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Objective Function based AHP Risk Evaluation System in Humid Tropical Regions

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Abstract AHP is the method of refining a plan like the risk assessment system for landslides, and the assessment system from analysis. This method is expected to apply to humid tropical region in the near future. AHP is a decision making tool and the structure is divided into hierarchy criteria and hierarchy alternatives. However, some other method, such as multiple regression analysis, is statistical inductive approach using many sample data.

In the nature or data collection at the field, we are not able to get the enough number of statistical data to fully explain the model. Particularly, number of landslide's data often is not enough to make statistical model. On the other hand, AHP method is easy way and more deductive using human experiences than other method. As well as, AHP can be converted to explicit knowledge from tacit knowledge we have as technology. However, these models using AHP are necessary to be verified using by some objective function, such as regression equation or probability of error. This occasion, we like to describe how to verify AHP application utility by some objective function.

Keywords Landslide, AHP,Objective function,Risk evaluation system, Explicit knowledge, Tacit knowledge

Review the AHP approach for the landslide risk evaluation

The AHP is one of the statistical approaches of the decision make processes. It has the characteristics for guide the making decision by a pair comparison or a pair parameters evaluation approach due to decision making. The structure is combined the factors such as the goal, criteria and alternatives. The calculation approaches will categorize into two groups. That is an approach of "relative comparison" and "absolute comparison".

Relative approach for decision making

One of the most expected AHP approach for application for decision making about the identification of the most suitable countermeasure. In such case, the flow chart clearly mention the goal as the suitable particular countermeasure, criteria such as the view point of economical, execution, effectiveness, durability, maintenance etc. And as the alternatives such as pile, anchor, embankment, cut, drainage, and monitoring will necessary (Fig. 1). The relative approach is easy and is basically logical to use for such purpose. Although, in case of Japan, the approach never have been tried yet.

Mr. N.G.Dung will promote the study in the project of SATREPS.

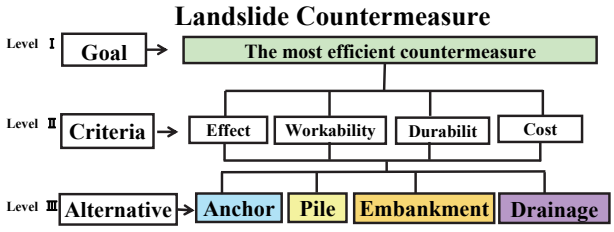

Figure 1 Example of AHP model

Absolute approach to risk evaluation for landslide unit

The AHP approach has been adopted to risk evaluation to the landslide topographic area. The methodology is already constructed. For example, many reports have been published. And it applied to the actual landslide risk evaluations.

In case of AHP application to the risk evaluation, the relative approach has some difficulties. The target landslide area distributes anywhere abundantly. So, the compare the alternatives in each criteria is impossible. In this case, the absolute approach is might be useful. This approach is explains as follows. 1) The standard criteria establish by the evaluation and discussion to the data package of micro features of landslide topography and the spatial distribution. 2) The meanings or the value of the indicators to the contribution of reactivation possibilities should be decided by items. The items distributed to the check sheet. The contribution values decided and put the score by the discussion by high level engineers (Fig. 2).

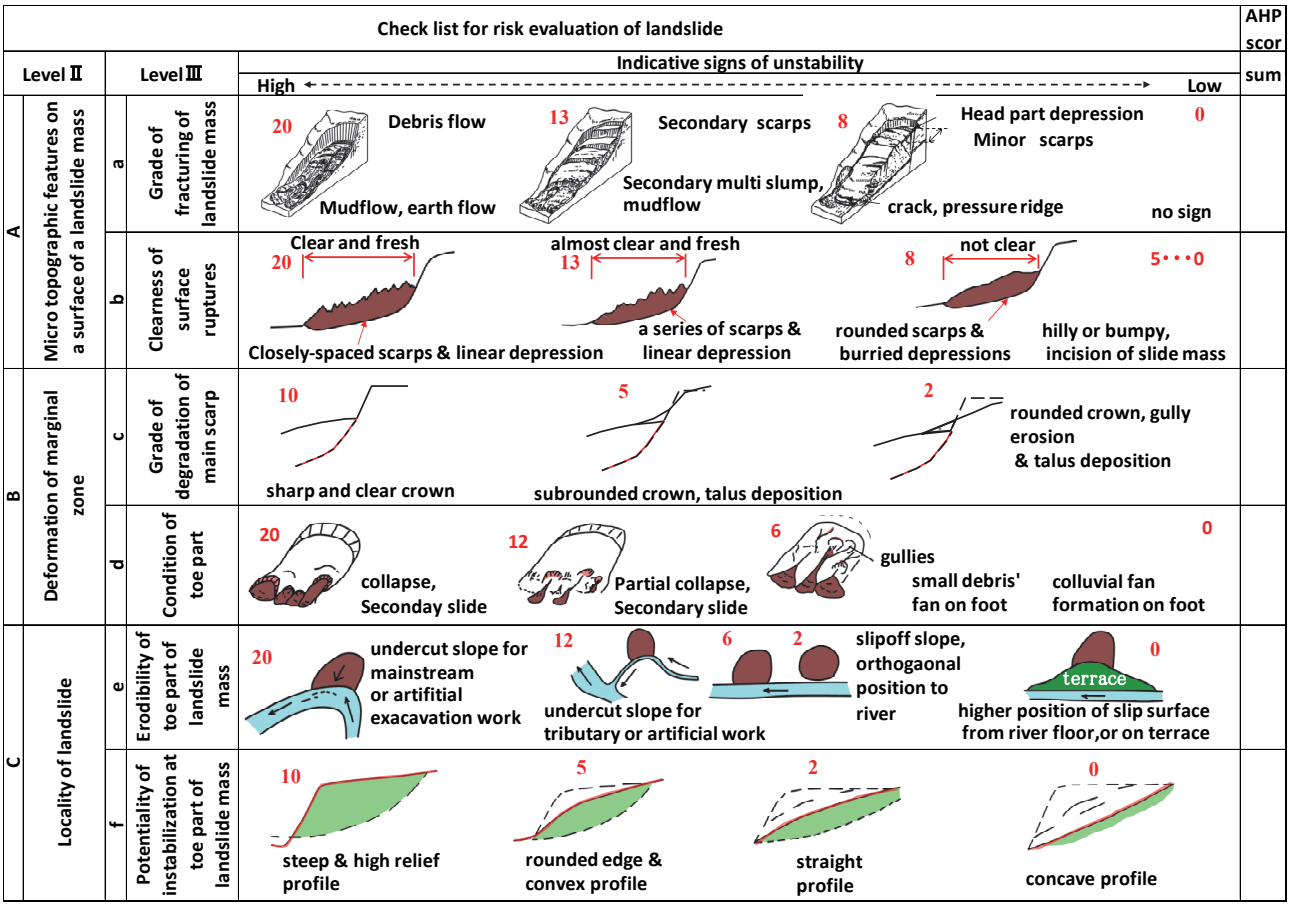

Figure 2 Example of a data sheet through AHP aerial photography

It is needless to say, in case of actual application to the risk evaluation, the verification is necessary (Fig. 3).

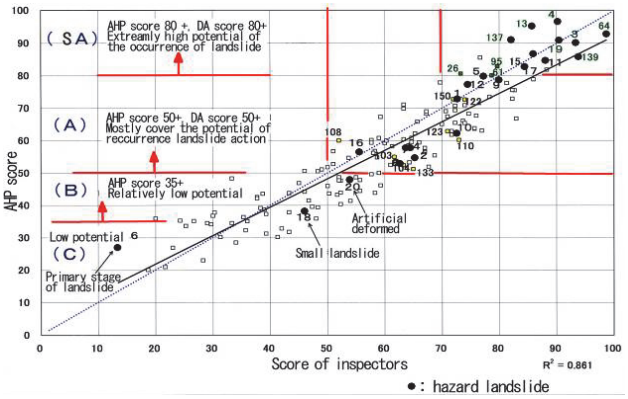

Figure 3 Relationship between AHPscore and Score of inspectors

Verification trial

Here we would like to introduce the two kinds of model for verification. One is the combined application model of buffer movement analysis and the other is the error provability analysis as new GIS statistical analysis technique.

By the way, the development of the risk evaluation model to the landslide topographic area, that advance was with the technique of aerial photo interpretation. There is the necessity the skill acquirement such as the topography of the landslide identification and micro landform classification by aerial photo interpretation. The skill is strongly reliance to the study of geomorphology and geology. The skill will be able to application in case of the Humid Tropical and Deeply Weathered Environment such as Vietnam.

The current model of risk evaluation to the landslide unit is useful. But there are some difficulties. That is not able to evaluate the susceptibility to the area of outside of landslide unit. The approach of aerial photo interpretation is only useable to the landslide unit. The approach is standing the point of view that is “the unit”. If we think the risk evaluation to all the area of slopes, it will have some contradiction. The idea of application to all slopes is based on the view point of “the continuity”.

The difficulty of the size is also important. The model can use for relatively large scale landslide unit. Because of the possibility of identification the unit depend on the quality and scale. In case of Vietnam, the

scale is 1 - 33000. This is too small for identify the surface landslide. In case of landslide mapping in Japan, 1 - 40000 photo use usually. And the size of identification decides larger than 150 meters in width one.

This means the approach of aerial photo interpretation is not able to use for the ideal design of route. Needless to say the small or surface landslide is also very dangerous. Such matter is discussing with Mr. D. V. Tien in ITST, Vietnam.

Combined application model of buffer movement analysis

The basic idea of the evaluation model of the susceptibility is as follows. The objective variable is the actual distribution of landslide sites or the area which is established by AHP, GIS etc. The explanatory variable is defined by AHP value that is caused by the series of parameters of morphometric features such as relief energy, above ground opening degree, inclination, catchment area etc. Here, the "combined application model of buffer movement analysis" will be trial use to the new GIS statistical analysis.

The model is not similar to the former one. In before, the causes were presumed from each physiographic characteristic of landslide. If we say presume in this approach, that is like a thinking the bird eye view. The characteristics of the model will say as follows. Firstly, the data of land features (topography, geology, landslide indicators, etc.) are collected from the area of buffering area. The data collection area means the buffering area which will shift to one direction step by step. Secondary the comparison of the actual landslide distribution and the score of buffering data is estimate as the level of harmonic proportion (Fig. 4).

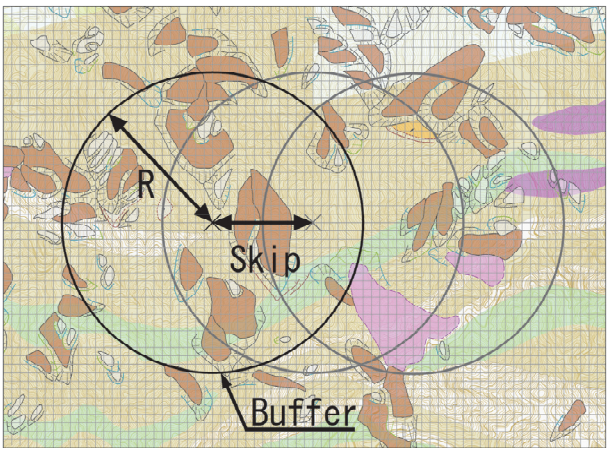

Figure 4 Buffer movement analysis conceptual diagram

Objective function for model verification evaluation

When we use the model for susceptibility evaluation, we have to carry the verification.

For example, in each buffer, we will get the correlation coefficient between the AHP score and the overlapping degree of landslide distributions. That is the numerical formula of the correlation coefficient as the objective function.

Furthermore, if we will be able to prepare the number of data, the specificity will be increase as the probability function.

Here, we have to think about the level of explanation of actual landslide distribution and the susceptibility assessment in all slopes. The buffer will divide in to the "existing" of "not existing". The "existing" is means landslide including in the buffer.

While, if the distribution of data of AHP scores normal, the distribution of "probability density function" will divide clearly. The two normal distributions separate clearly, this means that the evaluation of the susceptibility is well explained. So, the each median Y among the mean AHP score will decide as the temporal standard. For example, in case of "no existing" buffer group, there is the part of larger than the normal distribution of the probability. The "no existing", area means "probability of error" as the actually "no existing" but decide to "existing". On the other side, the probability of smaller than Y of the normal distribution of the probability of "existing", that also means "probability of error". Thus, we would like to define as the "blender probability". The model adaptability is explains as the distance or the overlapping of two AHP score distribution. (Fig. 5, Fig. 7,8)

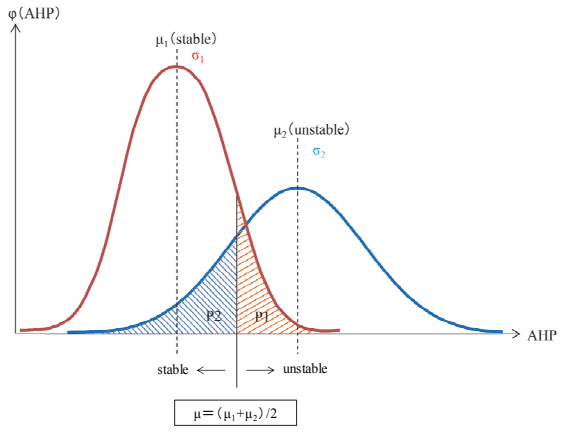

Figure 5 Distribution model of malpractice probability

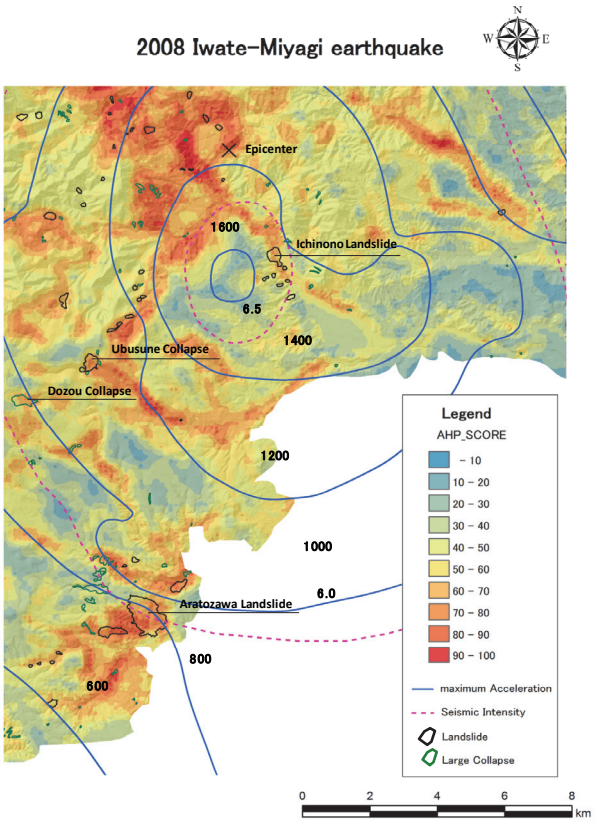

Figure 6 2008 Iwate Miyagi Sustainability Landslide model

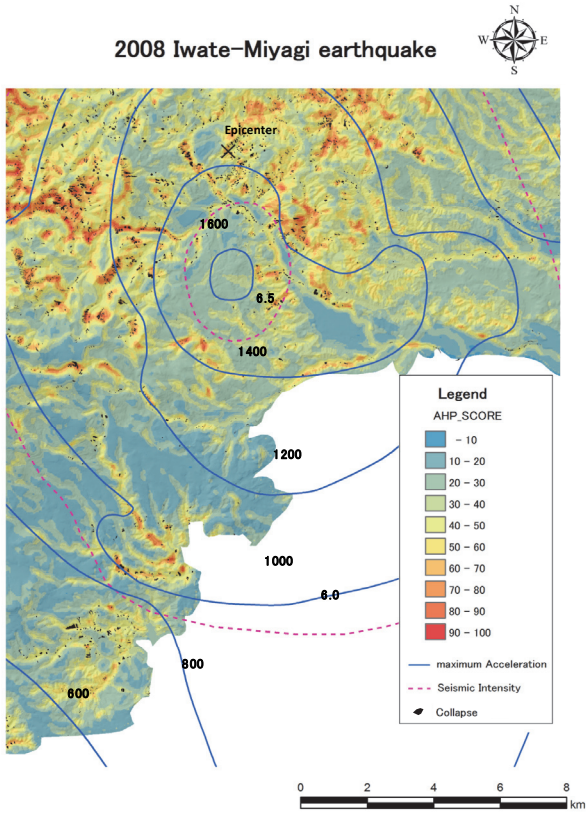

Figure 7 2008 Iwate Miyagi Sustainability collapse model

Summary

This occasion, we discussed the importance of the setting the objective function and the verification if we try the susceptibility evaluation and AHP approach to the slopes instability analysis. And also, we introduced new statistical approaches. That is the approach of the causative factor selection and the statistical analysis with buffer movement analysis based on the samples of landslide actual distribution. And the "blender probability" was defined. This is useful for separation of the "existing" or "no existing" distribution and the related parameter identification.

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