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RESEARCH ARTICLE

DETERMINANTS OF LIVELIHOOD SECURITY AMONG DISASTER VICTIMS IN RURAL CAMEROON

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ABSTRACT

Livelihood security has remained pervasive in most disaster areas irrespective of the interventions by governments as well as local and international development bodies. The inability to isolate distinct determinants of livelihood security may lead to interventions and solutions that may further increase, rather than mitigate livelihood insecurity. This study sorts out to identify determinants of livelihood security in the Lake Nyos area. Data was collected from both victims and non-victims in the three disaster villages and from three of the seven resettlement camps using a structured questionnaire. A probit analysis was used to identify the determinants of livelihood security in the research area. Results revealed that household size, education and age of the household head were influential in determining livelihood security. Household income had no influence on livelihood security in this region ($R^2 = 0.000$). Of these variables, age of household head showed the strongest relationship ($R^2 = 0.022$, $P = 0.045$). There is therefore a need for exchange of experiences between old and young household heads on livelihood security measures. Further research could be carried out in multiple case studies of natural disasters (e.g. floods and droughts) to test robustness of variables for relevance especially in developing countries.

INTRODUCTION

Disasters have been occurring more frequently in the past decade with devastating effects on the livelihoods of its victims, rendering it insecured. 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. At current rates, natural disasters are expected to cause an estimated US $ 314 billion in lost annually (UNISDR, 2015). Therefore, the hypothesis that sustainable development and livelihood security will be increasingly determined by the extent to which disasters are minimized especially in developing countries is therefore justified.

Though livelihood impacts caused by disasters are widely felt, their direct impacts often disproportionately falls on poor countries and the poor and marginalized people within such countries. For instance Ngwa *et al* (2015) found that more than 90% of the victims of the 1986 Lake Nyos disaster (which form the majority of the poor in the area) are likely to have insecured livelihoods in case another disaster was to occur. Therefore, 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) as well as the new Sustainable Development Goals. An example is the 2010 earthquake in Haiti, where poor household's cash stocks were completely obliterated following the disaster. These households were forced to rely on informal saving strategies which provided little to livelihood security.

They were left with little choice but to borrow; however, not sufficiently enough to restock their businesses, earn a profit, or sustain their current livelihoods. 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 (Feinstein International Center, 2013). Many determinants have been identified in past literature that significantly affects livelihood security (Scoones, 1998, DFID, 1999, Lindenberg, 2002,). Therefore the identification of important determinants of livelihood security will provide more information on the underlying causes of livelihood security and aid policy interventions especially in developing countries. This paper intends to contribute in this direction.

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Background of the problem and the research area

Cameroon's geologic and tectonic history makes her one of the most exposed countries to rapid onset of natural shocks and disasters in Sub-Saharan Africa which seriously affect negatively the livelihood assets of their victims, pushing the less poor and better off in to poverty and the poor deeper in to vicious cycle of poverty (Ngwa *et al*. 2015). Of interest to this article is the August 21st 1986 Lake Nyos Disaster. On August 21st 1986 in the North West Region of Cameroon, there was a natural gas eruption from Lake Nyos which emitted 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). Scientific investigations at that time revealed that Lake Nyos contained huge amounts of Carbon dioxide (300 million cubic meters) in the deeper layers, posing a threat of further released in the future, leading to a reoccurrence of a disaster similar to that of 1986 (Bang, 2008, Balgah and Buchenrieder 2011a and b, Balgah, 2012).

After the international conference on the Lake Nyos disaster was held in Yaoundé- Cameroon in March 1987, surviving victims were resettled immediately into safer areas (Sigvaldson, 1989). Between 1987 and 1988, seven resettlement camps were constructed in Kimbi, Buabua, Yemngeh, Ipalim, Kumfutu, Esu and Upkwa respectively. Most households were displaced immediately in to the resettlement camps from the affected villages after construction. The seven camps were set up to accommodate the 5,574 people who had survived the disaster (Bang, 2008).

Presently, there have been efforts by scientists to determine the exact cause of the disaster, assess the impact of the disaster and the recovery process of the victims as well as the livelihood situation of the victims (Halbwachs *et al*. 2004, Bang 2008, Balgah and Buchenrieder, 2011a, 2012, Ngwa *et al*. 2015). However, there is insufficient scientific information on the determinants of livelihood security in the disaster region. This paper therefore intends to contribute to this aspect.

LIVELIHOOD SECURITY: A BRIEF REVIEW OF LITERATURE

To improve understanding, it seems necessary to at least review key terminology that will frequently be applied in this article. A number of attempts have been made to define livelihood security in the literature. For instance, livelihood security is said to be obtained if people can cope with and recover from shocks and stress, maintain or enhance their capabilities and assets, while not undermining the natural resource base of the area (Scoones, 1998). Frankenberger and McCaston (1998) define household livelihood security as adequate and sustainable access to income and resources to meet basic needs (including adequate access to food, potable water, health facilities, educational opportunities, housing, time for community participation and social integration). From the above definitions, sustainability and security seem to be used interchangeably, nevertheless with sustainability weighing more on the future, while security seems to be attributed both to the present and the future. While Lindenberg (2002) views a livelihood as sustainable when people can cope with and recover from stress and shocks, maintain or enhance their capabilities and assets, and provide sustainable livelihood opportunities for the next generation, he does not provide a precise definition of livelihood security. Therefore a livelihood can be understood to be insecure in the short and long term, if it is not sustainable; and if it cannot withstand extreme events, such as natural disasters. As explained by Frankenberger and McCaston (1998) the negative impacts of livelihood insecurity can be reduced by timely detection of where livelihood insecurity is likely to occur and by establishing contingency plans that can be implemented rapidly before a significant erosion of household assets occur and other erosive coping strategies are activated. Therefore the capacity to detect changes in livelihood security at an early stage and to respond promptly could considerably reduce the costs of dealing with a full-blown emergency.

Most research on livelihood security has been centered on issues related to food insecurity, which was then linked to livelihood security (Frankenberger and McCaston, 1998, Lindenberg, 2002, Bogale and Shimelis, 2009). As food is considered to be only one of the priorities that people pursue, as well as the range of factors that determine why the poor take decisions and spread risk, in order to subsist in the short and long term, researchers have since the late 80s and early 90s developed concepts related to household livelihood security (Maxwell and Smith, 1992, Frankenberger and McCaston, 1998, Rahman and Shaheen, 2010). These household livelihood security models have been known to allow for a broader and more comprehensive understanding of the relationships of poverty, malnutrition as well as the dynamic and complex strategies that the poor use to negotiate survival (ibid). Therefore, livelihood security today is looked upon as the constant requirements to balance food procurements as well as the satisfaction of other basic material and non-material needs of individuals, households and/or communities.

A number of frameworks, indices as well as econometric models have been developed and tested to determining factors that contribute to livelihood security in many researches and organizations all over the world (Frankenberger and McCaston, 1998, Lindenberg, 2002, Barry, 2005, Rahman and Shaheen, 2010, Mutunga, 2012). This paper which focuses on the impacts of disasters on livelihood security adopts a reduced form of an econometric approach similar to that proposed by Barry (2005) to analyze the determinants of livelihood security in the Lake Nyos area (see also Devereux *et al.* 2004, Mutunga, 2012). In addition, these economic aspects have been lauded for their impact on community livelihood security (Fisher, 2008).

Though there are various livelihood security approaches that have been implemented by different organizations, in most instances, the overriding objective of using these livelihood security frameworks is to improve understanding of the multiple determinants of livelihood (in) security of individuals, households and communities and to establish contingency

plans that will improve on the livelihood security of the victims in both the short and long term.

METHODOLOGY AND SAMPLING PROCEDURES

Data was collected from both victims and non-victims living in the research villages using a structured questionnaire. The original questionnaire that was based on Zeller *et al* (2003) and that used by Balgah and Buchenrieder in their 2009/10 survey in the lake Nyos region was slightly modified to allow this research to capture new variables of interest. These variables permit an analysis of the determinants of livelihood security. Data was collected from 296 households (100 non-victimized and 196 victimized) by trained enumerators 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 houses of the interviewees. Participatory Rural Appraisal method complemented the structured questionnaire. Data was collected from the three affected villages and three of the seven resettlement camps.

Only victims and non-victims from the three affected villages (Nyos, Cha and Subum) who took part in the 2009/10 survey were sampled. Same procedure was applied to the three resettlement camps (Kimbi, Buabua and Kumfutu) closest to the affected villages. Data was entered and analyzed in SPSS (Statistical Package for Social Sciences), version 17.0. At 95% confidence interval ($\alpha = 0.05$), socio-economic analyses were performed for both victims and non-victims. Also, a regression analysis was done to elicit the determinants of livelihood security in the study area. Data has been presented in charts and tables.

Considerations in application of a quantitative method in livelihood security analysis

Household livelihood security frameworks have been pioneering community and family assessments and social program designs in relation to livelihood security, often providing the basis for more realistic assessments which reflect the circumstances that households or communities face more accurately (Mutunga, 2012).

Because of the variability observed in livelihood security measures, probability/logistic estimates have been advocated and applied. Barry (2005) for instance applied an econometric/quantitative approach, because of its ability to capture variance in livelihood security emanating from covariate and idiosyncratic shocks.

An additional strength of econometric models is that coefficients of each of the determinants of livelihood security can be estimated. The contribution of each determinant to livelihood security contributes critical input in the identification of appropriate interventions to address livelihood insecurity (Christiaensen and Subbarao, 2004, Mutunga, 2012). More so, probabilistic models do not pre-suppose linear relationships between the dependent and independent variables. As such, the dependent variable needs not be normally distributed prior to analysis (Pohar *et al*. 2004, Mutunga, 2012).

RESULTS AND DISCUSSIONS

RESULTS

Socio-economic situation of victims and non-victims in the Lake Nyos area

The literacy rate in the Lake Nyos area (slightly above 37%) is generally lower than the national average of 68% in the country (World Bank Report, 2013, Ngwa *et al*. 2015).

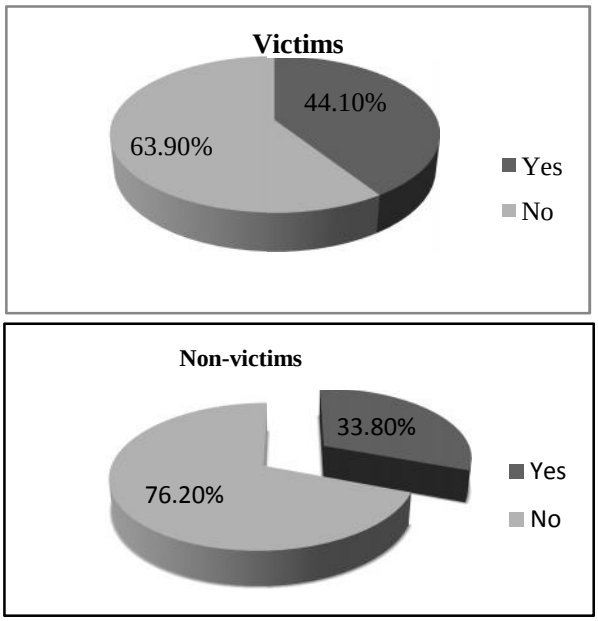

Fig. I Pie Charts Showing Whether Household Heads Can Read and Write

Note: Litracy rate above was captured as household head's ability to read and write, which suggests that the dynamics may be different if all household members are considered.

Table 1 Detail socio-economic comparisms

Socio-economic variable	Sample mean	Household status	Mean	Std. Deviation	P-value
Household Income (FCFA)	28,790	Non victims Victims	27,670 29,360	21,970 28,100	0.598
Age of household head (years)	46.74	Non victims Victims	41.22 49.58	14.355 13.093	0.000
Total household size	7	Non victims Victims	6 8	4 5	0.002
Household annual expenditures on clothing and footwear (FCFA)	23,340	Non victims Victims	28,340 20,800	74,050 29,090	0.023
Total value of small livestock (FCFA)	23,740	Non victims Victims	21,570 24,860	22,530 32,660	0.016
Value of large ruminant livestock (FCFA)	275,250	Non victims Victims	310,780 256,850	1,421,610 1,169,040	0.526
Total value of selected household assets (FCFA)	441,570	Non victims Victims	508,370 406,810	1,532,920 1,178,970	0.307

Note:
1. Household income has been rounded up to the nearest FCFA.
2. Size of household have been rounded up to the nearest whole number
3. The reason for the larger values for the standard deviations implies the data is skewed

We can infer from the above table that there is no significant difference in the monthly incomes as well as the value of household assets of both the victims and non-victims. However, differences exist in the mean age and household size, annual expenditure on clothing and footwear and the financial value of livestock for both livelihood groups.

probably an attempt to safe guard their lineage, in case of another disaster. Looking at livestock, the mean value for small ruminants owned by victims is significantly higher than those of non-victims (FCFA 24,860 and FCFA 21,560 respectively, P = 0.016) while that for large ruminants is higher for the non-victims than the victims (FCFA 310,780 and FCFA 256,850 respectively).

Table 2 Determinants of livelihood security in the Lake Nyos area

	Livelihood secured?						
		Yes (57.7%)			No (43.3%)		
	Parameter	Estimate	Std. Error	Z	P-value	95% Confidence Interval Lower Bound	Upper Bound
PROBIT	Household income	000	000	1.447	.148	000	000
	Total household size	**.006**	.033	.189	.850	-.058	.071
	Membership in networks	-.103	.211	-.487	.626	-.517	.311
	HHH's occupation	-.159	.088	-1.809	.071	-.332	.013
	Sex of HHH	-.347	.365	-.951	.342	-1.062	.368
	Education of HHH	**.164**	.139	1.184	.236	-.108	.437
	Age of HHH	**.022**	.011	2.003	**.045**	000	.043
	Marital status of HHH	-.191	.217	-.881	.378	-.618	.235
	Intercept	-.423	.855	-.494	.621	-1.278	.432

Note: HHH = Household head

DISCUSSIONS

As seen in figure I above, the literacy rate in the Lake Nyos area (slightly above 37%) is generally lower than the national average of 68% in the country (World Bank Report, 2013, Ngwa *et al*. 2015). The victims were however more literate than the non-victims (about 44% and 34% respectively).This higher literacy rate as explained by Ngwa *et al* (2015) for the victims was 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 sustainable agriculture since this form the backbone of their economy.

The fact that the average monthly income was not significantly different for the two livelihood groups (victims and non-victims) suggests that household income is more or less normally distributed in the Lake Nyos area. 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). However, that for the victimized households is significantly higher than that of the non-victimized households (about 49 and 41 years respectively, P = 0.000). In the Lake Nyos area, the mean household size is 7 for the sample 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) and Ngwa *et al* (2015) who suggest that higher household size of victims is

This smaller numbers of large ruminant livestock owned by victims could be seen as a strategy to prevent or reduce the negative effects on livestock assets if another Lake Nyos disaster was to occur.

In general, the value of some selected household assets (livestock assets, transportation means and household equipments) was higher for the non-victims than the victims (about FCFA 508,370 and FCFA 406,810 respectively). Though not significant, the difference of close to FCFA 100,000 (about 3.4 times the average victimized monthly income) in assets value owned by the non-victims 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, as 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 footwear yearly (t = 0.528, P = 0.023). This probably suggests that the more physical capital a household possess, the more the likelihood for them to acquire better social needs and livelihood security.

Determinants of Livelihood Security in the Lake Nyos Area

Based on the analysis of livelihood security proxied by the poverty bench mark of 1.25$ a day, previous research in this area reveals that a slightly higher proportion of victimized households are living below the poverty line and thus proxied to have insecured livelihoods than non-victimized households (97% and 94% respectively) (Ngwa *et al*. 2015). Therefore on average, more than 95% of the inhabitants in the Lake Nyos area have insecured livelihoods. In this study, a coded question was asked to both the victimized and non-victimized household heads whether they consider their livelihoods to be secured or not based on their individual subjective assessments. This binary variable was coded 1 for livelihood secured and 0 for livelihood insecured. The binary variable was then used for the probit regression analysis to find out its relationship with the tested socio-economic variables.

The results reveal that the total household size, maximum level of schooling and the age of household head are positively related with livelihood security in the lake Nyos region, while the main occupation of the household head, membership in networks, the sex and marital status were negatively related with the security of the livelihoods of the inhabitants of the Lake Nyos area (see table 2 above). This suggests that gender of household head for instance probably affects household diversification options, including the choice of income-generating activities (both farm and non-farm) due to culturally defined roles, social mobility limitations and differential ownership of, and access to assets, such as land . This result is in agreement with the findings of Adugna (2005), Berhanu (2007) and Adugna and Wagayehu (2008), who also found gender of the household head to negatively affect household livelihood security.

Surprisingly, the household monthly income had no influence on the security of the livelihoods of the household in this area. This can be explained by the fact that the average monthly income in these areas is more or less equal for both victimized and non-victimized household (normally distributed). Therefore, household monthly income does not lend itself as a crucial variable in determining livelihood security in these villages.

From the results, it is assumed that as the size of a household increases, the likelihood of the security of the livelihoods of the households in these areas also increases. Thus for any additional household member, the security of the livelihood of the households in this area increases by 0.006 units. The likely explanation for this is that in an area where most of the households depend on agriculture for survival (about 86% of the population), an increase in the household size provides more labour that can be used as inputs in farming, thus increasing food production. This result however contradicts that of Bogale and Shimelis (2009) who found increasing household size to be positively related with food insecurity and negatively related with livelihood security. In their work an additional member of the family increases the chances for the household livelihoods to become insecured by 49.7%. This contradiction can however be explained by the fact that while the infertile lands in Ethiopia could not support and feed the increasing population, the very rich and abundant lands in the Nyos area can support its growing population. Therefore, the Malthusian theory of population growth and resource stagnation as of now cannot be applied in the Lake Nyos area.

The sign of the coefficient of the maximum level of education also shows a positive relationship with livelihood security. This implies an increase in the years of schooling increases the likelihood for the livelihoods of the household to become secured. This is possible because as rural households acquire more and more education and experience especially in farming operations, accumulation of wealth and better planning, they tend to have better chances for their livelihoods to be secured.

The sign of the coefficient of determination between age of household head and livelihood security also indicates a positive relationship ($R^2 = 0.022$, $P < 0.05$). This suggests that for any increase in the age of the household head by one year, the probability for the livelihoods of that household to be secured increases by 2.2%. This result is in line with that of Bogale and Shimelis (2009) in which the age of the household head was negatively related with food insecurity and positively related with livelihood security. Adugna (2005), Berhanu (2007) and Epo (2010) also had similar results. One possible reason for this result as explained by Adugna and Wagayehu (2008) could be that farmers, whose ages are relatively younger, are likely to be pushed to engage more in non-farm activities than agriculture alone, as younger farm household heads may not get enough land to support their livelihood compared to the older ones. It may also be looked upon based on the argument that, as household heads get older and older, they tend to accumulate more assets (for instance number of wives and children) than the younger household heads. These assets are very important in agriculture when it comes to labour inputs.

Base on all the above results, the probit model can therefore be summarized as:

$$Y_i = 0.164X_1 + 0.022X_2 + 0.006X_3 + 0.432 + \varepsilon \quad \ldots 1$$

Where

Y_i = Household Livelihood Security Status
X_1 = Years of education of household head
X_2 = Age of household head
X_3 = Household size

From the equation, we realize that 16.4% of the livelihood security status of households in the Lake Nyos area is controlled by the level of education of the household head, 2.2% by the age of household head and 0.6% by the size of the household.

Looking at the independent/explanatory variables, they account for only about 20% of the livelihood determinants in this area. More so, only the age of the household head proved to be a very significant variable in determining the security of the livelihoods of the inhabitants of the Lake Nyos region ($R^2 = 0.022$, $P = 0.045$). There is therefore need to research on other factors that can significantly affect livelihood security in this area

CONCLUSIONS

The main objective of this paper was to assess the determinants of livelihood security between victims and non-victims of the 1986 Lake Nyos disaster in rural Cameroon. Quantitative and qualitative data were collected and analyzed from six villages, three disaster/ affected villages (Cha Nyos and Subum) as well as three resettlement camps (Bua-bua, Kimbi and Kumfutu). An analysis of the data leads to a number of key results.

Firstly, household size, maximum level of schooling and the age of the household head appeared to positively influence livelihood security in the lake Nyos region while the main occupation of the household head, membership in networks, the sex and marital status were negatively correlated with livelihood security. These variables were however not statistically significant in determining livelihood security in the research area, with the exception of the age of the household

head (R^2 = 0.022, P = 0.045). Secondly, the income of the household head in this region has no effect on the livelihood security of the households in the study area (R^2= 0.000).

Recommendations

Because age of the household head was found to significantly influence livelihood security in the Lake Nyos region, experience exchanges in workshops between older and younger household heads can enhance the attainment of livelihood security in the research region, irrespective of household type It is further recommended to extend this research to multiple case studies of natural disasters (e.g. floods and droughts) to assess the robustness of tested variables in influencing livelihood security as a prerequisite towards developing an appropriate disaster management framework of specific relevance for developing countries.

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