Fundamental Journals
IJFPS
International Journal of Fundamental Physical Sciences
ISSN: 2231-8186
Full length Research Papers
http://fundamentaljournals.org/ijfps/index.html

Comparison slide zones by Nilsen method with active tectonic zones produce of Smf index

R. Sharifi[1*], M.pourkermani[2], A.solgi[3]

[1]Department of Geology, Science and Research branch, Islamic Azad University, Tehran, Iran
[2]Department of Geology, Shahid Beheshti University, Tehran, Iran
[3]Department of Geology, Science and Research Branch, Islamic Azad University, Tehran, Iran

Email: R.sharifi1346@semnaniau.ac.ir

(*Received November 2011; Published Jun 2012*)

ABSTRACT

Slide zones under title erosion types related to more active tectonic factors for example stream length-gradient (Sl),ratio of valley-floor width to valley height (Vf), drainage basin shape (Bs), mountain front sinuosity (Smf), drainage basin asymmetry (Af) and hypsometric integral (Hi). This research is noticeable comparison produce slide zones by Nilsen. The active tectonic zones produce from Smf index under title one of the important active tectonic factors. Determination landform of geometry or morphometry factors is the one of best method for study and evaluation active tectonic. The first provided Dem maps in GIS software by topography, geology, tectonic maps participant with field activities. Then provided active tectonic map by Smf index into three class A, B, C and landslide hazard zonation map into five class stable zone, generally stable zone, stable moderately stable zone, moderately un-stable zone and talented to liquefaction zone. Comparison and conformity landslide hazard zonation map with hazard zonation into Smf index showed about percent 71(51120 hectare) moderately unstable zone and talented for liquefaction zone settled in A zone Smf map and percent 29 (20880 hectare) remained settled sequential percent 18 (12960 hectare) and percent 11 (7920 hectare) in B, C zone of hazard zonation active tectonic produce from Smf index. In other word in research showed relationship landslide zones produce landslide hazard zonation by Nilsen to active tectonic zones by Smf index in the study region.

Key words: Slide zones, Nilsen, landslide zonation, active tectonic, landform of morphometry or geometry, hazard zonation
DOI:10.14331/ijfps.2012.330030

INTRODUCTION

Different names such as the massive movement, slope of movement, dip movement, landslide and etc. are posed for the slopes instability and their movement (Bogoslovsky & Ogilvy, 1977).However, among these names the landslide is more common, technical and professional that in the present study, instead of all above-mentioned names, mostly the landslide term has been used. Considering the landslide phenomenon as a form of erosion in watershed management projects is highly significant. This phenomenon, as a form of unexpected disasters, has annually considerable human, financial and natural resources losses and damages in Iran or the world (Guzzetti, Carrara, Cardinali, & Reichenbach, 1999). Landslide phenomenon depends on several factors such as dip, geology, rain, vegetation, earthquake etc. (KEEPER, 1984). Moreover, it is as slide (transitional and rotational), flowing (debris flow, soil flow, mud flow, soil and mud flow etc.), Rock Falls types, which is more frequent in the flowing type area and its rock fall is higher compared with the other types. Therefore, the study of landslide subject is of special importance. Although, in order to achieve the reduced damages and loss caused by landslide, general planning and applying the landslide management is crucial, but can say that one of the most important actions in this regarding is identifying the areas with the potential of landslide risk, preparing zonation maps and planning for the appropriate operation in such areas (Ercanoglu & Gokceoglu, 2002). Preparation of landslide hazard zonation map has been initiated since four decades ago by different researchers in the different points of the worlds. Since numerous factors are involved in the occurrence of landslide, so, the zonation methods for identifying the hazards of landslide have not been standardized yet (Duman, Can, Gokceoglu, Nefeslioglu, & Sonmez, 2006); especially, considering the fact that climate, variate geological formations can have several impacts, and zonation with these factors Demands a particular characteristic in each area.

On the other hand, the comparison and relationship of landslide zones with those of tectonic active zones resulting from the Smf index is posed. In this respect, it remains to add that Iran has located at the middle part of Alps-Himalayas belt in terms of structural state, and its current shape is the result of orogenic activity, especially final Alp orogenic (Berberian & King, 1981). The structural geology condition and instability of Iran lands due to being located in a tectonic active area, is unquiet in terms of seismicity as well. In general, tectonically and in a wide scale, the region has located in the Alborz zone (Berberian & King, 1981), and definitely has been influenced by the events and processes of the given zone that the presence of crushed rocks in many sites and disturbance of the units and sedimentary formations and different faults with various mechanisms and dominant general strike of northwest-south and east to west is also indicating the subject. In terms of seismotectonic and its mechanism, it is also dependent on the general seismotectonic of the mentioned zone (this zone comprises about 10.43 percents of the Iran earthquakes) and has abundant earthquakes but mainly with magnitude 4 to 5.5 at Richter scale and with low focal depth (earthquakes with focal depth lower than 50 km) (Ambraseys & Melville, 2005). As a result, the issue of active tectonic is notable in the region and most indices of active tectonic such as drainage basin shape (Bs), mountain front sinuosity (Smf), stream length-gradient (Sl), ratio of valley-floor width to valley height (Vf), drainage basin asymmetry (Af), hypsometric integral (Hi) are presented in it.

GEOGRAPHY LOCATION OF STUDY AREA

Watershed management of Karaj has located in north of Tehran city and about Karaj-Chalus road in regions of Amirkabir dam to Ahowan apex ,it has 50°,57',46 - 51°, 29',54 longitude and 35°,44',58-36°,8',22 altitude and area about 125000 hectare(Fig.1). Watershed management of Karaj separate by Shemiranat Mountains from Jajrood River in east and by Kaharbozorg Mountain from Taleghan River in west and by Alborz Mountains from Chalus River in north.

Figure.1 Location map of study area (Tehran Province)

GEOMORPHOLOGY AND GEOLOGICAL OF REGION

The study area is the north part of Tehran city and in the part of middle Alborz Mountains. It is separate by Shemiranat Mountains from Jajrood River in east and by Kaharbozorg Mountain from Taleghan River in west and by Alborz Mountains from Chalus River in north. Lithological area has different groups of sedimentary rocks; igneous rocks metamorphic and structural tectonic zone of Alborz folding(Berberian & King, 1981). This area locked in Alborz folding zone and has contains of different folds and faults with general strike of the NW-SE and E-W. In the parts south and north of study area is passing great faults such as Abiek fault-Firoozkooh-Shahrood and Tehran north fault with general way E-W(Berberian & King, 1981). From geology view based on geology maps of Tehran, Karaj, Marzanabad, Ghazvin, Saveh, Amol, and aerial photos as well as field activities there is different formations and units from Precambrian to quaternary with different lithology such as sedimentary, igneous and metamorphic but mostly sedimentary in region(Fig.2).

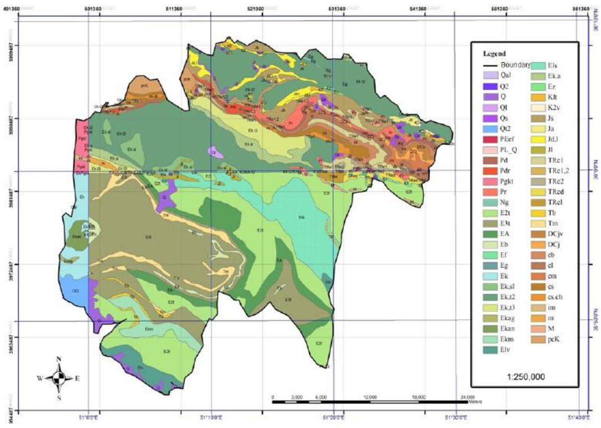

Figure.2 Geology map of study area

MATERIAL AND METHODS

The first provided maps Dem and projection of geology map (Fig.2), surface distribution landslide (Fig.3) by geology maps of Tehran, Karaj, Ghazvin, Saveh, Marzanabad, Amol and aerial photos and topography maps as well as geology and geography surveys and field activities in the soft ware GIS with 9.3 version. Map of slide and un-slide units or deposit provided with comparison surface distribution landslide map and geology map. Slope map into three classes, landslide hazard zonation map by Nilsen method, tectonic hazard zonation map with Smf index and maps area all above mentioned provided by Dem of maps below explanation:

GEOLOGY MAP

Study region Geology map by geology maps of Tehran, Karaj, Marzanabad, Ghazvin, Saveh, Amol, and aerial photos as well as field activities. It has 54 number of geology formation and unit from Precambrian to quaternary with different lithologies sedimentary, igneous and metamorphic (Fig.2) (Berberian & King, 1981).

SURFACE DISTRIBUTION LANDSLIDE MAP

Surface distribution landslide map by study region geology maps and aerial photos as well as field activities provided into groups four active landslides, ancient landslides, debris flows and rock falls (Fig.3).

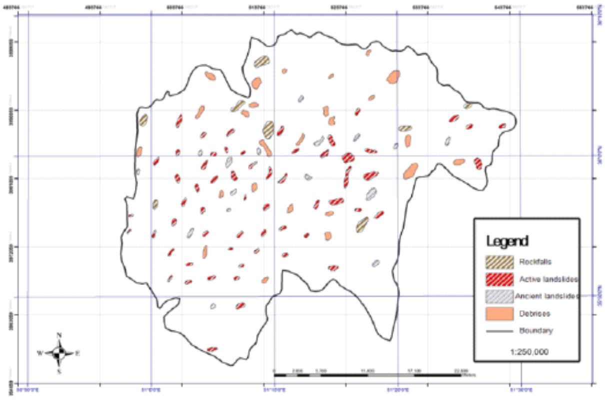

Figure.3 Surface distribution landslide map of study region

SLIDE AND UNSLIDEDEPOSITE MAP

Slide and un-slide deposits or units map provided from comparison geology map and surface distribution landslide map, two above-mentioned map, slide deposits or units are geology formations and units that have very landslide area but deposits or units un-slide are geology formations and units that have a little or less landslide area and upshot talented liquefaction units are about rivers (Fig .4).

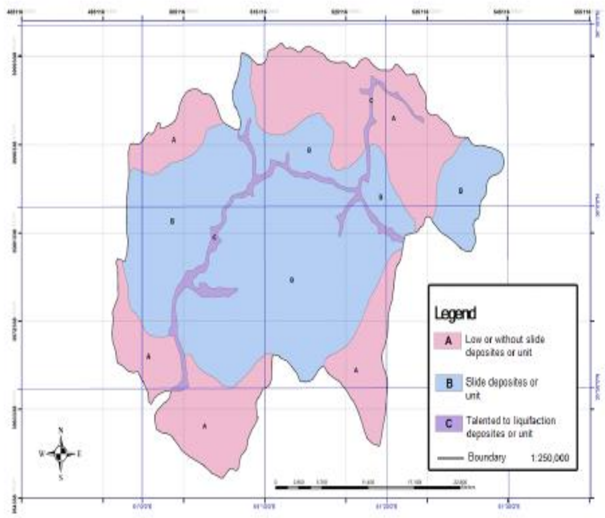

Figure.4 Slide and un-slide units or deposit

SLOPE MAP

For preparation landslide map by Nilsen, slope map into class three percent 5, percent 5 to 15 and more percent 15 is necessary that provided from Dem map topography in the GIS Software (fig .5)

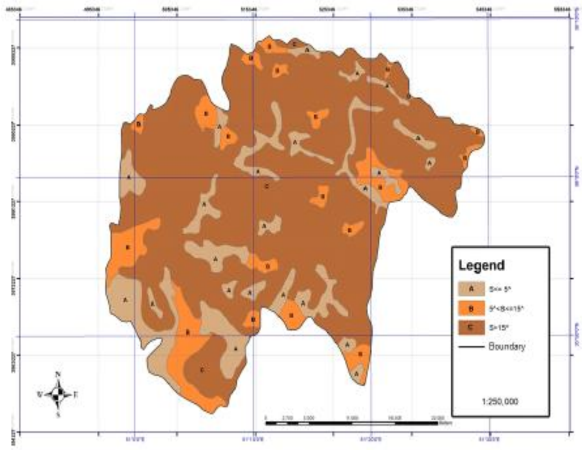

Figure.5 Slope into class three

LANDSLIDE HAZARD ZONATION MAP

In general the study of landslide subject is of special importance. Although, in order to achieve the reduced damages and losses caused by landslide, general planning and applying the landslide management is crucial, but one can say that one of the most important actions in this regard is identifying the areas with the potential of landslide risk, preparing zonation maps and planning for the appropriate operation in such areas(Ercanoglu & Gokceoglu, 2002). Due to landslide hazard zonation map by Nilsen method is acceptable accuracy in region, based on number 1 table provided landslide hazard zonation map into five class stable zone, generally stable zone, moderately stable zone, moderately unstable zone, talented liquefaction zone (Fig.6).

Table (1) Overlying dip and slide units in the Nilsen method

Dip→ **↓Unit**	$X \leq 5\%$	$5\% < X \leq 15\%$	$15\% < X$
Low or without slide units	stable zone	generally stable zone	moderately stable zone
slide units	moderately unstable zone		
Talented to liquefaction units	talented liquefaction zone		

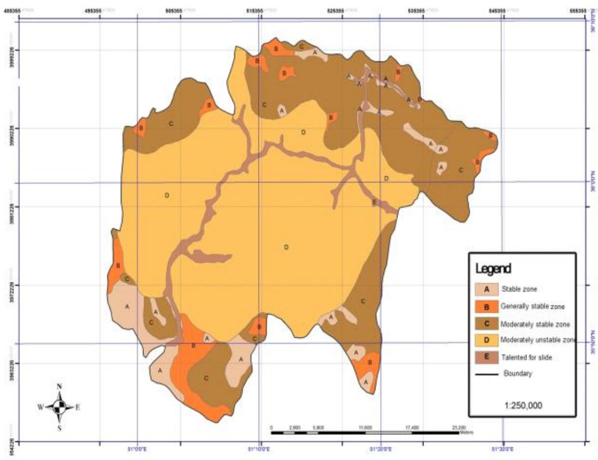

Figure.6 Landslide hazard zonation map by Nilsen method

ACTIVE TECTONIC ZONATION MAP BY SMF INDEX

In terms structural geology zone has been too tectonic disasters in variate geology areas(Berberian & King, 1981)and in terms active tectonic indexes such as drainage basin shape(Bs), mountain front sinuosity (Smf), stream length-gradient (Sl), ratio of valley-floor width to valley height (Vf), drainage basin asymmetry(Af) and hypsometric integral(Hi) is active and variation. However, due to the significance of the mountain front sinuosity (Smf) index, under title one of the important active tectonic factors is notable the study region. Generally sinuosity is index that presented equivalent between erosion forces with tectonic forces. The low sinuosity in the ahead mountain front with boundary active fault. If uplift rat be low or stopped however erosion process of mountain front erode with more than irregular. That sinuosity rate is more. If sinuosity rate be equivalent one then presented high active tectonic. If sinuosity rate be increase that presented low active tectonic formula of sinuosity is such as:

$$S_{mf} = \frac{L_{mf}}{L_s}$$

For determination and quantitative mountain front sinuosity metered length of surface line mountain front and length of straight line mountain front parameters based on table 2 in 74 local , that based on the mentioned determinations in variate zones metered rate Smf in study area , that is variate between 1.23 – 3.69. For zonation Smf index in region based on Bull &Mcfadden (Bull & McFadden, 1977), Rockwell et al (Rockwell, Keller, & Johnson, 1985)، Silva et al (Silva, Goy, Zazo, & Bardajı, 2003)، El Hamdouni et al (El Hamdouni, Irigaray, Fernandez, Chacón, & Keller, 2008) methods and patterning from themes, active tectonic zone be categorized to moderate active tectonic zone, inactive tectonic zone is sequential less 1.4 , 1.4 – 3.0 , more 3.0 invariant subbasins and themes map be provided in software GIS into three class A,B,C (Fig.7).

Table (2): Rates Smf index in subbasins of region

Row	Subbasins	Lmf	Ls	Smf
1	Mosha	9618.053615	9192.060859	1.05
2	Mosha	15026.418142	14034.641604	1.07
3	Mosha	9885.806534	8916.573272	1.11
4	Taleghan	5155.37581	4119.502699	1.25
5	Taleghan	9076.806436	7290.698026	1.24
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70	EmamzadehD awood	3430.307935	2984.803268	1.15
71	Azadbar	3731.045725	3718.497979	1.00
72	Azadbar	8460.168137	7650.389293	1.11
73	Azadbar	10928.530578	9900.279626	1.10
74	Gachsar	7022.347237	5470.804697	1.28

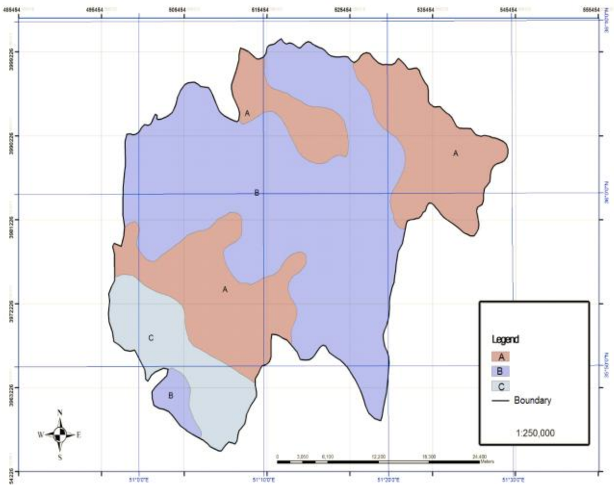

Figure.7 Active tectonic hazard zonation based on Smf index

DISCUSSION AND CONCLUSION

As mentioned, landslide phenomenon depends on the various factors of active tectonic indices. However, due to the significance of the Smf index, landslide phenomenon has been compared in the framework of landslide hazard zonation to method Nilsen method which is acceptable and with high accuracy in the region. Overlying and comparison landslide hazard zonation map (Fig.6) with active tectonic hazard zonation map (Fig.7) showing that first about percent 71(51120 hectare) moderately unstable zone and talented for liquefaction zone settled in A zone Smf map and percent 29 (20880 hectare) remind settled to sequential percent 18(12960 hectare) and percent 11(7920 hectare) in B,C zone, active tectonic hazard produce zonation from Smf index. In other word in research showing relationship landslide zones produce landslide hazard zonation by Nilsen to active tectonic zones by Smf index in the study region. As summary conclusion showing that:

-More landslide zonation of region settled in moderately unstable zone.

- Talented for liquefaction zones have least space.

- Active landslides in region have more space in moderately unstable zone, that showing Nilsen method accuracy in region.

- More determinations Lmf and Ls index showing active tectonic in region.

- Landslides rock fall and debris flow type distributed in more watershed management region.

- Overlying and comparison landslide hazard zonation map by Nilsen method with active tectonic hazard zonation map by Smf index showing that slide zones have high relationship with active tectonic by Smf index.

REFRENCES

Ambraseys, N. N., & Melville, C. P. (2005). *A history of Persian earthquakes*: Cambridge Univ Pr.

Berberian, M., & King, G. (1981). Towards a paleogeography and tectonic evolution of Iran. *Canadian journal of earth sciences, 18*(2), 210-265.

Bogoslovsky, V., & Ogilvy, A. (1977). Geophysical methods for the investigation of landslides. *Geophysics, 42*(3), 562-571.

Bull, W. B., & McFadden, L. D. (1977). *Tectonic geomorphology north and south of the Garlock fault, California*.

Duman, T., Can, T., Gokceoglu, C., Nefeslioglu, H., & Sonmez, H. (2006). Application of logistic regression for landslide susceptibility zoning of Cekmece Area, Istanbul, Turkey. *Environmental Geology, 51*(2), 241-256.

El Hamdouni, R., Irigaray, C., Fernandez, T., Chacón, J., & Keller, E. (2008). Assessment of relative active tectonics, southwest border of the Sierra Nevada (southern Spain). *Geomorphology, 96*(1), 150-173.

Ercanoglu, M., & Gokceoglu, C. (2002). Assessment of landslide susceptibility for a landslide-prone area (north of Yenice, NW Turkey) by fuzzy approach. *Environmental Geology, 41*(6), 720-730.

Guzzetti, F., Carrara, A., Cardinali, M., & Reichenbach, P. (1999). Landslide hazard evaluation: a review of current techniques and their application in a multi-scale study, Central Italy. *Geomorphology, 31*(1-4), 181-216.

KEEPER, D. K. (1984). Landslides caused by earthquakes. *Geological Society of America Bulletin, 95*(4), 406-421.

Rockwell, T., Keller, E., & Johnson, D. (1985). *Tectonic geomorphology of alluvial fans and mountain fronts near Ventura, California*.

Silva, P. G., Goy, J., Zazo, C., & Bardajı, T. (2003). Fault-generated mountain fronts in southeast Spain: geomorphologic assessment of tectonic and seismic activity. *Geomorphology, 50*(1), 203-225.