

## ***Interactive comment on* “Community-based landslide hazard probability and risk assessment: A case in west Hubei, China” by Sheng Fu et al.**

**Sheng Fu et al.**

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Dear Referee,

Thank you very much for your professional comments on our manuscript. These comments are all valuable and helpful for revising and improving our manuscript.

To keep manuscript turnover times low, we respond to you how we plan to revise and what we have done. We will submit the revised manuscript later as soon as possible.

General comments

First, it is important to clarify that the two versions of the manuscript were reviewed (August 23rd and October 22nd) and I can affirm that the manuscript improved largely

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in the second version. My comments refer to the version contained in the document named “nhess-2019-259-AC1-supplement”.

The manuscript contains the results of a solid and detailed research on hazard and risk at a local scale in the Hubei province in China.

In general terms, the ideas of the authors are clear. However, the document presents several grammatically awkward sentences, expressions that should be checked and lacks connections among the sentences. Therefore, proofreading and English editing services are recommended to ensure that the English of the manuscript is up to the publication standard.

Responses: Thank you very much for your comments. We will make great efforts to improve the language as best as we can by proofreading and English editing services, sorry for the grammatically awkward sentences and expressions.

Specific comments:

(1) The term Community-based leads the reader to think that the performed hazard and risk analysis involved members of the local community as part of a participatory methodology. In this case, it seems that you use the term “Community based” to refer to the scale of the analysis, more than the participants of the process. I would suggest to change the title accordingly. For example, in the introduction you used the more appropriate term “community-level”, or you could use something like local -level, community scale, or any other term that refers to the scale of your work.

In general, when using the term community, it is not always clear if it refers specifically to the Yuyanguan community, or if it is used to refer to a local scale. This creates confusion among the reader so I would suggest to check the manuscript and clarify this when necessary.

Responses: Thank you very much for your comments and suggestion. We used the term “community-based” in the manuscript to refer to the scale. In Chinese language

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the term “community-based” can refer to two senses: scale and administration. Sorry for the confusing words from Chinese to English. Community level is a good suggestion. We will change the title as ‘Landslide hazard probability and risk assessment at the community level: A case in west Hubei, China’.

(2) The introduction contains all the necessary information. However, the current order generates confusion among the readers. I would suggest to switch the first and second paragraph and include some connectors. Additionally, the use of the future sentence should be avoided.

Responses: Thank you very much for your comments and suggestion. We will re-manage the order of the paragraphs. The future sentence and related language mistakes will be carefully checked and avoided.

(3) Considering that readers might not be familiar with China’s administrative division and geography, the study area description should be complemented with basic geographic and administrative information. It is clear that the area is in the Hubei province, but is not clear in which Prefecture and/or County the communities are located, and what villages the selected communities include. Additionally, it would be interesting to mention when the area started to be inhabited and if there has been any recent intense urbanization development, considering that one of the landslide triggers are man-made actions, such as roads construction.

Responses: Thank you very much for your comments and suggestions. We complement some necessary information about the geography and villages in the selected community. Meanwhile, it is a very good suggestion to state the urbanization of the community, which is very helpful for readers to understand the triggers of the landslides. We will revise the first paragraph in part 2 as: The current study area, Yuyangguan community (N 30°03′- 33°15′, E 110°08′- 110°08′), is located in Wufeng county, western Hubei province, China (Fig. 1). It covers an area of about 34 km<sup>2</sup> and includes 15 villages, such as Sanfangping, Dafangping, Caojiaping etc. The

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community started to be inhabited about 750 years ago, and intense urbanization development and the national road construction crossing the community began in 2012. The study area was selected due to frequent landslide activities and caused subsequent damages in recent years. The residential area is surrounded by steep slopes, with an elevation of 180 to 680 m.a.s.l. The climate is characterized as a typical monsoonal climate, with an average annual precipitation of about 1500 mm.

(4) Since in some points you focused only in Yuyangguan community and in some others, you complement it with information of and Chengguan community (i.e. line 175), I would suggest to clarify since the beginning what is the goal and scale of the analysis in both communities.

Responses: Thank you very much for your suggestions. The objective of the manuscript is to assess landslide risk for Yuyangguan community. But when we analyze the size probability, it is found that the samples of the historical landslides are not sufficient for statistical analysis in size probability. So, we complement some other samples from the neighboring Chengguan community, considering that historical landslides and geological environment are similar in both two communities. We will complete more detailed information about the similarities in Line 98 of the manuscript version of 'nhess-2019-259-AC1-supplement': Administratively, these two communities are in one county called Wufeng. Geologically, both communities belong to the same geological structure belt named Changleping anticline fold which extends nearly east-western direction. The formation consists of the Silurian and Ordovician rocks. Landslides occurred in these two communities are same types as shallow and soil slope movement in weathered bedrock. The triggering factors of the landslides are rainfall and slope cutting in urbanization development.

(5) In the methodology section I suggest to include a figure with a conceptual map of the different components of the hazard and risk analysis process.

Responses: Thank you very much for your suggestions. We will include a figure for

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the methodology as following attachment of Fig. 7 Flow chart of the methodology for landslide hazard risk assessment.

#### Technical corrections

(1) The last sentence of the introduction is confusing “This achievement may also be utilized into community scale landslide risk assessment in a mountainous area in Hubei, China.” I would suggest you to check the whole paragraph in order to articulate the different sentences, while avoiding repetition.

Responses: Thank you very much for your comments. We checked the whole paragraph and agree with you to avoid repetition. The whole manuscript will be improved in language and expressions.

(2) In Fig. 1, please clarify what each inset represents at administrative or geographical level. Inset (b) seems like a province but it looks deformed, and is not clear what the limits of inset (c) correspond to. Maybe you can try by adding thin administrative division lines at prefecture level. Additionally, it is recommended to include a frame in the bigger map to show where the zoom area is located (as done in Fig. 8).

Responses: Thank you very much for your comments and suggestions. Insert (b) is a county called Wufeng, which includes the studied community Yuyangguan. Insert (c) is a zoomed area (the study area of Yuyangguan community) from insert (b). Sorry for the confusing. We added some necessary lines in Fig 1 (please see the attachment of Fig 1).

(3) Line 63, check the phrase “Weathered rocks in Silurian are the primary source of landslides”, maybe you mean something like “As a consequence, weathered Silurian rocks are the primary source of landslides.”

Responses: Thank you very much for your comments and suggestions. The meaning here is what you understand. We will revise this in the manuscript as: As a consequence, weathered rocks in Silurian and Ordovician (O2g) are the primary source of

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landslides, the records of which and their bedrocks are shown in Table II.

(4) Line 64, the sentence “Weathered rocks in Silurian are the primary source of landslides” seems to contradict the affirmation of the introduction regarding that “that Quaternary deposits and weathered eluvium from Ordovician limestone are the two major controlling factors.” This confusion is presented again in the first paragraph of the section 5.1.

Responses: Thank you very much for your comment. We observed in the field that the source of majority landslides is from the weathered rocks in Silurian, and only two landslides in Yuyanguan are from weathered limestone in Ordovician. But in susceptibility analysis, we find that the weight of weathered rocks in Silurian is not the highest. It is because that the frequency of landslides in Silurian is lower than it in Ordovician, due to the area of Silurian in the map is much larger than the area of Ordovician. We will clarify the description with more details. Sorry for the confusing.

(5) Line 67, check the phrase “This fault is a seismic activity belt”, seems to refer more to “This fault is a seismically active belt”

Responses: Thank you very much for your comment. The phrase in the manuscript will be changed as ‘This fault is a seismically active belt’.

(6) Line 75, check the phrase “Rainfall and human activities contribute significantly to the slope movement”, could be something like “Rainfall and human activities contribute significantly to trigger mass movements. . .”

Responses: Thank you very much for your comment. The phrase in the manuscript will be changed as ‘Rainfall and human activities contribute significantly to trigger mass movements. . .’.

(7) Line 75, clarify that the mentioned landslides are just examples and connect this to the following paragraph.

Responses: Thank you very much for your comment and suggestion. One more sen-

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tence will be added in the end of this paragraph: These two landslides are examples, and more landslide records are prepared by aerial photos interpretation and then validated in field investigation.

(8) All maps. Yuyangguan and Chengguan communities should be labelled in all the maps.

Figure 5. Please remove the labels that do not correspond to locations, but to specific buildings, ex. School, health center, etc.

Fig.5, 8, 11 it is not clear why the zoom frame shows the area around Huanglongzhai, instead that Yuyangguan or Chengguan

Responses: Thank you very much for your comment. Because of the non-sufficient description on the studied community, the following figures in the manuscript gave you a confused impression. Figures of 5, 8 and 11 are for the area of Yuyangguan community, the zoom frame in which shows an area with high risk slopes and buildings. Sorry for the confusing and we will revise all the figures in labels after carefully checking.

(9) Table II. I would suggest to organize the landslides by date, in order to allow the reader to have an idea of recurrence.

Responses: Thank you very much for the good suggestion. We will re-organize the landslides by date.

(10) Line 148, explain what  $W^-$  and  $W^+$  corresponds to.

Responses: Thank you very much for the good comment. We will add the explanation for  $W^-$  and  $W^+$  as: In WoE method,  $W^+$  and  $W^-$  were used as the weights where the evidence was present or absent respectively, thus the contrast (difference of  $W^+$  and  $W^-$ ) was used as a weight for each morphometric or geo-environmental factor.

(11) Line 238. I suggest to support the affirmation "Assuming that the past is the future, landslides in the study area will probably occur with the same amount of landslides over

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the next 50 years as the past 50 years.” That, considering Climate change, but also the anthropic incidence as landslide trigger. That affirmation depends largely in the history of the area, i.e. if the area has sustained a stable urban development in the last 50 years the affirmation is valid, but if it is not the case, then the affirmation should be supported with strong arguments.

Responses: Thanks for your very good comments. We are agreed with your idea that the affirmation depends largely in the history of the area. While dealing with the landslide issues, the hazards are increasingly connected with human activities and climate change which are becoming as the active triggering factors. If we purely consider the landslide from controlling geological factors, the sense of “assuming the past is the future” seems to be reliable during short period of decades or centuries comparing to geological time scale. In order to simplify the hazard probability calculation in this study, we used this assumption even it has limitation for the future. Anyway, the expression of the assumption is too deterministic, so we modified the expression softer as “assuming the past reflects the future”. We have also discussed this limitation in section 5.3. More details are added about the possible changes in line 359 to line 361. Of course, further study and development are being taken in our research now following your constructive comments.

(12) Line 253. Please include some arguments to support the decision of using 50 000 cubic meters and 100 000 cubic meters for the size scenarios, since, according to Table II, there have been historic landslides with a considerably larger volume.

Responses: Thanks for your very good comments. We will implement some sentences at the end of the paragraph: In fig. 10b, we find that the number of landslides begins to increase rapidly when the volume is greater than 50 000 cubic meters, which represents a probable threshold value for landslide hazard volume. While, the value of landslide volume larger than 100 000 cubic meters can represent the majority number of landslides as shown in Fig. 10b. Also, the value of 100 000 cubic meters is a standard threshold for landslide classification provided by China Geology Survey and

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widely accepted value in landslide hazard risk control in China.

(13) Fig. 10 (b). Correct the label of Number of landslides

Responses: Thanks for your comment. We will correct the label of 'Number of landslides'.

(14) Line 322, please check the wording of the last sentence of this paragraph.

Responses: Thank you very much for the comment. We will carefully revise the last sentence of this paragraph in grammar and wording.

(15) Line 360, maybe you refer to "the number of landslides", instead than "the number of historical". Please check.

Responses: Thank you very much for the comment and suggestion. We will add the missing word "landslide".

(16) Line 364, regarding the affirmation "... risk management on slope units with very high-class hazard probability and very high-risk can be suggested as relocation or engineering works," the decision to relocate people is a delicate one, and should be taken based in a large array of information, not solely in risk maps of not detailed scale. In this case, I would suggest to review the affirmation and to propose a more detail geotechnical analysis of the very high-class areas, instead than inviting to relocate the people based solely in these results.

Responses: Thank you very much for your comments. We totally agree with you that the decision of relocation or engineering works on slopes with very high-class hazard probability and very high-risk must be considered based on large array of information. The regional risk zonation is informative for planning. But for specific site treatment, it is essential to complement geotechnical analysis which gives strong support for decision-making. So, we have corrected expression in the context.

We will revise the last paragraph in section 5.3 as: From susceptibility to risk assess-

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ment, in general it is assumed that landslide will occur under the same condition where historical landslides occurred. However, morphometric, geo-environmental conditions will change with time. For example, the slope degree, elements at risk and land use cover may change because of the new infrastructures, or the number of historical landslides will increase due to heavier rainfall. Future studies are necessary in terms of the changing conditions for more accurate results and more practical applications. So far, the series of maps can be referred as the basis for landslide risk control and land use planning in Yuyangguan community. Risk controlling measurements can be planned on each slope unit using a matrix from the combination of landslide hazard probability and risk maps. For example, risk management on slope units with very high-class hazard probability and very high-risk can be suggested as relocation or engineering works. The precondition is that more detailed geotechnical investigation and comprehensive analysis is complemented. While, the slopes with high-class hazard probability and mid-class risk are suggested as monitoring programs if it is important for the safety of the surrounding population, roads, or other elements at risk. Meanwhile, the results of the four return periods and two size scenarios can be used for multi-temporal land use planning, such as short term (in 5-year), mid-term (10-20-year), and long-term (50-year). The annual risk value on each slope can be used for cost-benefit analysis in risk decisions. Meanwhile, the studies answer the question raised by Guzzetti et al. (2005) that how to combine a large number of hazard maps efficiently for different users.

(17) Line 368. Check the sentence coherence.

Responses: Thank you very much for your comments. We will carefully check the sentence coherence and grammar.

We tried our best to improve the manuscript and will make changes in the manuscript. We feel great thanks for your professional review work on our article, and hope that the corrections and responses will meet with approval.

Looking forward to your reply.

Sincerely, Lixia Chen

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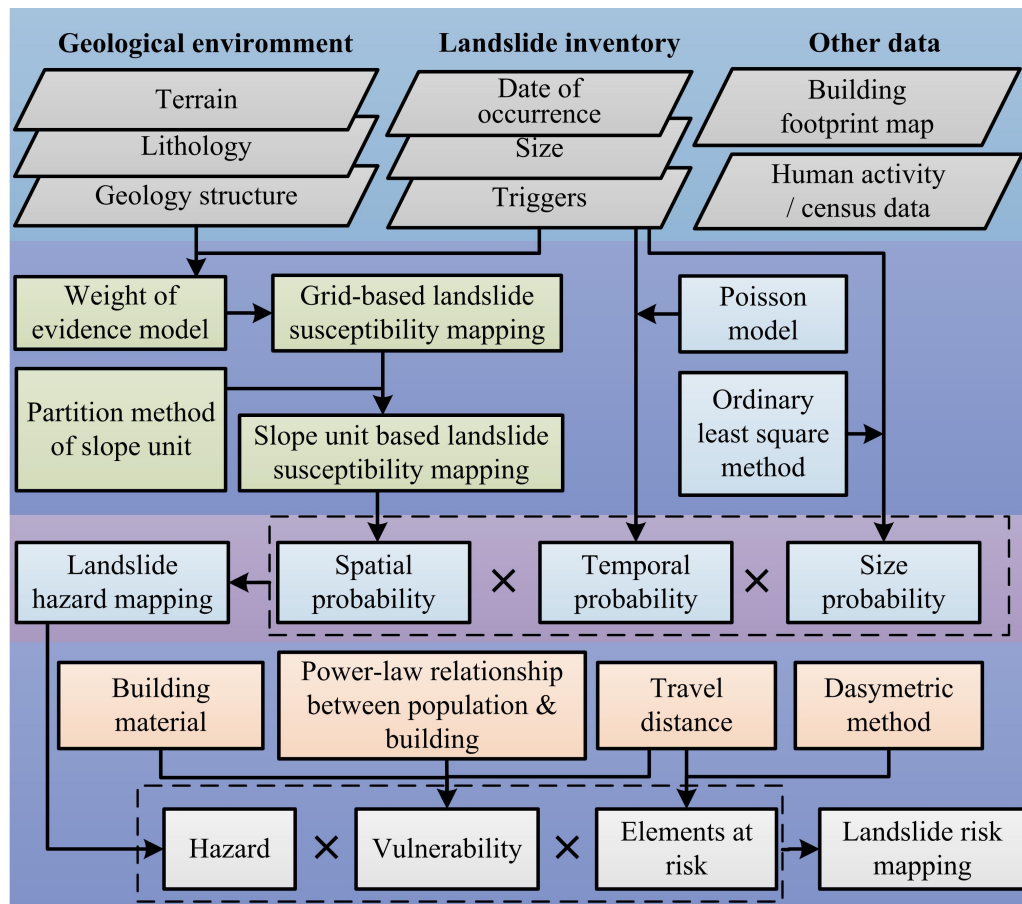
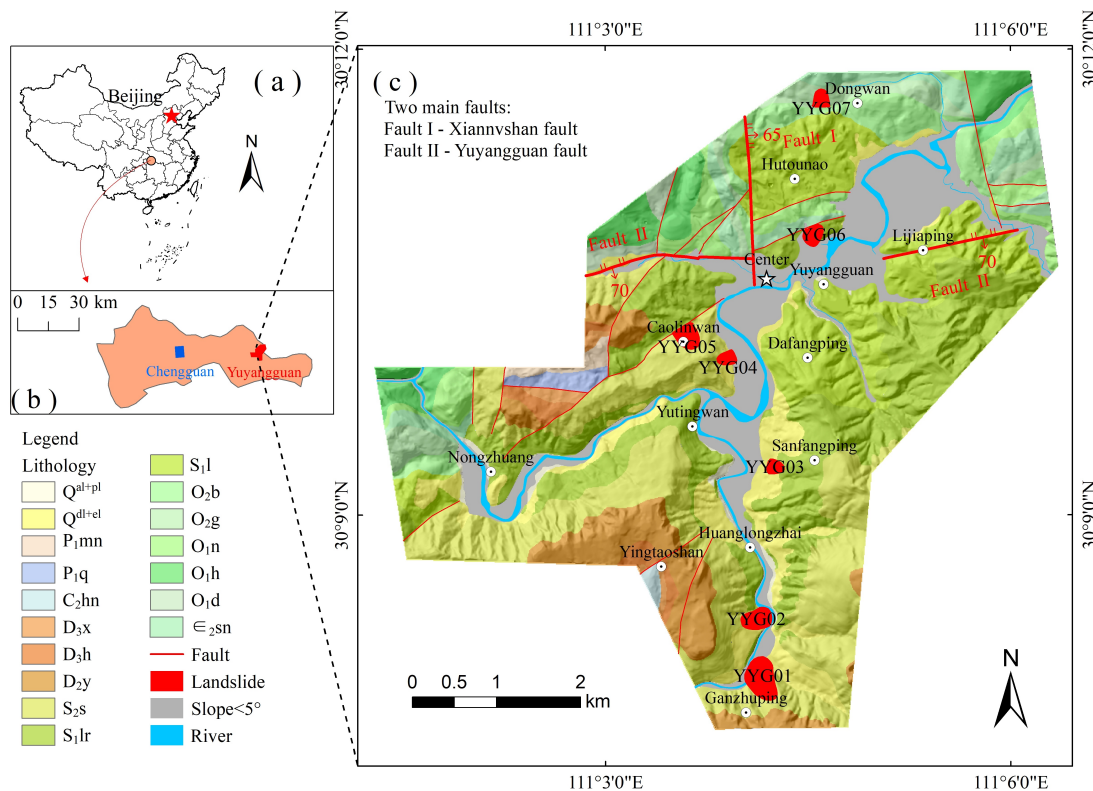


Fig. 1. Fig. 7 Flow chart of the methodology for landslide hazard risk assessment



**Fig. 2.** Fig. 1. a) Inset showing the map of China with the color (b) Representing the county which includes the case community Yuyangguan and the neighbor community Chengguan. c) Shows the distribution of lit

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