Proceedings of 11th IOE Graduate Conference
Peer Reviewed
ISSN: 2350-8914 (Online), 2350-8906 (Print)
Year: 2022 Month: March Volume: 11

The Differentiated Impact of the Gorkha Earthquake on Richer and Poorer Households

John Friberg[a], Sushil Bajracharya[b]

[a] *Research Associate, Institute of Engineering, Tribhuvan University*
[b] *Professor and Assistant Dean, Institute of Engineering, Tribhuvan University*
[a] friberg.jt@gmail.com, [b] sushil_bajracharya@ioe.edu.np

Abstract
This study uses research from the aftermath of the 2015 Gorkha earthquake in Nepal to document and quantitatively compare the differentiated impacts of the disaster on richer and poorer households. The economic impact on a household is taken as the proportion of household wealth lost in the disaster event. Through this measure the implications for affected households can be appreciated more clearly, especially when seen in relation to a level of income and wealth considered minimally necessary for an acceptable standard of well-being in the specific context. Poorer households are seen to suffer greater impacts, with significantly greater proportional losses of their wealth, even though they least of all can afford it. The research methodology used participatory approaches to develop typical profiles of households representing different segments of the community, from those who are least affluent to those who are better-off. In the pressing circumstances of community emergencies, taking local perspectives on the economic environment in this way, through broad-brush, representative input, may often best meet the need at hand. The numerical indication of household economic impact allows for meaningful comparison and consideration of contributing factors. While this straightforward parameter serves the goals of operational disaster-related efforts, it could also lead to further conceptual approaches.

Keywords
disaster impacts, household economic vulnerability

1. Introduction

Disaster outcomes vary widely, depending not only on the severity and typology of the event (geological, meteorological, epidemiological, socio-political, etc.) but also on the characteristics of the affected population. These impacts may include death, disease, and disability, as well as material and economic loss. Typically, the losses can be assessed quite comprehensively. For example, the cost of the disaster to the national economy is routinely quoted, or an average cost to the affected population might be cited. Individual case studies also portray the experience of affected households or population groups in greater detail. Amidst the very diverse effects, the observation is often made that households of lower socioeconomic standings suffer greater impacts in a disaster than those who are well-to-do [1, 2].

Nevertheless, it is often difficult to appreciate the differing outcomes for the poor and for those who are better off. Sufiyan [3] states that few empirical studies have been conducted that demonstrate the difference in effects between rich and poor in quantitative terms. Furthermore, household impacts need to be seen against the backdrop of the conditions that would be "normal" for the population before, or apart from, the occurrence of the disaster. If a household loses some proportion of its assets or means of livelihood in a disaster, the significance of that loss can only be judged in light of their position before its occurrence. The same loss may have very different implications for different households, depending on their starting positions, assuming that they should be compared to the same local standard.

Research into the effects of the Gorkha earthquake disaster highlights the importance of such a perspective. The magnitude 7.8 earthquake occurred on April 25, 2015, causing approximately 9,000 fatalities, and about twice that many injuries. As the most powerful earthquake to hit Nepal since 1934, it

severely impacted 14 of the country's 75 districts, affecting 5.6 million people. More than 90% of their houses were destroyed in several districts. The houses destroyed totaled more than 500,000 with 280,000 heavily damaged [4]. The cost of the disaster is variously quoted at US$ 5 billion to 10 billion [5]. While the serious losses to the country can be summarized in statistics like these, considering the implications for specific households and communities raises the following questions:

• Taken as the economic impact on a typical household, what proportion of household wealth was lost in the disaster?

• By what means can household wealth be assessed?

• How does this proportional loss vary between richer and poorer households?

• How does the household wealth before and after the disaster relate to a minimum standard considered necessary for the household to adequately sustain themselves?

This paper reviews pertinent literature in Section 2, and a research methodology to address these questions is presented in Section 3. As described in Section 4, the data for this research was collected in the aftermath of the Gorkha earthquake, to develop wealth profiles for typical households in respective population segments of the community (from poor to those who were better-off). The effect of the earthquake on those profiles was also assessed, as well as the minimum levels of income and wealth that the communities considered to be adequate. The results of the research are presented and discussed in Sections 5 and 6, with conclusions in Section 7.

2. Literature Review

Disaster research falls at the intersection of multiple disciplines and specialties, due to the wide variety of natural and other hazards that can strike a community, the range of household and community vulnerabilities they may expose, and the complex ways in which disaster results can unfold. These various areas of literature find specific applications in the context of Nepal, which is subject to many geo-meteorological hazards, such as floods, landslides, and earthquakes. At the same time, relatively low human development standards and lagging national economic and institutional progress mean the population is highly vulnerable to hazards such as these. Thus, many case studies from Nepal disasters offer an array of "lessons learned" [6, 7] . The need of preparation for, and adaptation to, specific types of hazards is also treated extensively in the Nepal context [8, 9]. Approaches to characterizing the general vulnerability of population groups have also been applied in Nepal. One effort in recent decades has been the application of a social vulnerability index, or SoVI [10], where a range of demographic data is aggregated into a limited number of components, with each component contributing to an overall SoVI score. The spatial distribution of higher or lower scores is shown by mapping the resulting scores across the geographical area. Two recent applications of the SoVI approach to Nepal use data from the 2011 census: Gautam [11] uses 13 variables to give results at the district level. Aksha, et al. [12] use 39 variables to give results at the village (VDC) level.

These studies build upon broad areas of disaster literature that might be summarized as follows:

Disaster typologies, case studies, and databases. The nature of different disasters varies widely, depending on their cause [13]. They may result from natural hazards (such as earthquakes, floods, tropical storms, droughts, snowstorms), biological and medical factors (epidemics, crop failures, invasions of locusts or other pests), social crises (wars, insurgencies, political revolutions), economic failures (market crashes, depressions, etc.), as well as man-made industrial or environmental events (oil spills, industrial accidents, nuclear or chemical contamination, fires, etc.). Various academic journals are devoted to disaster studies, (such as Natural Hazards; Disasters; and Environmental Hazards). Databases are also maintained for the same purpose, such as the Emergency Events Database (http://www.emdat.be/). This is maintained for public use by the Center for Research on the Epidemiology of Disasters (CRED) of the Catholic University of Louvain, Belgium, and is perhaps the most comprehensive database available related to natural disasters [14].

Relief, recovery and reconstruction (RRR): disaster response. A similarly wide literature focuses on the aftermath of disasters [15, 16]. Some of this is theoretical in nature, but it also includes operational guides and "best practices" for relief, recovery, and reconstruction efforts, as compiled by agencies such as the World Bank, UNDP, Oxfam, and

other humanitarian agencies. Many approaches been mainstreamed, based on decades of experience in numerous disasters, as different areas of specialization have been developed by various agencies.

Disaster risk reduction (DRR): preparedness and prevention. The emphasis naturally moves from dealing with the aftermath of one disaster, to being prepared for the next event; from restoring the losses taken by disasters, to preventing those losses from happening in the first place [17]. In this way RRR and DRR priorities are aligned together, as is evident in the efforts of the National Reconstruction Authority in Nepal in rebuilding after the 2015 earthquake, and strengthening building code requirements to prevent future tragedy and loss. The scope for combining response and prevention is especially relevant in certain sectors, including infrastructure and housing reconstruction [18, 19, 20]. Certain journals make a specific focus here, such as International Journal of Disaster Risk Reduction and International Journal of Disaster Risk Science.

Poverty and vulnerability: measurement, reduction and alleviation. Significant progress has been made in recent decades in reducing the numbers of people who live in absolute poverty [21]. But disasters often have a decisive role in keeping or pushing people into poverty, in effect placing them in a kind of poverty trap [22]. Thus, disaster literature increasingly connects with areas pertinent to economic and social development, or poverty reduction and alleviation [23, 24].

Capabilities, strengths, and resources: building resilience and sustainable livelihoods. In these fields there has also been a healthy shift away from an emphasis on weaknesses, gaps, and vulnerabilities in the population, to a recognition of the existing strengths, assets, and capabilities. This is reflected in literature that aims to affirm, assess, and build community capacities and sustainable livelihoods. Progress in these directions has a direct bearing on resilience to disasters [25, 26].

However, in view of this wide range of literature, a gap still appears with regard to the questions posed above, concerning the proportional loss which households may suffer in disasters: How can this best be assessed in the demanding circumstances that typically accompany disasters? And how does it compare between richer and poorer households?

3. Methodology

This research is predicated on a basic assessment of household wealth before and after a disaster, as outlined in Figure 1, with the goal of measuring the household economic impact I^{hh} as the proportional loss which the given household undergoes through the disaster event.

$$I^{hh} = \frac{\Delta W}{W_{init}} \tag{1}$$

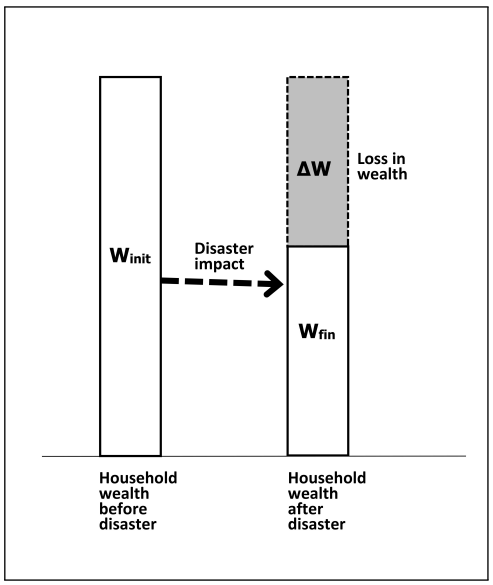

Figure 1: Disaster impact on household wealth

This is a straightforward proposition, conceptually speaking. But forms of wealth vary significantly between communities and societies. Households also rely on many resources besides the income and assets that would be counted in a formal portfolio. These can include "social capital" (advantages accessible through relationships, memberships, and networks); "human capital" (job skills, experience, expertise, good health, etc.); and "natural capital" (advantages derived from the natural environment) [27]. All of these contribute to their economic well-being, and could be thought of as forms of wealth. But many of these contributors to household wealth are difficult to evaluate directly, or to capture through other means. Besides the issue of defining the components of household wealth, there are practical issues involved in assessing it: official records with detailed economic information at the household level often are not available. Conducting comprehensive house-to-house

surveys to gather such information also entails high demands for the data collection.

This research proceeded by interpreting a household's wealth as their conventional assets, including the family house, agricultural fields, livestock, and other possessions, without attempting to assess the non-conventional "capitals" mentioned above, or non-local resources such as funds sent home by family members working in the cities or abroad. The approach adopted for data collection was based on community development approaches which use participatory exercises in group contexts. This capitalizes on the knowledge that community members have of their communal situation, which is a strong feature in traditional societies. A community group discussion (CGD) was designed, similar to a structured group interview or a focus group discussion. Taking data at the aggregate, community level in this way is more practical in a post-disaster situation, than collecting detailed personal data from a large population through household surveys.

4. Data Collection

The fieldwork was carried out in three districts in the mid-hills and high mountain regions of the country. Figure 2 shows the communities included in the research, with four in Rasuwa District, six in Sindhupalchowk, and five in Dhading, for a total of fifteen. Most of the locations were small villages typical of those found throughout the mid-hills of Nepal. Besides the rural villages, a number of CGDs were also held in a number of the "bazaars" (small towns or central markets) of the research areas.

In each of the CGDs, consensus was developed about the minimum income Y^{min} needed by a household of average size to live at standard considered minimally acceptable level in normal circumstances. This income would allow the household to sustain itself at a standard the community considers minimally acceptable in providing for its needs, in meeting necessary expenses and basic social obligations, without making optional expenditures such as for unnecessary "luxury" goods. These expenses would include the on-going investment required to maintain this level, but none that would enable the household to advance economically. For instance, costs for children's education would be included through the level the community considers to be minimally reasonable, but not for higher education beyond that level. This income Y^{min} in effect serves as a subjective poverty line, based on community response to the "minimum income question" [24].

Locations of Community Group Discussions (CGDs) held

CGD Number	District	VDC or nagar(gau)palika	Community
	Rasuwa		
Ras-1		Timure	Khaidi
Ras-2		Tongman	Dalphedi
Ras-3		Bridhim	Lingling
Ras-4		Timure	Timure bazaar
	Sindhupalchowk		
Mel-1		Melamchi	Jorayetar
Mel-2		Mahankal	Gyalthungtol
Mel-3		Palchowk	Gohiribesi
Mel-4		Palchowk	Mijartol
Mel-5		Melamchi	Phalametol
Mel-6		Melamchi	Melamchi bazaar
	Dhading		
Dhad-1		Ri	Dhamghadi IDP camp
Dhad-2		Lapa	Dangsarpakha IDP camp
Dhad-3		Sertung/Jharlang	Alchidanda IDP camp
Dhad-4		Tipling	Ratomato IDP camp
Dhad-5		Nilkantha	Kumalgau

Figure 2: Communities where research was conducted

The CGDs then delineated various population segments comprising the community, from the very poor to the very wealthy. (Figure 3 shows a sample data sheet that summarizes the input taken from one of the CGDs.) A profile was developed in the CGDs for a "typical household" in each of the respective segments, according to the kind of house they lived in, their irrigated and/or unirrigated fields, number of livestock, and other possessions. The household wealth W typical for each segment was derived from the value of these holdings. Since the communities involved in this research had little access to financial markets, the household wealth included only tangible assets. Employment was not included as a component of household wealth, since few people in these communities had regular jobs apart from their farming, although they would take irregular or seasonal work when it is available. The sufficiency of the production from these holdings to meet household needs was described, as well as the measures they resorted to in case of shortfalls. The minimum wealth W^{min} corresponding to the minimum income Y^{min} was derived from the level of sufficiency cited by the CGDs for certain segments to be able to produce the minimum income from their holdings.

FIELD DATA SUMMARY SHEET
Discussion Number: Dhad-4
Information taken by: John, Sonam
Date of discussion: 2015 Oct 16
Participants: 15 with 4 speaking

Area: Upper Dhading
VDC & Wards: TIPLING VDC
Community (-ties): In this camp people from all 9 wards mixed together
Ethnicity: Tamang

Number families in community: 700
Houses destroyed/heavily damaged: All of them
Number of deaths in EQ: 9
Number of injuries: 5 or 6

(Figures in Nepal Rupees)

Comments: *Good info*
This discussion held in Ratomato Pokhari IDP camp near Dhadingbesi.
About 200 families moved here and
About 500 families stayed in Tipling area.
Those who came here tend to be poorer than those who stayed.

Basic expenditures for one month
For foodstuffs (grains & meat): 6,200
Other cash purchases: 10,000
Total Basis Expenditures (BE): 16,200

Basic expenditures (BE) adopted for this area. per month: 13,900; per year: 166,800

			Poor		Median		Better-off	
How many families in each category:			400/700		200/700		100/700	
Own production sufficient for how many months in 1 year:			3		6		9	
Main Assets								
House			250,000		350,000		650,000	
		Price	Qty	Value	Qty	Value	Qty	Value
Paddy fields			0		0		0	
Upland fields	per ropani	10,000	3	30,000	5	50,000	10	100,000
Water buffalo			0	0	0	0	0	0
Cows		20,000	2	40,000	4	80,000	8	160,000
Goats		7,500	2	15,000	5	37,500	10	75,000
Chicken		1,200	4	4,800	4	4,800	4	4,800
Ox		15,000	1	15,000	2	30,000	2	30,000
Sheep		12,500	0	0	6	75,000	12	150,000
Total Assets	TA before EQ			354,800		627,300		1,169,800
	TA after EQ			104,800		277,300		519,800
Asset Horizon (years)	AH before EQ = TA/BE			2.13		3.76		7.01
	AH after EQ			0.63		1.66		3.12
Supplementary income from outside work								
	Work as porters 500-800/day or laborers. 25,000 in 6 months of the year			600 NRs/day				
	Gather herbs and medicines.							
BE Gap not met by own production				125,100		83,400		41,700
Days of extra work /year/family needed				209		139		70
TA_{MF} Total assets for marginal family				1,419,200		1,254,600		1,559,733
AH_{MF} Asset horizon for marginal family (years)				8.5		7.5		9.4
r_{MF} Discount rate related to marginal family				0.118		0.133		0.107
				11.8%		13.3%		10.7%

Figure 3: Sample Community Group Discussion (CGD) data sheet

The losses suffered in the earthquake were outlined, so that for each segment an assessment could be made of the household wealth both before the disaster (W_{init}) and afterward (W_{fin}). Normal prices before the disaster event were used to determine values, without considering possible effects on asset values.

From three to six population segments were profiled in each of the CGDs, depending on the specific community. Some segments with anomalous characteristics (generally the very poorest, or the most affluent, who were least representative of the communities) were excluded from the data sets. The information taken about the losses for a few of the segments in the Nepal CGDs did not allow for post-earthquake profiles to be developed, and these segments were excluded from data sets relating to disaster effects.

The CGDs usually required about two hours to complete, with the numbers of participants (up to 20 or more) varying from place to place. Typically, 3 to 5 community members were the main respondents, while others also offered input in the course of the discussion. Figure 4 shows photos related to the fieldwork.

Effects of the 2015 Gorkha earthquake.

Camp for displaced communities in Dhading.

Community group discussions (CGDs).

Figure 4: Photos from research fieldwork

While the data is based on the subjective responses given in the CGDs, confidence in its reliability is based on the open discussion and deliberation involved in reaching a consensus. The results from multiple CGDs fall in a consistent range. In some cases the results could be compared with known external benchmarks. The figures from the CGDs relate to segments of the community, rather than to individual households, and the segments comprised differing numbers of households. Thus the results cannot be taken as statistically representative for the population as a whole. Nevertheless, since the segments correspond to definite groups of households, the resulting profiles certainly reflect the situation in the selected villages, which were also typical of the rural communities of those areas.

5. Results

The community group discussions (CGDs) demonstrated that the research participants could easily relate to the subjective standard of a minimum income needed for a household of average size (5 persons generally was the consensus) to maintain itself at a minimally acceptable level in the community. Figure 5 shows a summary of the values for the minimum income Y^{min} of given in the CGDs.

Figure 6 shows a summary of the figures for the minimum household wealth W^{min} associated with Y^{min}, based on the proportion of Y^{min} which the participants indicated certain segments could generate from their own local holdings. The average results indicate that a typical household generating Y^{min} from its own resources would need a household wealth W^{min} of NRs 1,897,000 to sustain the minimum income Y^{min} of approximately NRs 13,800 per month (or NRs 166,000 per year.)

Minimum necessary monthly income $\mathbf{Y^{min}}$		
Range	NRs 10,800 –16,200	
Average	NRs 13,820	
Standard Deviation	NRs 1,740	
Annual $\mathbf{Y^{min}}$		
Average	NRs 165,840	US$ 1,580
Annual $\mathbf{Y^{min}}$ per person		US$ 316
Nepal per capita GDP		US$ 744

Notes: n = 15
1 US$ = 105 NRs in 2015.
Average taken of 5 members per household.

Figure 5: Data for minimum necessary household income Y^{min}

Minimum necessary $\mathbf{W^{min}}$	NRs	US$
Range	1,210,000 – 2,640,000	11,520 – 25,140
Average	1,897,000	18,070
Standard Deviation	413,000	3,930

Note: n = 23

Figure 6: Data for minimum household wealth W^{min} associated with Y^{min}

	Range	Average	Standard Deviation
$\mathbf{W_{init}}$	NRs 142,000 – 2,664,000	NRs 952,000	NRs 551,000
$\mathbf{W_{fin}}$	NRs 42,000 – 1,554,000	NRs 432,000	NRs 366,000
$\mathbf{I^{hh}}$	0.292 – 0.796	0.593	0.116

Note: n = 31

Figure 7: Data for household wealth W before and after disaster, economic impact I^{hh}

Figure 7 summarizes the data for the wealth W of the representative households typifying the respective population segments in the communities. It includes the wealth both before and after the earthquake (W_{init} and W_{fin}), and the household economic impact I^{hh}, which indicates the corresponding proportional loss.

Figure 8 shows W_{fin} paired with W_{init} and mapped on a scatter diagram, resulting in the following linear estimation (with W in 1,000 NRs):

$$W_{fin} = (-173) + (0.636)W_{init} \quad (2)$$

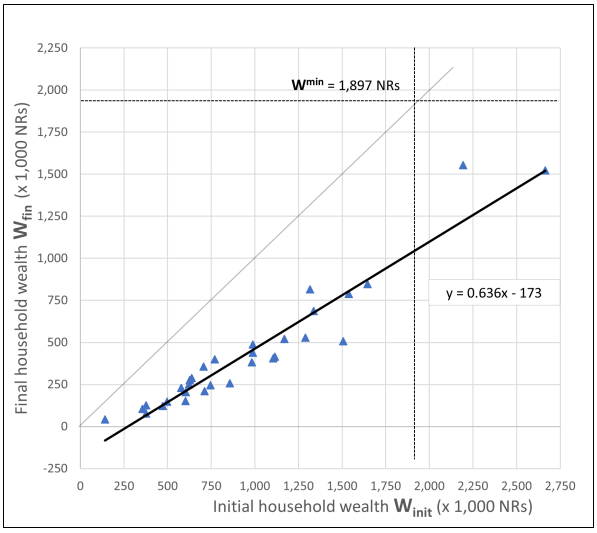

Figure 8: Household wealth before and after the earthquake

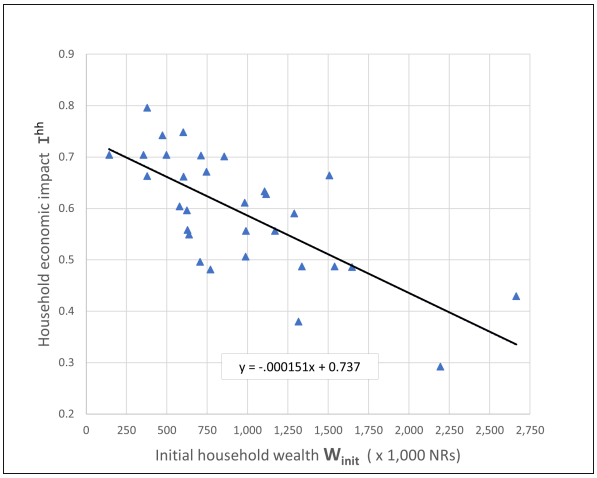

Figure 9: Household economic impact vs initial household wealth

Greater household wealth before the earthquake translates to a similar relative position after the

earthquake, as would be expected. But the points all fall well below the 45 degree line (which would indicate no change in wealth) and this reflects the significant losses caused by the earthquake to all of the population segments.

To show the proportional loss suffered by the respective population segments, Figure 9 shows the household economic impact I^{hh} paired with W_{init}. A clear negative relationship is observed with the following model estimation (with W in 1,000 NRs):

$$I^{hh} = 0.737 - (0.000151)W_{init} \quad (3)$$

This indicates that the poorer population segments indeed sustained greater household economic impact than the wealthier segments. This strongly supports observations in previous literature that disaster losses are more serious for households in lower socioeconomic standings, vis-à-vis those who are better off. The anti-poor bias of the disaster is evident in the downward slope of the estimation in Equation 3.

6. Discussion

These findings demonstrate the unequal effects of the Gorkha earthquake disaster on poor and on wealthier households in simple numerical terms. The contrast is quite striking, as the disaster takes a greater proportional toll from those who already have much less. These implications are especially serious given that most of the typical households profiled here already lie well below the minimum level of wealth W^{min} that the communities consider acceptable.

Without a detailed, comprehensive understanding of the specific context, the approach used here still gives a useful indication of the impact on the households, as a means to gauge its severity and to make comparisons. The discussion and deliberation in the CGDs resulted in clear and confident responses from the participants both about the minimum income question and about the holdings that would typify households in the respective population segments. The methodology adopted for the data collection shows potential for application in operational settings, where time and survey resources are limited, since it referenced "typical" households rather assessing actual individual households. Since it relied on subjective responses, it would be instructive to use empirical means to obtain comparable data in future research. More rigorous data collection procedures (such as household surveys) could be applied under the same conceptual framework.

It is important to consider the human realities reflected in the results. One criteria mentioned in the CGDs for a minimally acceptable level of well-being was having meat to eat at least once a week. This suggests that the subjective standard of well-being in this context approaches a subsistence level.

The fact that the communities involved in this research maintain a certain level of continuity and stability indicates that they rely heavily on other resources, apart from the local holdings assessed in this research. Further investigations should make a more comprehensive assessment of the means by which households sustain themselves economically. In particular, outside resources such as funds and remittances sent home by family members working in the cities or in other countries should be included in this assessment. Over the last decades, the migration of rural Nepalis to urban centers and the numbers of workers taking employment in other countries has continued to increase. At the time this research was conducted, the number of Nepalis working outside their country was at least 2.2 million, not including those working illegally in other countries, or not covered by official statistics [28]. The remittances sent back to Nepal by these workers were $6.28 billion in 2016, equal to 29% of Nepal's GDP [29].

Using the same terms (namely, the household economic impact I^{hh}), further research could also explore the divergent effects that result from different types of disaster events, or from dissimilar impacts on different assets held by affected population. In settings where households have more diverse wealth holdings, such as in advanced economies, this assessment would be less straightforward. The present research presents a very simple case, in that the earthquake primarily affected village houses, and these were also the main wealth holdings of the population. This highlights the importance of identifying critical community resources with a view to diversify, strengthen, or otherwise protect their important assets. In Nepal, the importance of cost-effective, earthquake-resistant construction methods to avoid catastrophic losses becomes clear. Village houses in Nepal were traditionally built with fieldstone and mud-mortar, often two or three stories high. The combination of relatively tall structures and

heavy construction materials with poor shear strength made them extremely vulnerable to lateral forces in an earthquake. As promoted by the National Reconstruction Authority, new building codes address these deficiencies in construction efforts since the earthquake.

7. Conclusions

As demonstrated here, the 2015 Gorkha earthquake exacerbated the underlying disparities between rich and poor by disproportionately affecting those who are already poor. This matches patterns observed in other disaster studies. The approach presented here provides a straightforward means of gauging this phenomenon in numerical terms, through a simple proportional measure that is easily interpreted. Pairing this measure with levels of income and wealth that are minimally acceptable in the community underscores the serious implications for households that are close to that level, or below it. As a straightforward means to compare dissimilar households and population groups, it could also provide a basis for analyzing and comparing different disasters in diverse contexts, and for considering practical ways to reduce disaster impacts. As discussed above, there is scope for further applying and adapting the participatory methodology used in this research. While household economic impact is an accessible, straightforward measure as presented here, it also shows potential for further conceptual development.

Acknowledgments

Sincere thanks to the Institute of Engineering, Tribhuvan University, for hosting the 11th Graduate Conference, and for making the presentation of this research possible. Also to local partners who assisted in the fieldwork, and to the communities who participated in this research.

References

[1] Alice Fothergill and Lori A Peek. Poverty and disasters in the united states: A review of recent sociological findings. *Natural hazards*, 32(1):89–110, 2004.

[2] Michael R Carter, Peter D Little, Tewodaj Mogues, and Workneh Negatu. Poverty traps and natural disasters in ethiopia and honduras. In *Social Protection for the Poor and Poorest*, pages 85–118. Springer, 2008.

[3] Abu Muhammad Sufiyan et al. Disaster and poverty: the differential impacts of disaster on the poor in the gulf coast region. 2014.

[4] UN-OCHA. https://www.humanitarianresponse.info/en/operations/nepal/document/nepal-earthquake-2015-situation-report-no20-3-june-2015. [Online].

[5] Stephen Starr. The Guardian. https://www.theguardian.com/cities/2018/dec/05/kathmandu-earthquake-debt-nepal. [Online].

[6] Komal Raj Aryal. Disaster vulnerability in nepal. *International journal of disaster risk reduction*, 9:137–146, 2014.

[7] Lulu He, Jonathan C Aitchison, Karen Hussey, Yongping Wei, and Alex Lo. Accumulation of vulnerabilities in the aftermath of the 2015 nepal earthquake: Household displacement, livelihood changes and recovery challenges. *International journal of disaster risk reduction*, 31:68–75, 2018.

[8] Amod Mani Dixit, Ryuichi Yatabe, Ranjan Kumar Dahal, and Netra Prakash Bhandary. Initiatives for earthquake disaster risk management in the kathmandu valley. *Natural hazards*, 69(1):631–654, 2013.

[9] Marcus Moench and Ajaya Dixit. *Adaptive capacity and livelihood resilience: Adaptive strategies for responding to floods and droughts in South Asia*. Institute for Social and Environmental Transition (ISET), 2004.

[10] SL Cutter, BJ Boruff, and LW Shirley. Social vulnerability. *Social Sciences Quarterly*, 84:242–261, 2003.

[11] Dipendra Gautam. Assessment of social vulnerability to natural hazards in nepal. *Natural Hazards and Earth System Sciences*, 17(12):2313–2320, 2017.

[12] Sanam K Aksha, Luke Juran, Lynn M Resler, and Yang Zhang. An analysis of social vulnerability to natural hazards in nepal using a modified social vulnerability index. *International Journal of Disaster Risk Science*, 10(1):103–116, 2019.

[13] Piers Blaikie, Terry Cannon, Ian Davis, and Ben Wisner. At risk. *Natural hazards, people's vulnerability and disasters*, 1994.

[14] Pascal Peduzzi, Hy Dao, Christian Herold, and Frederic Mouton. Assessing global exposure and vulnerability towards natural hazards: the disaster risk index. *Natural hazards and earth system sciences*, 9(4):1149–1159, 2009.

[15] P Ashdown. Humanitarian emergency response review (herr). *Department for International Development, UK, March*, 28, 2011.

[16] Abhas K Jha. *Safer homes, stronger communities: a handbook for reconstructing after natural disasters*. World Bank Publications, 2010.

[17] Mary Baughman Anderson and Peter J Woodrow. *Rising from the ashes: development strategies in times of disaster*. Routledge, 2019.

[18] IFRC. Owner driven housing reconstruction guidelines. 2010.

[19] Theo Schilderman and Michal Lyons. Resilient dwellings or resilient people? towards people-centred reconstruction. *Environmental Hazards*, 10(3-4):218–231, 2011.

[20] National Research Council et al. *National earthquake resilience: research, implementation, and outreach*. National Academies Press, 2011.

[21] World Bank. Poverty and shared prosperity: Piecing together the poverty puzzle, 2018.

[22] Michael R Carter and Christopher B Barrett. The economics of poverty traps and persistent poverty: An asset-based approach. *The Journal of Development Studies*, 42(2):178–199, 2006.

[23] Aline Coudouel, Jesko S Hentschel, Quentin T Wodon, et al. Poverty measurement and analysis. *A Sourcebook for poverty reduction strategies*, 1:27–74, 2002.

[24] Jonathan Haughton and Shahidur R Khandker. *Handbook on poverty+ inequality*. World Bank Publications, 2009.

[25] Lasse Krantz. The sustainable livelihood approach to poverty reduction: An introduction. *Swedish International Development Cooperation Agency*, 2001, 2001.

[26] Surya Gyawali, Sudarshan Raj Tiwari, Sushil Bahadur Bajracharya, and Hans Narve Skotte. Promoting sustainable livelihoods: An approach to postdisaster reconstruction. *Sustainable Development*, 28(4):626–633, 2020.

[27] Paul B Siegel and Jeffrey Alwang. An asset-based approach to social risk management: A conceptual framework. 1999.

[28] Anup Kaphle. The Washington Post. https://www.theguardian.com/cities/2018/dec/05/kathmandu-earthquake-debt-nepal. [Online].

[29] World Bank Open Data. https://https://data.worldbank.org/. (2016), [Online].