

## ***Interactive comment on “An integrated methodology to develop a standard for landslide early warning system” by T. F. Fathani et al.***

### **Anonymous Referee #1**

Received and published: 21 June 2016

::: General comments :::

Dear authors,

I have been invited to review your manuscript titled "An integrated methodology to develop a standard for landslide early warning system" submitted to NHSS. Although I am terribly busy at the moment, have just finalised two other reviews and promised myself not to review anything in the next month, I could not resist as the topic of LEWS is very interesting and also my field of interest.

I very much appreciate the topic of the manuscript as it deals with landslide early warning systems but does not only focus on technical instruments. There are not many papers that highlight the importance of societal aspects of early warning and relate their works to all the four key elements of UN-ISDR.

C1

Based on my review, I suggest some revisions. Please find my comments and suggestions below.

Best regards and keep up your good work, another reviewer

::: Specific comments :::

Language: Overall, the language and grammar are ok but there are still some issues that require a revision, preferably by a native speaker. I pointed out some mistakes but I guess that there are more. For example, in the title, it should be systems, not system.

Introduction: This section gives a reasonable introduction to the topic but then explains debris flow EWS as one example of an EWS. I find this strange because there are so many local and regional scale LEWS (not necessarily for debris flows) but 'the debris flow EWS' is noted as if it were the only EWS. You should rather give some examples of explicit LEWS examples. I suggest having a look at 'Thiebes 2012: Landslide Analysis and Early Warning Systems. Springer Thesis Series. DOI 10.1007/978-3-642-27526-5, download here: <http://othes.univie.ac.at/15245/>' and 'Thiebes, B. & Glade, T. (2016): Landslide early warning systems – fundamental concepts and innovative application. In: Aversa, S., Cascini, L., Picarelli, L. & Scavia, C. (eds.): Landslides and Engineered Slopes. Experience, Theory and Practice. Proceedings of the 12th International Symposium on Landslides, 1903–1911. DOI: 10.1201/b21520-238' – these are also a lot newer than the ones you mention later on (i.e. Glade and Wieczorek 2005 and Guzzetti 2008).

Scale: You do not mention in the manuscript that you are only dealing with local scale / single landslide LEWS. I think it would be good to point this out in the introduction.

Universality: You aim to develop a universal concept for LEWS implementations, however, you frequently refer to conditions that are typical for tropical conditions, e.g. the rainy season. So, I am asking myself how universal it is in the end. I actually think that the concept is also applicable to non-tropical countries and I therefore suggest to

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slightly rewrite the sections where you refer to conditions that are related to tropical countries, e.g. by highlighting that in your case certain activities were carried out relative to the rainy season but that in other parts of the world the timing should be chosen differently.

Evacuation map: When I worked on LEWS in SE-Asia, I found a public evacuation map in the village centre to which everyone was invited to contribute by adding new landslide features that were found during field inspections. I am not recommending you to add this to the manuscript but rather to consider this for your upcoming activities. I guess that such a map is probably easier to accept by the local population.

Warning levels: The lowest level is already 'caution'. Why have you decided to not have a green level which means everything is ok? Wouldn't that be useful? By having a green level, it is easy to see that the system is still working and it reminds people that they have a system. Again, nothing that needs to be integrated in the manuscript, rather meant for food for thoughts.

Legal aspects: Legal aspects are not dealt with - these frame the possibilities for an LEWS to a large extent and it should be mentioned that they are not discussed in the paper.

Figure 2: Would it make sense to include the inspection of a trained officer as a sensor? Presently, it seems like the opinion of the trained officer is a shortcut to a warning, i.e. the decision on the warning is not issued by local authorities (decision maker). Similarly, it seems like the local control centre can directly issue a warning - another intentional shortcut? In any case, please elaborate the issuing of a warning a bit more and consider to add a couple of sentences on how a warning should be issued and what the chain of information and decision making is.

Installation of monitoring equipment (page9): I was a bit confused when I read this because for some time I thought that the sensors are only installed in the field when there is already a landslide warning. After reading it again, I think this is not the case –

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you were only explaining that the SOP have to be implemented and then the sensors are installed. Maybe try to write this a bit clearer.

Warnings based on rain gauge measurements: I am not entirely happy with this as rainfall thresholds strongly depend on landslide types and previous knowledge. Without long time-series it is difficult to estimate the critical rainfall conditions. And even if you have long time series, what kind of threshold do you use? Hourly rainfall, daily rainfall, intensity-duration, antecedent rainfall... there are so many options. And then small landslides might be triggered by intense rainfall but large events rather because of rainy seasons with high total rainfall. How to determine the critical threshold if no monitoring system is yet available?

Determination of warning thresholds (not rainfall thresholds!) by experts: Should the local population or the mayor/head of the village be involved in this? This would increase the acceptance of false alarms and missed events. If the community wants to make sure that no alarms are missed, they have to deal with more false alarms; if they do not want false alarms, they might have some missed alarms for minor landslide events. Wouldn't the involvement of users increase the acceptance of false/missed alarms and the LEWS in general?

In your manuscript, you suggest 7 sub-systems for LEWS and relate this to the 4 elements of UN-ISDR. I completely agree with you that the 7 sub-systems make sense and include important activities. However, by adding them 'outside' of the 4 UN-ISDR elements you weaken the overall concept and are from my understanding not consequent. Actually, all the new-subsystems can comfortably be included within the 4 pillars of UN-ISDR. Sub-systems 3, 4 and 5, for example, are from my point of view part of the RESPONSE (UNISDR element 4). I recommend to redraw figure 1 and to add your sub-systems as parts of the 4 main elements. By doing so, your concept is better connected to the larger framework without losing any detail.

::: Technical corrections :::

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Locations of the figures and the table are unclear as it is not mentioned in the text where they should appear.

P1 L8-9: landslides do not occur more often in areas of high population and low accessibility - it is rather that cause more disastrous effects there. Please rewrite a bit.

P2 L1-2: 'One example of efforts to implement the system is the debris flow early warning system.' - There are many examples of LEWS, not necessarily focussing on debris flows. And why 'the' debris flow EWS'? I suggest to change to 'one example are debris flow EWS'.

P2 L14: please add some more recent publications and dedicated LEWS reviews (I suggested some in the general comment section).

P4 L10: Capital letter in the beginning of the sentence.

P4 L27: the grammar in the sentence beginning here is not correct.

Citation Yueping. I think this Yueping Yin from the Geological Survey of China - where Yin is the last name. Please double check.

P6 L25: conventional and radar methods? This should be rather remote, proximal or close-range monitoring. Also correct in Figure 2.

P8 L2: end of the dry season. Do you have only tropical countries such as Indonesia in mind or theoretically all parts of the world. Mentioning the dry season hints the former. Please check.

P8 L24: should be plural: surveys

P10 L6: use the abbreviation SOP again.

P11 L13: see SOP comment above.

Figure 3: There is a typo in the figure: 'Universitas Gadjah Mada ini cooperation with private sectors' should rather be 'Universitas Gadjah Mada in cooperation with private

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partners/companies'. Are all the marked points implemented LEWS? This was not entirely clear to me. If yes, then please add this as a legend header, e.g. 'implemented landslide early warning systems' The word 'Legend' can be deleted as this is obviously a legend.

Figure 7: should be plural in the figure caption. And: mobile or HT - what does HT mean?

Table 1: should be plural in the caption. And: I would suggest to explain a bit what the different warning levels mean. For example: Caution = landslides possible; warning = landslide likely; evacuate = landslide occurrence imminent.

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Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., doi:10.5194/nhess-2016-209, 2016.

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