Reply on RC1

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Author comment on "Integrated seismic risk assessment in Nepal" by Sanish
Bhochhibhoya and Roisha Maharjan, Nat. Hazards Earth Syst. Sci. Discuss.,
https://doi.org/10.5194/nhess-2021-354-AC1, 2022

Thank you very much for the comment. We hope the following description addresses your comments:

1. Casualty risk analysis:

• Our study is inspired by the theoretical concept designed by Cutter (1996) and Cardona (2005). Basically, the idea is to combine the components of natural hazards threat (seismic hazard), potential economic losses (seismic risk), and social vulnerability by binding them to particular places.

• The main objective of our study is to compute probabilistic risk analysis (physical risk) from the exposure model and physical vulnerability model (probability of loss at a given intensity level) of the country and then integrate the results with the socio-economic parameters. The average annual loss is taken as physical risk, as done in the studies of Burton and Silva[1]; and Chaulagain[2] (for Nepal). Hence, just as in those studies, all other estimations like casualties, non-structural damage, business interruption is assumed as proportional to that of building damage cost.

• We agree that the detailed casualty analysis might improve the hazard analysis, but this study is primarily focused on combining seismic-physical risk and social vulnerability i.e., integrated risk analysis (seismic hazard aggravated by social factor).

• In the conclusions, it is stated that 'The authors are aware of the fact that numerous estimations such as casualties, non-structural damage, business-interruption loss and loss to critical infrastructure may improve the indicator of physical risk'. However, only economic losses to buildings are utilized at this stage as an initiation for integrated seismic risk analysis in Nepal. (line 374-375).

• Table 1 in the paper has been presented to demonstrate the death numbers as a result of historical seismic events as a part of the literature review.

2. Counterfactual risk analysis:

• We hope that the future seismic hazard and risk analysis involve the counterfactual risk analysis. "If the shaking in 2015 had been some other day, the repercussions would have been more intense." Such counterfactuals are based on experts' hypotheses and convenience[3]. However, our procedure to assess the hazard curve and seismic losses is a completely probabilistic approach void of such counterfactuals. As previously mentioned, our main focus is to calculate integrated earthquake risk for Nepal. So, for physical risk, we have quantified the casualty in terms of estimated losses for a collection of assets within the seismic risk analysis.

3. Census:

• The detailed report of Census 2001[4] was published in December 2003 (two years after the census). In the case of Census 2011, the national report[5] was published in November

2012 (one year after the census), while its detailed monograph[6,7] was published in December 2014 (three years after the census). Now for the 2021 census, delayed due to the COVID pandemic, the census survey that was supposed to be conducted in early 2021 was delayed to late December. A rough estimate of total populations has been announced as January 24, but a detailed report and data availability might take a year or more, just like the previous two censuses. However, we really hope that the detailed report will be made available soon so that an advanced study integrating every possible uncertainty and requirement can be conducted.

[1] Burton, C.G., Silva, V., 2016. Assessing integrated earthquake risk in OpenQuake with an application to Mainland Portugal. Earthquake Spectra 32, 1383–1403.

[2] Chaulagain, H., Rodrigues, H., Silva, V., Spacone, E., Varum, H., 2015. Seismic risk assessment and hazard mapping in Nepal. Natural Hazards 78, 583–602.

[3] King G, Zeng L. The dangers of extreme counterfactuals. Political analysis. 2006;14(2):131-59.

[4] Central Bureau of Statistic (CBS), 2003. Population Monograph of Nepal

[5] Central Bureau of Statistic (CBS), 2012. National Population and Housing Census 2011 (National Report).

[6] Central Bureau of Statistic (CBS), 2014a. Population Monograph of Nepal Volume I (Population Dynamics).

[7] Central Bureau of Statistic (CBS), 2014b. Population Monograph of Nepal Volume III (Economical Demography).