

## Reply to second round of reviewer comments on NHESS-2024-1300

We thank the reviewers for their further comments on our manuscript: “A participatory approach to determine the use of road cut slope design guidelines in Nepal to lessen landslides” by Ellen B. Robson, Bhim Kumar Dahal and David G. Toll.

Below we provide detailed responses to these comments and the edits made to the manuscript. The reviewer’s comments are shown in black text, while our responses are in blue text. We highlight the added text in bold and strike out the deleted text.

### Reviewer 1 (R1)

Discussion:

(R1-00) The use of road construction as a political bargain is a recurring theme in the text; however, the paper doesn’t explore recommendations to tackle this issue.

(Reply to R1-00) Thank you for this comment. We believe that we have adequately addressed this in the general recommendations section where we state:

‘We found that politicians can have a negative impact on landslide risk by prioritizing rapidly expanding road lengths (and widths) to gain popularity, instead of constructing well-designed roads with safe road cut slopes. We suggest that politicians can improve their priorities in road construction by coordinating more effectively with other stakeholders in road slope management and road users and recognizing road slope management as a key component in their disaster risk management protocol to commit to the SFDRR.’

In the newly added section on ‘Future research recommendations’ we have now added: **‘This study points out that politicians in Nepal use roads as a political bargaining tool. We suggest that further research should be conducted to investigate how political influence in road construction can contribute to landslide risk. We have two suggestions for the main lines of investigation into this topic: (1) research conducted to understand how road construction varies over time within an election cycle, so that the impacts following an election can be anticipated; and (2) how the link between political concerns, road construction, and road failure varies across different parts of the country. As a starting point, we need to better understand the distribution of roads, road construction, and road cut slope failures in space and time.’**

Conclusions:

(R1-01) While the study offers valuable insights for Nepal, especially regarding technical recommendations, it is essential to expand on the broader implications and applicability of these conclusions to other regions facing similar challenges. This particularly pertains to weighing the advantages and limitations of participatory

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approaches rather than providing specific technical recommendations for road cut slope design in Nepal, which are already covered in the Results and Discussion.

(Reply to R1-01) Thank you for your comment. We believe that we have already expanded on the broader implications and applicability of this study in the general recommendations section of the conclusions. We have now edited these into a bulleted list to make readability clearer:

‘This study highlights the roles and responsibilities that key stakeholders have in road slope management and improvements that these stakeholder groups can make to reduce the risk of road-related landslides. These improvements are relevant to other LIC/LMICs that need to improve the management of road-related landslide risk in line with the SFDRR (e.g. Bhutan and Ethiopia - Hearn and Massey (2009), the mountainous regions of India - Sana et al. (2024), Indonesia - Diara et al. (2022), Malaysia - Rahman and Mapjabil (2017)), and include:

- Policymakers need to set standards and laws for road slope management processes, and ‘encourage the establishment of necessary mechanisms and incentives to ensure high levels of compliance’ with these standards and laws (UNDRR, 2015, p. 17).
- Policymakers need to define and clarify a protocol for land acquisition and compensation, quality assurance checks, and spoil disposal, and provide incentives to encourage compliance with this protocol.
- We also suggest that they need to define the protocol and provide incentives for the uptake of clear guidelines.
- We found that politicians can have a negative impact on landslide risk by prioritizing rapidly expanding road lengths (and widths) to gain popularity, instead of constructing well-designed roads with safe road cut slopes. We suggest that politicians can improve their priorities in road construction by coordinating more effectively with other stakeholders in road slope management and road users and recognize road slope management as a key component in their disaster risk management protocol to commit to the SFDRR.
- Engineers and technical specialists have a crucial responsibility in designing and excavating road slopes so that they do not contribute to landslide risk. The responsibility that they have in disaster risk reduction should be conveyed to them more clearly in their training.

The coordination of these key stakeholder groups is crucial to ensure that road slope management is effective in reducing the risk of road-related landslides.’

To address your suggestion on weighing the advantages and limitations of participatory approaches, we have added the following to the section on ‘Future research recommendations’:

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**‘Finally, we believe that this participatory study has successfully gathered the experiences and perspectives of Nepali road engineers on the use of the current guidelines and how they can be improved. However, as stated in the limitations section, this study (and participatory study of any kind) is subject to biases introduced by the involvement of participants. Despite this, we recommend that a participatory study of this kind can be replicated in other LIC/LMICs that need to improve the management of road-related landslide risk, to ensure that improvements are made in line with the needs of road management stakeholders.’**

(R1-02) The conclusions section is lengthy, content overloaded in duplicated content from previous sections, particularly in terms of technical recommendations. A concise summary of both the gaps/challenges and the recommendations is necessary to enhance clarity and impact.

(Reply to R1-02) Thank you for highlighting this. We have now cut down the text in the conclusions section to remove repetition, particularly in the technical recommendations section.

(R1-03) Next steps should prioritize future research rather than detailing the requirements for new guidelines. Any text currently in that section should be relocated to the discussion to maintain relevance, while a clear research outlook should be articulated. The conventional statement of: “Future research should focus on...” in alignment with emerging/remaining knowledge gaps and/or methodological limitations encountered.

(Reply to R1-03) Thank you for this suggestion. We have now moved the original text in the next steps subsection into a subsection at the end of the discussion titled ‘Next steps for guideline development’. We have then added a new subsection at the end of the conclusions titled ‘Future research recommendations. This includes the following text:

**‘This study points out that politicians in Nepal use roads as a political bargaining tool. We suggest that further research should be conducted to investigate how political influence in road construction can contribute to landslide risk. We have two suggestions for the main lines of investigation into this topic: (1) research conducted to understand how road construction varies over time within an election cycle, so that the impacts following an election can be anticipated; and (2) how the link between political concerns, road construction, and road failure varies across different parts of the country. As a starting point, we need to better understand the distribution of roads, road construction, and road cut slope failures in space and time.’**

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We suggest that further research is needed on effective coordination and communication between stakeholders in road slope management.

This study also underscores the challenges of interdisciplinary work within disaster risk reduction (Donovan et al., 2023). We suggest that there is a need to develop vocabularies and best practices for interdisciplinary research and action at the intersection of roads, risks, and resilience.

Finally, we believe that this participatory study has successfully gathered the experiences and perspectives of Nepali road engineers on the use of the current guidelines and how they can be improved. However, as stated in the limitations section, this study (and participatory study of any kind) is subject to biases introduced by the involvement of participants. Despite this, we recommend that a participatory study of this kind can be replicated in other LIC/LMICs that need to improve the management of road-related landslide risk, to ensure that improvements are made in line with the needs of road management stakeholders.'

#### Reviewer 2 (R2)

Technical comments:

(R2-00) Line 20 – using a new sentence starter instead of “whilst”. Either needs to be a conjunction or a different word to start the sentence. Reads awkwardly as is.

(Reply to R2-00)

Thank you for recognising this. We have revised the manuscript to remove ‘While’ so it now starts with ‘The’.

(R2-01) Line 90 – the transition from line 89 to the new para on line 89 does not flow well. Not sure it needs to be a new paragraph. You could remove the sentence beginning “It is argued that these geopolitical...” and go straight from “... projects.” Into “Thus, and as argued by Rosser et al and KC et al (maybe remove ref to Robson et al 2021 which is used quite a lot throughout), landslides in Nepal tend to be caused by a complex interplay of geophysical and geopolitical processes that are challenging to unpick and address (also see later comment re. importance of speaking across disciplines etc).

(Reply to R2-01) Thank you for this suggestion. The manuscript has been updated as per your suggested revised sentence structure:

‘Key findings of this research were that roads were being haphazardly constructed, that there is poor communication between the key stakeholders, and that slope stabilization is not prioritized in road construction projects. **Thus, and as argued** by Rosser et al. (2021) and KC et al. (2024), landslides in Nepal are caused by a complex interplay of geophysical and geopolitical processes that are challenging to unpick and address.’

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(R2-02) Line 157 – 166 – It feels like there’s quite a bit of repetition in this paragraph. Consider paring down so that you only reference Paudyal and Robson refs only one or twice.

(Reply to R2-02) Thank you for highlighting this. We have updated the paragraph to read to remove repetition of citations.

(R2-03) Line 208 – Note typo on Gill reference.

(Reply to R2-03) Thank you for highlighting this. We have updated the manuscript to fix this error.

(R2-04) Line 279. Feels like the sentence starting “However” should come before Fig 3.

(Reply to R2-04) We have updated the manuscript as per your suggestion.

(R2-05) Line 515 – As I read this, I find myself thinking there is something to say here about the challenges of interdisciplinary working for DRR (e.g. Donovan et. al, 2023), which also links nicely to your conceptual section where you outline that landslides/disasters are characterised by complex interactions between the geophysical and geopolitical (consider adding specific reference to interdisciplinarity in the last bit of section 2.1?). In short, is there scope to mention this as an area for future research? I.e., mention that there is a need to develop vocabularies and best-practices for interdisciplinary research and action on the links between roads, risks, and resilience? Whether this comes around this section or nearer the end would be up to you.

(Reply to R2-05) Thank you for this suggestion. We have added the following paragraph to the section on ‘Future research recommendations:

**‘This study also underscores the challenges of interdisciplinary work within disaster risk reduction (Donovan et al.,2023). We suggest that there is a need to develop vocabularies and best practices for interdisciplinary research and action at the intersection of roads, risks, and resilience.’**

Reference(s)

Donovan, A., Morin, J., & Walshe, R. (2023). Interdisciplinary research in hazards and disaster risk. *Progress in Environmental Geography*, 2(3), 202-222.