

LANDSLIDES CHARACTERISTICS AND CLASSIFICATIONS IN HASHTJIN AREA (NORTHWEST OF - IRAN)

Abstract. Identification and recognition of various types of landslide in Hashtjin area (NW-IRAN), and their specific characteristics were the main purpose of this study. The results of this study showed that Hashtjin is of the area most susceptible to landslide in Iran with more than 13% its surface being affected by mass movement activity. Two categories of landslide have been identified, single and zone landslides. Active landslides make up 55% of the total number of the landslides, and they vary in characteristics and factors. Approximately, 95% of the damages occur in pastures and agricultural lands.

Key words: landslide, characteristics, classifications, susceptible areas and damages.

Introduction. Landslide is one of the most dangerous natural disasters. It causes a lot of damage to natural and unnatural resources [10]. Annually, landslides which take place in the mountainous regions and the highlands, cause significant amounts of destruction and damage in Iran. Ansari and Blurchi [1], Uromeihy and Mahdaviifar [7], studied about this subject and published their results. Nowadays, landslides are classified based on their varying characteristics [2]. In this research, some of the major landslides of the Hashtjin region in northwest of Iran have been categorized based on some of their most important characteristics. In this research, the new information has been added to data base to influence the analysis of landslides. These data bases form the foundations of expert systems for susceptibility, hazard, risk zonation and mitigation.

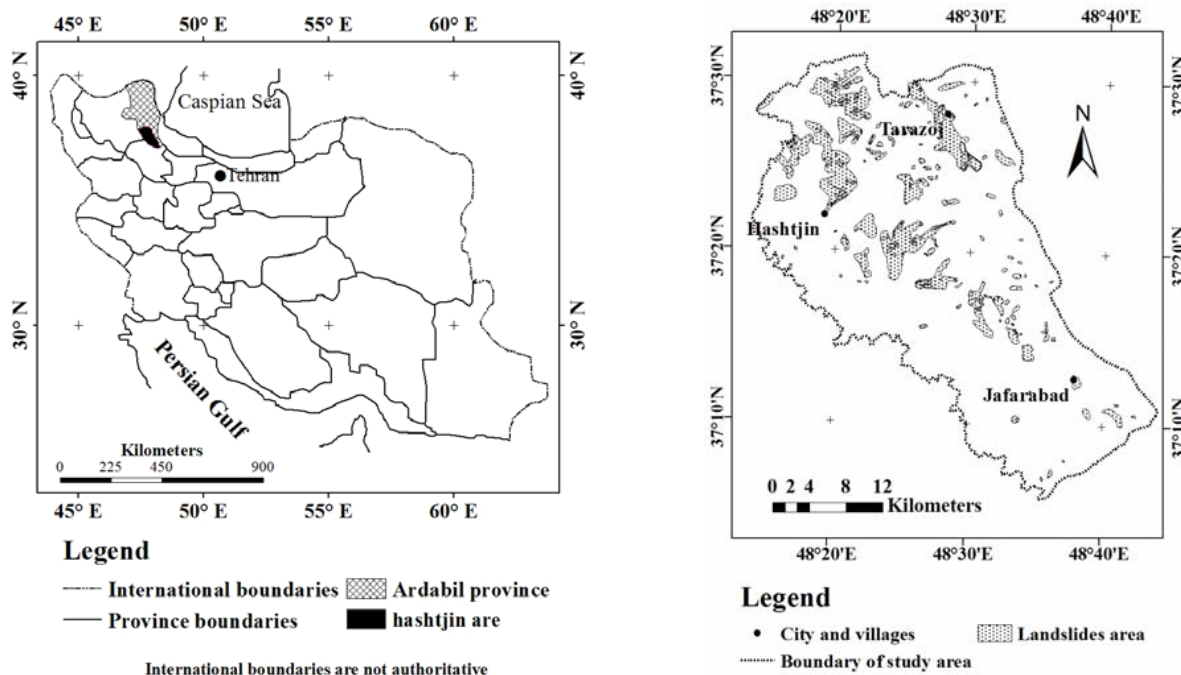


Fig 1. The position of the region of study

Materials and methods. This study were done in Hashtjin region, with 1071 kilometer square in area, is located in the Khoreshrostan county of Khalkhal (NW-IRAN), between the Eastern geographical longitude of 48° 14' to 48° 44' and northern longitude of 37° 06' to 37° 32' . 120 landslides were mapped and investigated in this area (fig. 1).

A landslide distribution map with magnification of 1:50000, using the geological and topographical maps (1:50000) and aerial photos (1:20000) with the aid of field work, was prepared. On the basis of Varnes method [8], characteristics of 120 landslides, both during the office and field studies, were recorded in the forms for data collection. The data was transferred to Excel and SPSS data banks, descriptive statistics was analyzed using Cross tables, and the correlation between the characteristics of the landslides was studied.

Results. Lithology and landslides type

It may be reasonably expected that the properties of the slope-forming material are related to lithology, which therefore should affect of likelihood of failure. The main landslides of Hashtjin region are divided into two groups: single landslides and landslide zones. The correlation of landslide frequency with lithology is shown in table 1 and 2. Single landslides with makeup of rock and earth (soil) are the most frequently occurring landslides in this region. The second place goes to landslides with earth materials, and the next place is of the landslides with rock materials. Rotational movements, translational movements and combination of the two, which count for 88.5% of the total movements, are the most frequent types of this group of landslides.

Table 1

Lithology and type of the single landslides

Lithology	Single landslides								
	Rotational	Translational	Rotational and translational	Rock falls	Rock and earth falls	Debris flow	Earth flow	Debris and earth flow	Total
Rock	1	15	5	1	-	-	-	-	22
Earth	18	3	7	-	-	-	3	-	31
Debris flow	-	3	2	-	-	2	-	-	7
Rock and earth	4	8	17	-	1	-	-	-	30
Rock, earth and debris	-	-	-	-	-	-	-	-	-
Debris and earth	-	-	2	-	-	-	-	4	6
Total	23	29	33	1	1	2	3	4	96

In the case of landslide zones, the frequency of creep, unmappable and widespread landslides are the same (Table 2).

Lithology and type of the landslide zones

Lithology	Landslide zone				
	Creep	Unmappable slides	Widespread slides	Creep and unmappable slides	Total
Rock	-	-	-	-	-
Earth	4	2	1	1	8
Debris	-	-	-	-	-
Rock and earth	1	4	6	2	13
rock, Earth and debris	-	-	1	-	1
Earth and debris	-	2	-	-	2
Total	5	8	8	3	24

Frequency and movement time

Frequency of the landslides in Hashtjin area has been classified as low, moderate and high [3]. High frequency refers to recurrence intervals of less than 40 years (recent), moderate frequency refers to recurrence intervals of 40 to 300 years (old), and low frequency refers to recurrence intervals of higher than 300 years (fossil). These classifications have been established based on similar experiences in other countries [4].

Frequency of the fossil landslides (higher than 300 years) with 7.5% of the total number of the slides is the lowest in this region. Out of this 7.5%, 2.5% of the movements have recurred within the past 40 years. In the old landslides (40 to 300 years) of the region, the border of the recurred movements is more obvious, and the scarps and the depletions are fairly distinguishable. The plant coverage on the sides of surface of rupture and the scarps of the movements is not complete, and the toe, in some cases, is obvious. This group of landslides have the highest frequency of occurrence, approximately, 80%, of landslides in this region, and out of 96 cases which their first movements had taken place in the past, 60 cases have shown signs of movement within the past 40 years. The recent landslides (less than 40 years) with obvious scarps, fairly fresh sides, ruffled plant coverage, completely distinguishable boundaries, and active creeping sliding zones, and even with known rupture date, make up 12.5% of the slides of this region (Table 3).

Stability conditions

Based on stability condition, the landslides of the region are categorized into three groups: Active, inactive and stabilized. It was found out that 66 cases, 55%, of the slides of the region are active, and 54 cases, 45%, of them are considered to be inactive or stabilized (table 4).

Damages

Approximately, 95% of the damages from the slides in this region take place in the pastures and the agricultural lands. The villages of Gehraz, Jafarabad and Tarazoj have completely been destroyed and all of their residents have vacated the villages within the past few years. Destruction of the orchards, roads, power lines and phone lines is a normal event in this region (table 5). Another direct damage which is caused by these slides is production of sediments. The capacity of the Sefid Rood dam is 1800 million cubic meter, and based on the storage capacity calculations, it was estimated that the dam would be filled up with sediments within 110 years, but the conducted studies have shown that the sediment produced by the landslides has filled up 800 million cubic meter of the total capacity of the dam in just 19 years. According to the conducted studies, more than 1/3 of the 50 million tons of the sediments which enter this dam annually, 14.3 million tons of it is due to wear of the top soil of the Hashtjin region, most of which is the byproduct of the landslide activities [5].

Table 3

Frequency of the landslides based on the movement times

First movement time	Last movement time			total
	Recent (<40 years)	Old (40-300 years)	Fossil (>300) s	
Recent (<40 years)	15 (12.5%)	-	-	15 (12.5%)
Old (40-300 years)	60 (50%)	36 (30%)	-	96 (80%)
Fossil (>300 years)	3 (2.5%)	2 (1.7%)	4 (3.3%)	9 (7.5%)
Total	78 (65%)	38 (31.7%)	4 (3.3%)	120 (100%)

Table 4

Stability degree of landslides based on the ages

Age	Degree of stability		
	Active	Dormant or stabilized	Total
Recent (<40 years)	16 (13.3%)	4 (3.3%)	20 (16.17%)
Old (40-300 years)	44 (39.2%)	47 (36.7%)	91 (75.8%)
Fossil (>300 years)	6 (2.5%)	3 (5%)	9 (7.5%)
Total	66 (55%)	54 (45%)	120 (100%)

Table 5

The major damages in the region

Damage	Pasture	Farmlands and orchards	Pasture and farmlands	Forest	Main and county roads	Total
Frequency	56	26	31	5	2	120
Percentage	46.6	21.6	25.8	4.16	1.66	100

Discussion

The presence of rock materials in 51.7% of the translational landslides, weathered marl and extensive hydrothermal altered rock in 78.25% of the rotational landslides, and earth-rock materials in 51.51% of the rotational-translational landslides prove a fairly clear correlation between the type of the landslide movements and the type of its lithology. Based on Varnes landslide movement scale [9], the rate of movement of the rock and rock-earth slides of the area has been fast, and the earth and earth-rock slides have usually been slow, and most of the slides of the past few decades have had rate of movement of moderate to high. More than 55% of the slides which have been studied show signs of activities within the past 40 year. The study has produced similar results to those at Yalcin [11] study in turkey, indicating that in 99 cases, 82.5%, of the studied landslides, clay minerals are present, and 52 of those cases are active at the present time, the clay soils within the volcanic, pyroclastic and sedimentary formations play an important role in causing landslides and their characteristics [6]. These characters are used in the studies related to the causes of landslides, and building models of the zones which are highly susceptible to landslides. And also are used in risk and danger assessments.

Conclusion

In this study, the major characteristics of the slides of the region were identified, and the results of the research were used in risk and danger based zoning of the region. The zoning was

done to help the researchers and the authorities in determining most appropriate methods of damage control and reduction, and deciding on the best course of action in trying to stabilize and manage these landslides and land movements.

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КЛАССИФИКАЦИЯ И ОСОБЕННОСТИ ОПОЛЗНЕЙ ХАШТИНСКОЙ ОБЛАСТИ (Северо-Западный ИРАН)

Аннотация. Идентификация и признание различных типов оползня в области Nashedj (ИРАН СЗ), и их определенные особенности были главной целью этого исследования. Результаты исследований показали, что более чем 13% региона подвергается воздействиям оползней. Оползни разделены на две категории: единственные и общие. 55% оползней активны и движения их изменяются различными агентами. Приблизительно 95% убытков происходит в областях сельского хозяйства и пастбищах.

Ключевые слова: оползень, особенности, классификации, восприимчивые области и убытки.