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Effects of Discharge Levels on Instability of Dams and Watersheds (Case Study: Kolse Dam Located In Sardasht)

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Abstract
The Zaab river basin is located on the Southwest of Western Azerbaijan and Northwest of Kurdistan province. It has an area of 3527 square kilometers and it flows in Tectonics valley. In addition, the central part of this river's basin includes repeated mass movement of materials. Every year the earth undergoes different landslides and mass movements which all impose threats on properties, agricultural lands and roads and paths. In this paper, the author has tried to evaluate and determine the effects of discharge levels on instability of the damn and Basin of Zaab River. The research method includes recognition and classification of instabilities on earth and explanation of their causes.

Keywords: Instability of Slopes, Landslide, Zoning, Zaab Basin.

Introduction

In mountainous areas, prior to execution of water development, environment management, communication networks development and industrial and residential facilities development projects, it is necessary to detect the risks of occurrence of material flows on the surface of ground. Mass movements of materials and slope instabilities are needed to be evaluated and also it is necessary to zone them in order to avoid repetition of incidents such as Mam Zine village in the city of Sardasht. In 1986, a landslide imposed serious risks and several financial losses on this village. Several elements are effective on controlling seepage and leakage of water from reservoirs among which, discharge levels are the most important ones. For controlling reservoirs leakages, at first, discharge levels must be studied in details and afterwards, necessary actions should be taken towards barricading these pores and canals. In this article, at first, different effects of disjunction levels on dam instability are explained and afterwards, the applied instruments for these measurements are explained. The following provides a brief description regarding Sardasht's Kolse dam as well as its features and purposes. After that, the Geological status of Zaab's basin is studied.

The studied site

The area under research includes parts of mountains of Southwest side of the Western Azerbaijan province in the Basin of Zaab River which is located between the Northern latitude and eastern longitude. In terms of political divisions, it belongs to the city of Sardasht and covers the eastern and western slopes of the aforementioned valley with a guitar like shape.

Its maximum eastern-western expansion is 30 kilometers and also its maximum northern-southern expansion is 25.33 kilometers. It covers for one city, three towns and more than 70 villages and also includes a population of over seventy thousand people. Of the total area of Zaab's Basin in Iran, only 520 square kilometers are included in this study. Eastern and western

mountains of Zaab valley have a northern-southern expansion in this area which has made a landscape different from inner parts of Azerbaijan and Kurdistan (Figure 1)

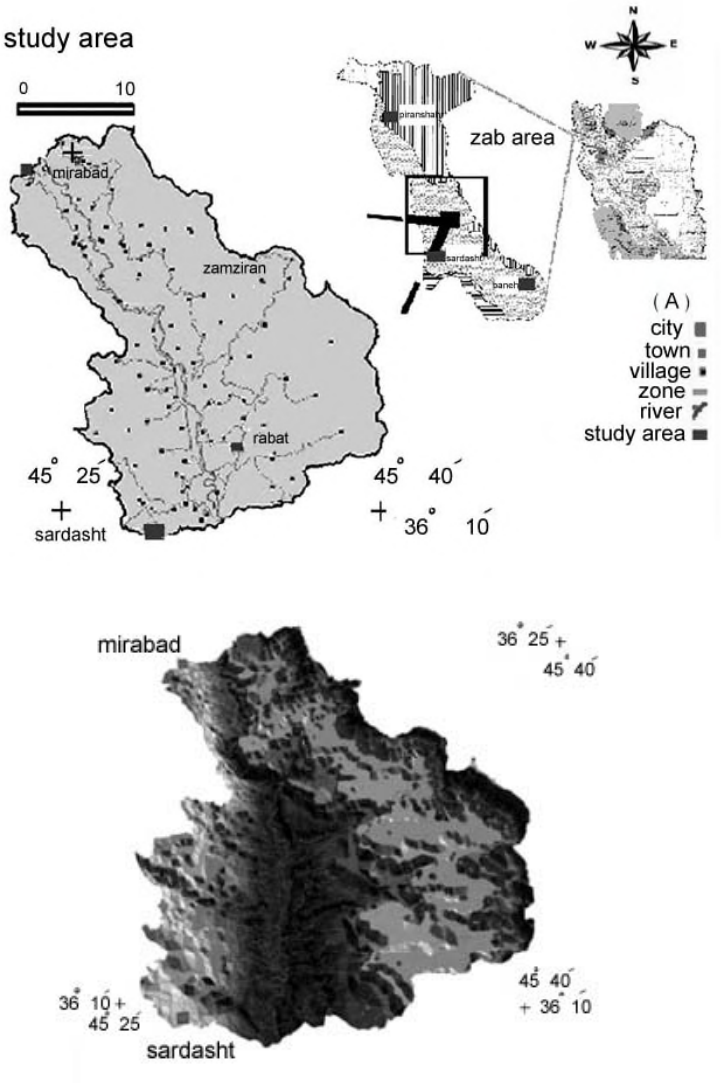

Figure 1: Geographical map of the studied site and its digital elevation model

Materials and Methods

The main required materials for this research included topographic maps, geographic maps, geology maps, vegetation information, and aerial and GPS satellite pictures. For obtaining feasible results, this research emphasizes on observation and according to needs, the site was visited and inspected. The following steps comprise the different phases of this research:

1- Determination of the research area according to topographic maps, aerial images and filed studies.
2- Filed studies and inspections and reading the data regarding slope instabilities through GPS provided images and development of present instabilities map.
3- Classifying the region into different slopes (with similar features in terms of slope angle and slope direction) on the topographic maps according to water division lines,

elongation of edges and ridges, rivers and elevations with reliance on aerial images and field studies in addition to smoothing down the slopes with similar features for development of maps and providing the possibility for performing systematic, feasible and coherent studies.

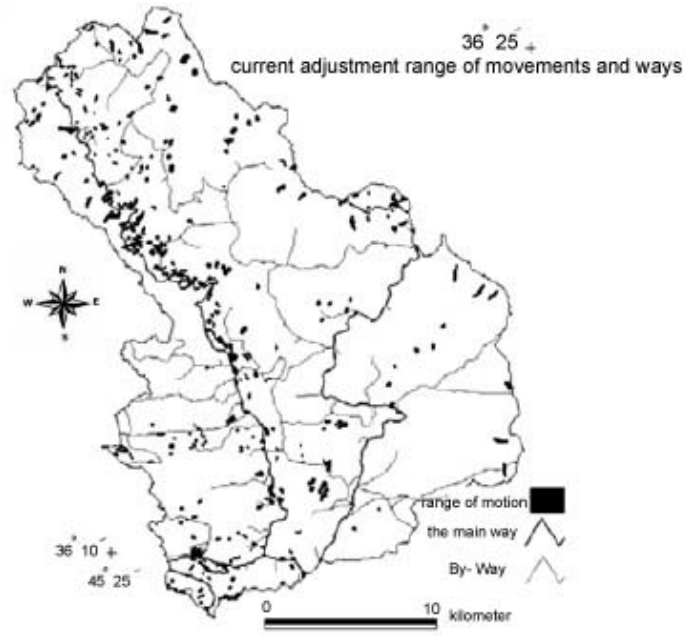

Figure 2: Present slope instabilities and access roads

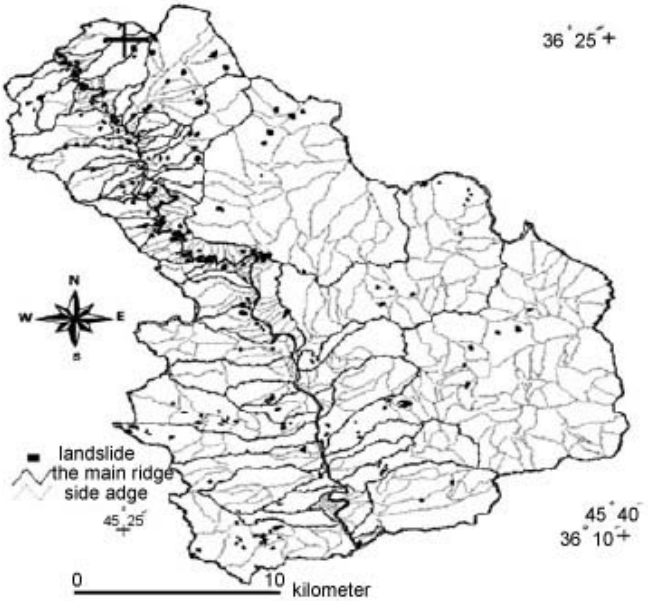

Figure 3: Area's slopes map and dispersion of slope instabilities on them

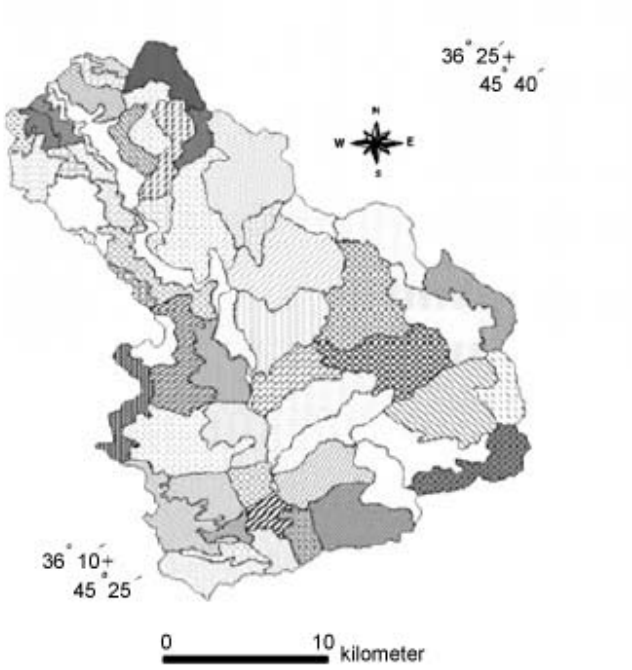

Figure 4: Areas working units map

4- Development of basic maps for effective elements in occurrence of slope movement phenomenon including lithology maps, slope, relative height, land use, status of undersurface waters and important geological structures as well as conformity of current slope movements on maps for precise evaluation of relations and roles of effective factors on instability.
5- Ranking each unit according to maps and emphasized scores table which were used by Anbalagan and summing the scores of each unit for determining the stability status of each unit.
6- Final zoning of the area into 5 classes in terms of instability risk (very high, high, average, low and very low).
7- Analyzing and concluding.
8- Evaluation of effective elements on instability of slopes and their rankings.

The phenomenon of slope instability depends on several different humane and natural factors. The required data for analysis of slope instability and evaluation of related risks include geomorphological data, topographical data, land use, engineered geology and Geotechnics and Hydrological data.

For obtaining the intended results, the emphasis of this research is put on detection of effective factors on instability of the dam and Basin of Zaab River according to existing information sources as well as site inspections. Therefore, for obtaining the intended results, the studied area I divided into 60 working units. In addition, face similarities are the criterions for determination of units and also existence of significant differences has differentiated each unit from another.

Effective factors on instability of dam and watershed

Mass movements of particles and materials are considered as the major processes which change the morphology of slopes. For understanding the mechanism and process of these movements, it

is necessary to be familiarized with the site's public and general features as well as being familiar with type, size and abundance of landslides. It is also necessary to be familiar with their geomorphological occurrence manner. In this regard, effective factors on instability of dams and watershed are separately studied in order to be able to sum up the scores of working units and development of instability risk zoning map. Effective factors on instability of dam and watersheds are as follows:

A) Geology and lithology

There are folded sedimentary mountains prolonged through Iran's border zone with Iraq starting from Ararat to Sardasht. In terms of tectonics, these mountains are exposed to trends prevailing in Azerbaijan and trends prevailing in eastern Turkey, western Azerbaijan and northern Kurdistan.

In addition, effects of trends prevailing in North West of Zagros Mountains are also present. In this regard, mountains that are prolonged from Ashnavie are highly ordered and are almost lined up. In addition, these mountains are tangibly prolonged from northwest to southeast. These mountains are a medium between highly unordered volcanic formations and sedimentary mountains. In general, the Basin of Zaab River and the mountains located in studied site are on one hand influenced by trends prevailing in Azerbaijan and on the other hand are influenced by trends prevailing in Zagros. Nabavi considers the southern section of Zaab Basin as included in Sanandaj-Sirjan Zone. This zone is however immediately located on its northeastern side. By following tectonic phenomena in this zone it can be concluded that in terms of natural geography, it belongs to western mountains. However, in terms structure, it is similar to central Iran. Sanandaj-Sirjan unit is one of the most challenging tectonic units of Iran.

Figure 5: Vishkedol landslide on the west of Sardasht road

Figure 6: Lithological map and dispersion of current slope instabilities on it

B) Slope morphology

Slope is considered as one of the most important morphological factors in occurrence of instabilities on skirts. Slopes are mapped by the help of regional topographic maps and geographical information systems. (Figure 7). Distribution of slope groups depends on morphological evolutions of stones in the area and also, the angel of skirts' slopes determines the features of the site. In addition to slope classifications, skirt movements are related to different levels of slope in order to evaluate slope instabilities (Figure 7).

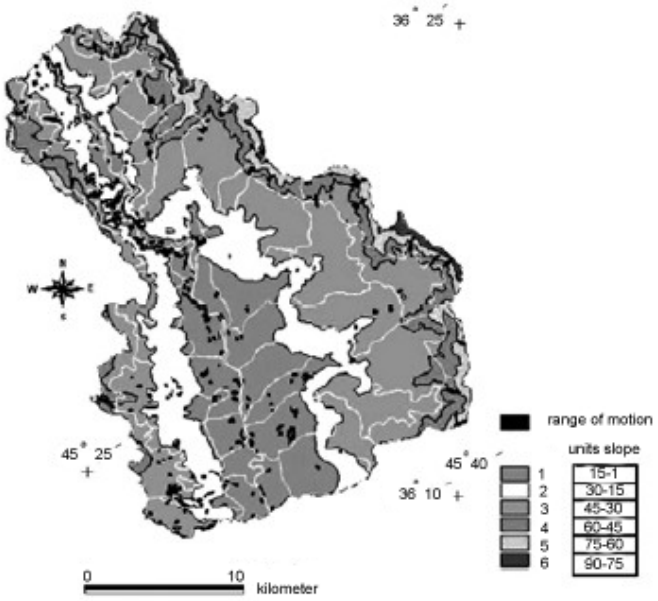

Figure 7: Area's slope map and its slope instability dispersion

The area and percentile area of each class of slope in this area are related to slopes with angels of 30-40 degrees (table 3). The slope of 25-45 degrees skirts cover more than 45 percent of the total area of the site and are found suitable for skirt movements. Some researchers consider slopes of more than three degrees as slopes suitable for mass movements and also a large part of this site includes such slopes. In this regard, according to the factor of slope, there is a high potential for mass movement of particles and materials in this area (figure 7).

Table 1: Rankings of different discharge levels on dam and watershed instability

unit	Area (km)	lithology	Structural status	Slope geometry	Relative height	Land use	Undersurface waters	risk	Total score
1	4/66	2	2	0/5	0/3	0/65	0/	High	6/35
2	8/53	1/2	1/5	0/5	1	0/8	0/9	Average	5/9
3	3/36	2	2	1	1	1/2	1	Very high	8/2
4	2/63	1/8	1	0/8	0/6	0/65	0/6	Average	5/45
5	11/75	2	0/5	0/8	0/6	1/5	0/6	Average	6
6	3/91	0/8	0/5	1	0/3	0/65	0/5	Low	3/75
7	8/61	0/4	0/8	1/2	1	0/8	0/6	Low	4/8
8	4/77	0/4	2	1/8	0/6	0/8	0/7	High	6/3
9	18/1	1/2	0/4	1/2	1	0/7	0/7	Low	5/2
10	7/64	1/2	0/3	0/5	0/6	1/5	0/7	Low	4/8
11	9/61	2	2	0/5	0/3	0/7	1	High	6/5
12	13/53	2	1	0/8	0/6	0/8	0/4	Average	5/6
13	9/53	2	2	1/8	0/5	0/65	0/6	Very high	7/55
14	4/29	0/4	0/1	1/7	0/6	1/2	0/7	Low	4/7
15	9/87	0/3	1/9	1	1	2	0/9	High	7/1
16	2/31	0/4	0/1	1/7	1	0/8	0/3	Low	33/9
17	3/72	2	1/9	1/4	0/6	0/8	0/8	Very high	7/5
18	0/68	0/3	0/4	0/8	1	0/8	0/4	Low	3/7
19	9/35	0/3	1/5	1/7	1	0/8	0/7	Average	6
20	2/57	0/8	1/8	0/8	0/6	1/2	1	High	6/2
21	2/39	0/8	1/7	0/8	0/6	0/7	1	Average	5/6
22	2/38	0/3	1/9	1/5	0/6	1/8	0/9	High	7
23	6/92	0/4	0/1	1/2	1	2	0/4	Average	5/1
24	3/02	0/4	1/1	0/8	0/3	0/8	0/8	Low	4/2
25	2/8	0/4	1/9	0/8	0/6	1/5	0/8	Average	6
26	2/74	0/4	0/3	0/5	1	1/8	0/4	High	6/4
27	8/81	1/8	2	1/2	0/6	0/6	0/8	High	7
28	6/48	1/5	0/3	0/5	0/3	0/7	0/5	low	3/8
29	2/87	0/2	0/3	0/8	0/3	0/7	0/5	Very low	2/8

C) Structural status

Important geological structures include major and minor faults, slopes, elongation of layers, escarpments and pins. Contrasts in structural discontinuities and slopes are formed by the aforementioned content.

In addition to the inequalities and level disruptions, faults also create new activity domains. In terms of the studied site, after dividing the local mountains into two eastern and western sections, the Piranshahr fault passes through the Zaab Basin and north of Iraq's Kurdistan. It is also parallel to Zagros thrust. With respect to the role of tectonic factors, stones in this area have a wide range of strength. In addition, this area's newer formations are separated from older Precambrian tectonics through thrusts and faults.

Zoning the instability risk of dam and watershed

According to effective factors on instability of skirts in this area, other factors are ranked in each unit. After summing up the scores for each unit, a total score was yielded. And this total score includes the scores of each and every effective factor.

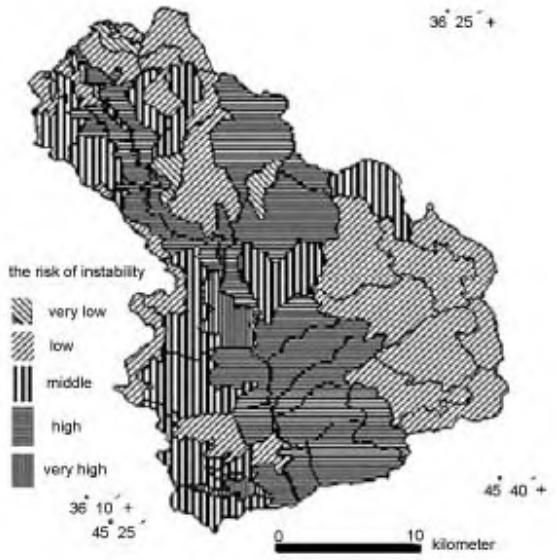

Figure 8: Skirt instability risk zoning map

Conclusions

Nature is the geomorphology's lab and discussing and evaluating geomorphological phenomena not only requires theoretical studies, but also requires certain field inspections and studies in order to be able to obtain feasible results and test these results. This approach was employed in this article and therefore, consistency of results with observed facts has increased the importance of this issue.

According to the developed zoning map, the level of each zone is according to the instability risk in each of eastern and western skirts of Zaab valley in Kolse dam and according to it, 38 percent of this area has an instability risk of high to very high and only two percent of this area has a very low risk.

References

1. Adeli, H. 2008. Geotechnical Engineering, Vol. I, Tehran University Press.
2. Aghanabati, Syed Ali. 2011. Iran Geology, Geological Country.
3. Azhari, M. 2009. Mirghaderi, seyed rasool- discharge levels.
4. H., E. 2011. Leakage of dams and methods of prevention, geology blogs .retrieved in 2015, the www.azut.blogfa.com .

5. Nakin, A. 2012. Page and line measurements made by Clark and Brunton compass, Tarbiat Modarres University.
6. Panahi, Mansour and Mirdar, A. 2005. Harvesting and processing information and training software Stvhanfsal Dips, Institute of Education, Ministry of Industries and Mines.
7. PBO. 2000. Publication 186, Guide injection of hydraulic structures, PBO.
8. Plan and Budget Organization. 2000. Issue 188, instructions permeability experiments, the PBO.
9. Plan and Budget Organization. 2002. Issue 224, instructions Standard Penetration Test (S.P.T.) in geotechnical studies, PBO.
10. Qasemi, Mohammad Reza. 2009. the foundations of structural geology, Geological Country
11. Regulations dam design (standard instructions 2800) Geotechnical Research Center, Third Edition.