>
<td>48.6%</td>
<td>8.1%</td>
<td>51.4%</td>
</tr>
</tbody>
</table>

To better understand these dynamics, a comparative analysis was done by village type, (for disaster villages and the resettlement camps). Figure 3 below presents the results of the analysis.
Only about 7% of the households in the resettlement camps will still have secured livelihoods compared to 9% of those in the disaster villages. Therefore, almost 81% of households in the resettlement camps as compared to about 79% in the disaster villages will see their livelihoods become insecure in the wake of the simulated shock. While this difference is not significant (P > 0.05), it is obvious that on average over 80% of all households will witness livelihood insecurity in case of the simulated shock and its anticipated effects.

Finally, we examine the livelihood security dynamics between victims and non-victims. As presented in figure 4, close to 11% of non-victimized households will still have secured livelihoods, compared to about 6% of the victimized households in case of the simulated extreme event. Though not significant, the higher proportion of victimized households that will see their livelihoods become insecure could be attributed to the fact that the Lake Nyos disaster victims lost almost all of their assets during the disaster and are still in the process of recovery whereas most of the non-victimized households already have enough capital to secure their livelihoods. Further these households as explained by Armando (2007) and Bang (2008) may lack the necessary household buffers to counteract the effects of shocks/disasters on asset depletion.
5. Conclusions and Recommendations

5.1. Conclusions

The livelihood security concept remains vital to supporting research efforts in understanding the poverty dynamics and its relationship to sustainable livelihoods. With increasing climate variability, there is a need to understand livelihood dynamics as part of efforts to deal with the aftermaths of extreme natural events. This paper has empirically assessed livelihood security between victims and non-victims of the 1986 lake Nyos disaster in Cameroon. Simulation analysis was also performed to predict the future dynamics. Based on the research, some key conclusions can be made. Firstly, livelihood security proxied by per capita income was not different between household and across village types (disaster villages and resettlement camps), with most of the households having insecure livelihoods (more than 90%). Most households also live below the poverty line. This suggests that livelihood insecurity is widespread in the area, and does not discriminate by household type. Secondly, an increasing number of households were predicted to become livelihood insecure, in case a shock that warranted 10% of household income and assets were to occur.

5.2. Recommendations

Based on the results we derive the following two recommendations.

Firstly, any efforts towards improving livelihood security in the research area should target both victims and non-victims, as both household types are generally witnessing insecurity in their livelihoods. Secondly, it is evident that most of the households in the research area live below the poverty line. Therefore, victims and non-victims alike should be targeted for poverty alleviation programs.

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