Intl. J. Humanities (2017) Vol. 24 (3) (14-29)

Human Settlements and the Role of Natural Disasters: A Case Study of Landslide at Tepe Mehr Ali

Mahmood Heydarian[1], Majid Sarikhani[2], Alireza Sardari Zarchi[3], Yaser Mrdani[4], Mohsen Mardani[5]

Received: 2016/1/18 Accepted: 2018/7/5

Abstract

Natural events and disasters always have a devastating impact on human settlements and incur economic and social effects on societies by destroying buildings and infrastructures. One of these destructive phenomenons is landslide that could damage communities, meadows and forests, communication lines, and monuments extensively in many parts of the globe, especially in mountainous countries such as Iran. Some information is currently available about the morphological cause and effects of some apparent cases. However, the destructive effects of this phenomenon on ancient settlements have not adequately been mentioned. This study examines an ancient landslide by combining data from two seasons of archaeological excavations of Tepe Mehr Ali, located in Fars province, and related interdisciplinary studies. The results of the excavations, geological evidence and morphology of the site indicate that the southern slope of the mound (about 35 degrees) to Balangan River, represent a landslide event leading to the abandonment of this site for some time during settlement periods.

Keywords: Landslides; Tepe Mehr Ali; Balangan River; Ancient Layer; Trench; Geo-Archeology.

---

1. Assistant Professor of Archaeology, Faculty of Humanities, Shahrekord University, Shahrekord ,Iran, heydarianm@yahoo.com (Corresponding Author).
2. Assistant Professor of Archaeology, Faculty of Humanities, Shahrekord University, Shahrekord, Iran.
3. Assistant Professor of Archaeology, Department of Archaeology, Iranian Archaeological Research Center, Tehran, Iran, sardary@yahoo.com.
4. MSc Student, Technical and Mechanical Laboratory of Alborz Province Soil, Ministry of Road and Urban Development.
5. MSc Student, Technical and Mechanical Laboratory of Alborz Province Soil, Ministry of Road and Urban Development.

1. Introduction

Archeological investigations show that landslides have been one of the causes of settlement destruction and survivors' abandoning of their living sites (Jones and Thompson, 1965; Johnson, 1987). Studies on the effect of this phenomenon on ancient settlements (pre historical periods) have been limited to sedimentary examinations in the field of archeology. The purpose of these studies was to comprehend sedimentation background and layers sequence in order to reconstruct the environmental and climatic conditions of human settlements. Mc Burney (1970) proposed worthwhile reports on the ancient climatee of central Zagros through sedimentary data and ancient plants studies as well as excavating the Humian rock shelter. Geo archeological studies reported from 1975 to 1979 on Qara Su River located on the east of Ravansar and the west of Kermanshah and Brookes based on natural layers sequence found out that torrential processes caused burial of many ancient mounds under layers of muddy sediments with 10 meters thickness around the shores of the main river some 10000 years ago (Taheri, 2007). Berberian et al. (2012) studied on the Kashan Fault activity and stated that an ancient earthquake happened in 3800 B.C. and the aftermath climate change caused the springs to get dry and the settlements to destruct in Tepe Sialk in Kashan. Of course, there are many examples of landslides in Iran which can be mentioned below and the features, characteristics, reasons and dangers of some of them and its effect on human's life are studied: Seymareh (Saimareh)/Kabirkouh (Stein, 1940; Harison and Falcon, 1936; Shayan, 2004,), Tang-e-Zireh/Shimbar (Ambraseys and Melville 1982), Gahar Lake/Oshtorankouh (Harrison and Falcon, 1934), Lake Zarivar/Kurdistan (Van Zeist and Bottema, 1977), Shalmanrood/Gilan (Feiznia et al. 2001), Dashtegan-Rudbar (Ekramirad et al. 2012) and Mohammad Abad/Jiroft (Moh ammadi and Tavakoli, 2008).

During two seasons of excavations at Tepe Mehr Ali in the vicinity of Mollasadra Dam in the north of Fars, unknown and discomposed cultural layers were found. Surveying the geomorphologic situation of the layers, analyzing soil-mechanism related issues, and also examining the external and environmental conditions of this territory, it can be claimed that an earthquake happened on this mound. All the archeological data was obtained from trench investigations that were done before mound drowning. The extension of this phenomenon could be estimated if we possibly had at least enough opportunities.

2. Tepe Mehr Ali and its Importance in Archeological Studies of Northern Fars

Tepe Mehr Ali is located near the confluence of two rivers of Balangan and Ghadamgah, 5 kilometers from the south of Sade, a city in the vicinity of Eqlid in the north of Fars (Fig. 1). This mound has a cone shape with approximate measures of 120 and 90 meters - a hectare square. Its height is 11 meters. Rescue archeological excavations on this mound were performed with direct command of the cultural heritage organization in two seasons in 2007 (Sardari Zarchi and Rezayi, 2007 and Sardari Zarichi, 2009), simultaneous with the time of water intake in Mollasadra Dam on Balangan River because of being close to each other.

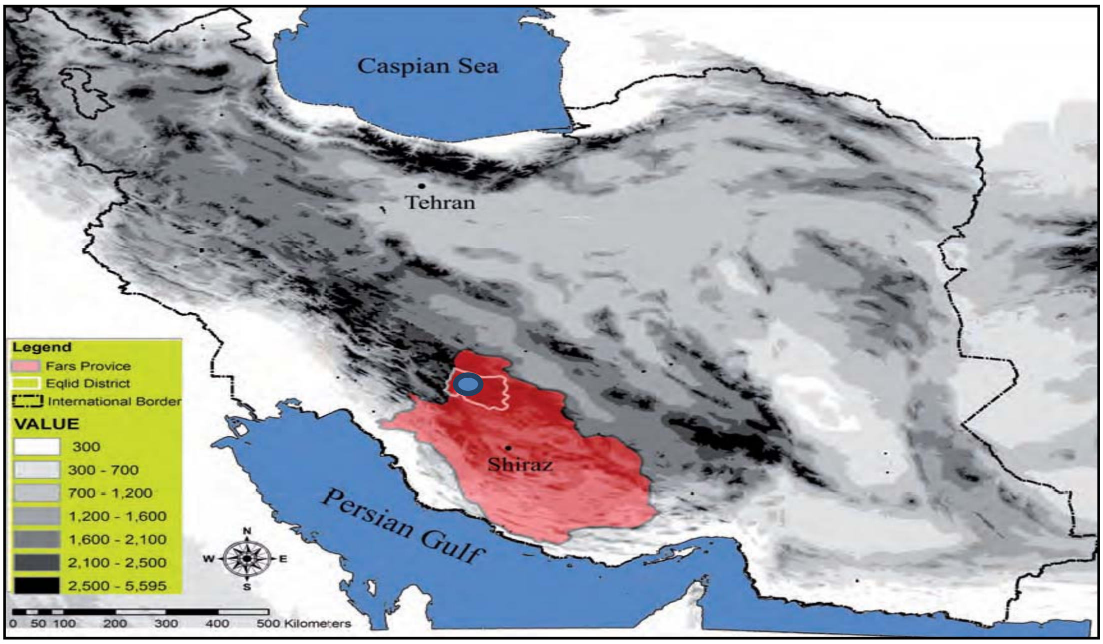

Fig. 1 Location of Tepe Mehr Ali in Sade Plain at West of Eqlid in the North of Fars

According to the results obtained from excavation of 11 surrounding at different spots of the mound (Fig. 2) and radio carbon experimentation of recovered coal pieces, it seems that after a consecutive establishment in the Shams Abad period – 5000 B.C. - until the Banesh period - 3400 B.C., this mound had constituent cultural layers. Data analysis indicated that it was settled during the late Neolithic- early Chalcolithic (Shams Abad) age. Again, in Bacon and Lapoi periods, there was a burst of population and therefore settlements. This mound was abandoned at the end of the late Banesh period. The reason why Tepe Mehr Ali was abandoned in this period therefore requires our attention.

1. Geological Status of the Region

Sade Plain in the west of Eqlid, which is located in the north of Fars, is constituted of upper Cretaceous pack stones in the form of Chile and Marnie covered with alluvium and quaternary alluvial terraces (Fonouni al-Asl, 1997). In terms of Geology, it is covered with alluvium and quaternary alluvial terraces and Pliocene Conglomerates. The surrounding rocky heights have been constituted of lower Cretaceous Hymarni limestone, and upper Jurassic Chile limes. In fact, this is a small section of the southern east Zagros syncline, which is composed of many anticlines and tectonic synclines.

This area of Zagros is regarded as a folded one. One of the geomorphologic features of this section is the Rocky Mount with deep V shape valleys along the vast plains that are surrounded by these parallel mounts and are extended from western north to eastern south. This area of Zagros is located in Fars province, so it is also called Fars Zagros (Alayi Taleqani, 2003). Limestone mountains in this area are located along Iran Karsti Belt; because of abundant raining and high levels of underground water sources, the main proportion of water sources of this plain is supplied by Karsti springs on the hillside. These springs are the main sources of Balangan River, which crosses Sade Plain in the east- west direction. Its geological structure is plain, smooth and constituted of a number of connected ancient lines close to a changing axis with the west-north to east-south direction. Sade plain has a cold and dry weather because of being located in a mountainous surrounding; the average annual rainfall is about 300-330 millimeters in the plain and about 400-600 millimeters on the mounds. Because of too much height (2200 meters in the plain and 3300 meters above sea level), rainfall mostly occurs in cold seasons and in the form of snowing.

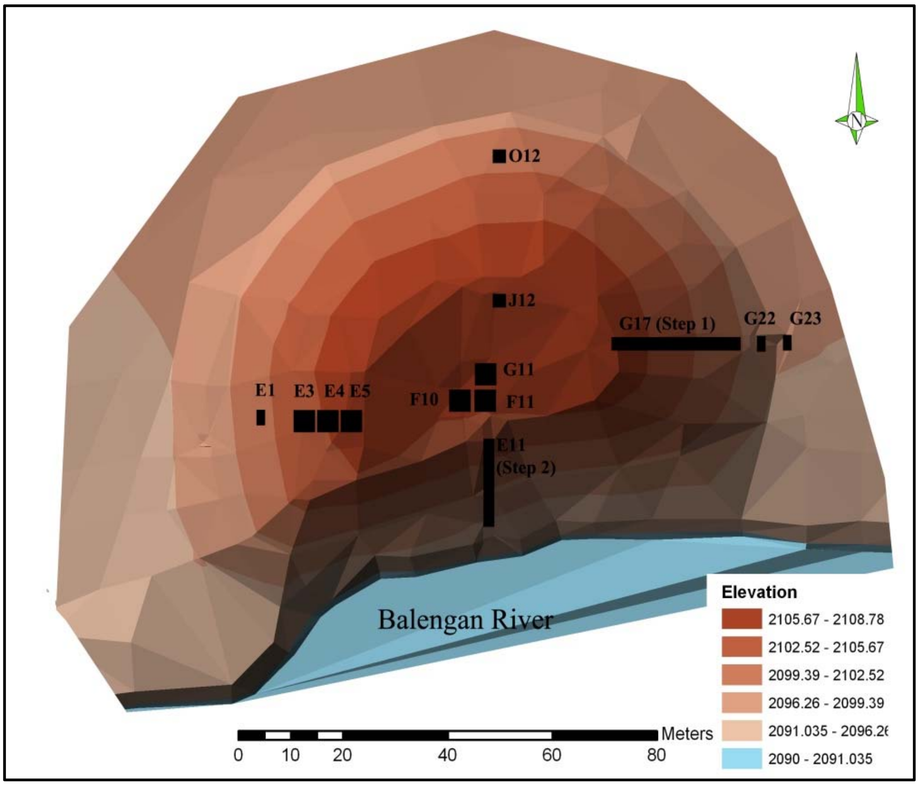

Fig. 2 Location of 11 Major Trenches at Different Spots of Tepe Mehr Ali

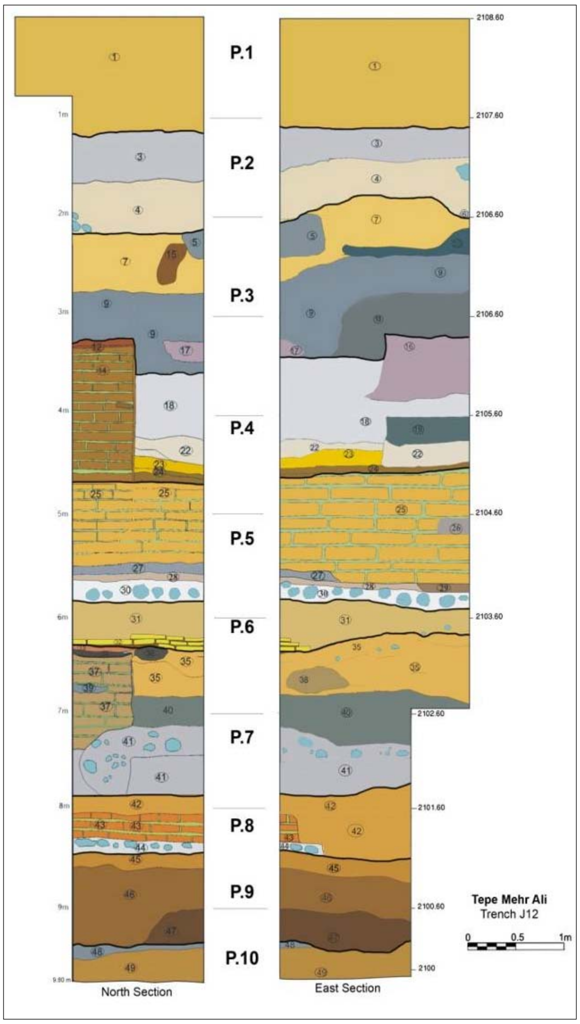

Fig. 3 Stratigraphical Section of Trench J 12.

3. Materials and Methods

Stratigraphy is the first method used in this study. After the excavation, data was collected through discriminating cultural figures and structural information and then recorded them in separate special forms. After recording substrate-related data, by measuring substrate volumes and positioning deposits based on upper, parallel and lower layers, the data was controlled by related plans. After layering the units, it was the time for their descriptive classification. At first, the data obtained from stratigraphy was presented precisely and then the classified description of the substrates in a less specific framework and with a more general consideration was presented. After analysing the raw information obtained from forms, designs and plans, some chronological information was gained about the process of layers' formation, substrates sequential proportion as well as the stratigraphical framework. After a close examination of previous details, a complete chronology was proposed.

Archaeological data collected from 11 trenches on this tepe was surveyed (Fig. 2). Accordingly, finding no trace of landslide, Trench J12 was chosen as the evidential sample for perception of northern deposits of the Tepe (Fig.3). Trenches G11, F11 and F10 located on the surface of the Tepe and parts of the floated mass are discriminators of downfall boundary of slide mass and determiners of the location and depth of rupture and its effect on cultural deposits. Trenches E1, E3, E4 and E5 and Trenches G17, G22 and G23 excavated on the western hillside were investigated with the purpose of measuring landslide dimensions and its effect on cultural layers' formation.

4. Landslide: Features and Occurrences

Conforth (2005) defines landslide as any event occurs as a result of tottery hillside and causes relocation of a mass of materials along with the hillside. This event, as a natural occurrence, is geologically constituent of shakes and processes causing a mass of soil and stone to slide into lower hillsides because of the gravity (Berberian, 1994). Ahmad and Mc Caplin (1999) used the terminology of landslide for all mass movements along with hillsides such as falls, topples and debris flows. Further, landslide as a downside gravity movement of constituent materials of hillsides such as stones, soil or artificial gravel soil which can be in the form of falling, sliding, flowing or a mixture of them (Varens, 1958). In 1978, Kasen, by considering a collection of theories and ideas in 28 articles, defined landslide event as a mass movement with a main element of gravity, which has a rapid movement of ruptured mass (Shariat Jafari, 1996). Sometimes, the movements are so rapid and have a speed of about 10 kilometres per hour and they are so slow and are not intelligible without evidential and time passage (Varnes, 1958). Based on rupture shape, landslides are categorised into two types of rotational and transitive slides (Bromhead, 2010). In the first type, as the name denotes, materials move downward on a U-shape surface, but in the second type, the transferred mass along a rupture surface disc moves downward the hillside. The main features of a landslide are illustrated in Picture 4.

Zezere (1999) proposes that the most prominent cause of landslide occurrence is as follows: geological structure, land applied geology, pre-occurred landslides and human activities. Wu et al (2001) referred to heavy soil texture as the most important cause of landslide. Kumak and Gerald (2001) have identified land slop, geology and surface structure as effective factors on the landslide occurrence. Lidia believes that raining and water are the main causes of landslides among which an intense continuous raining affects geological structure, permeability and hillside slope (Lydia and Bengochea, 2002). Talebi et al. (2007) also propose that slope geometry and temporal changes of the amounts of underground water sources and the depth of underground waters are the main causes of landslides in damp areas. Totally, this event can occur as a result of various geological, geomorphologic, hydrological, biological and humanistic factors though at the starting point of this event, usually, an external stimulus or a trigger is the most determinant factor. Intensive raining, snow melting, changes in underground water sources, earthquake and rapid soil drifting are the main triggers of landslides (Sidle and Ochiai, 2006). Hillside slope and morphology also play important roles in landslide occurrences. Emergence of this factor, an exigent one, strengthens the effective roles of other factors in mass movements. In a similarly shaped landside with symmetric material features, an increase of landside slope has the most coefficients in mass movements (Dai and Lee, 2002). All in all, various factors such as geological features (Lithology weathering, structural factors and seismicity), hydrology and hydrological circumstances, topography, morphology and weather affect stability of the slope can cause landslides (Shoaei and Qhayoumian, 1998; Angeli et al., 2004). These factors can be classified into three: geological, morphological and humanistic factors (USGS: Fact sheet, 2004):

1. Geological factors are weathered fragile materials, ruptured cleaved and creviced materials, discontinuous directing at the opposite side of layering, schistosity, fault, contact surfaces, permeability differences and materials toughness.
2. Morphological factors among which uplifting as a result of volcanic tectonic activities, iceberg melting pressure elimination, river erosion, underground erosion (break up and boiling), sediment uploading on the landsides, vegetation elimination (fire and drought), snow melting, weathering as a result of glaciating and melting, weathering as a result of expansion and contraction are the most prominent ones.
3. Humanistic factors such as excavation and uploading on the hillside, lowering of underground water sources, woodcutting, irrigation, mining, artificial quake fluctuation, and water are affective. It must be noted that humanistic factors play no role in the process of under investigation landslide.

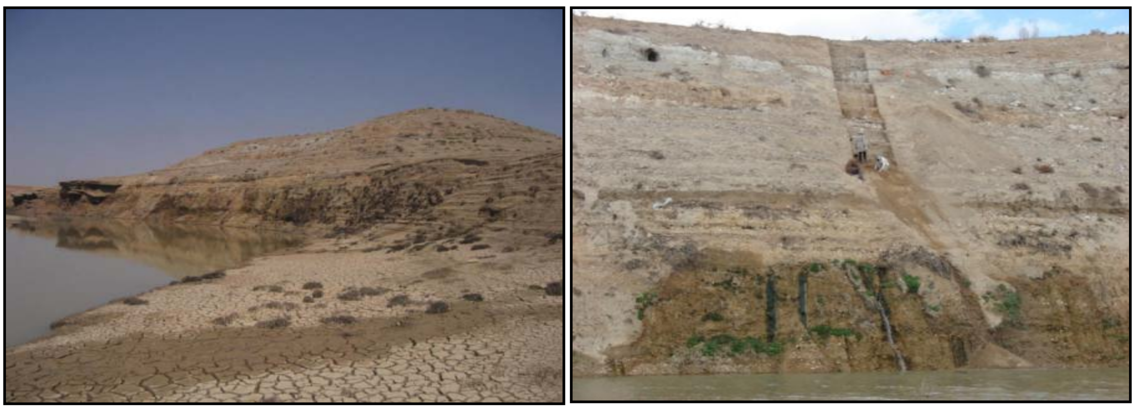

Fig .4 Right: High Level of Underground Waters and Their Flow Through the Mound, Left: Clay Mineral in Between Various Ancient Layers.

5. Evidence of Landslide Occurrence on Tepe Mehr Ali

Mound morphology shows that an ancient landside happened on the southern hillside. We cannot clearly identify many of the evidences of landslide morphology but the abundant of erosion and weathering is an indication of the age of this landslide. On this landside, the shape of the mound changes suddenly and reaches Balangan River with a steep slope (about 35 degrees, Figs. 4, left; 5, 6 and 7). The evidence indicates that the direction of Balangan River changes toward the mound, which is the main cause of hillside. Erosion caused by destructive floods has caused the southern hillside to rupture as a result of the gravity. Other factors affecting the occurrence of this landslide are high level of underground waters and their flow through the mound (Fig. 4, right). The evidence of underground waters was totally apparent in the cuts and partitions of Balangan River during the lowering water season. Existence of such bulky volumes of underground sources is because of alluvial fans on which, the plain as well as the city of Sade are located. The loads and permeation of snow melting waters, and the abundance of clay mineral in between various ancient layers (Fig. 4, left) can have a prominent role in the landslide occurrence. The water permeation inside clay minerals caused the minerals to act as lubricants and decreased soil-cutting resistance, and played an important role

6.1. Environmental Evidence

in landslides occurrence (Fig.5). Permeation of raining and other water sources on the hillside increases pore pressure, decreases soil suction and increases soil weight and finally, decreases soil cutting resistance and causes the hillside to slide (Giannecchini, 2006). But other factors such as water permeation manner, soil features, dampness and raining history must be considered, too (Wieczorek, 1996).

6.2. Archaeological Evidence

The most prominent evidence of landslide occurrence belongs to the eastern cut of Trench F10 (Figs. 8 and 9). The pictures and plans of this trench show rows of brick layers that are crooked in an abnormal shape. These evidences are also obvious in Trench F11 (Fig. 10), which is the adjacent trench. Investigating the layers of the eastern and western walls of these trenches and comparing them with Trench J 12 (Fig. 3) as the control trench that was not affected by landslide clearly shows that the ancient layers are cut, crooked and disordered. The crookedness and cut of the walls toward the south are visible along with eastern and western walls of Trenches F10 and F11 and are visible from a depth of 1 meter to 5 meters in all layers. In deeper places, the layers are horizontal again (Sardarizarichi and Rezayi, 2007).

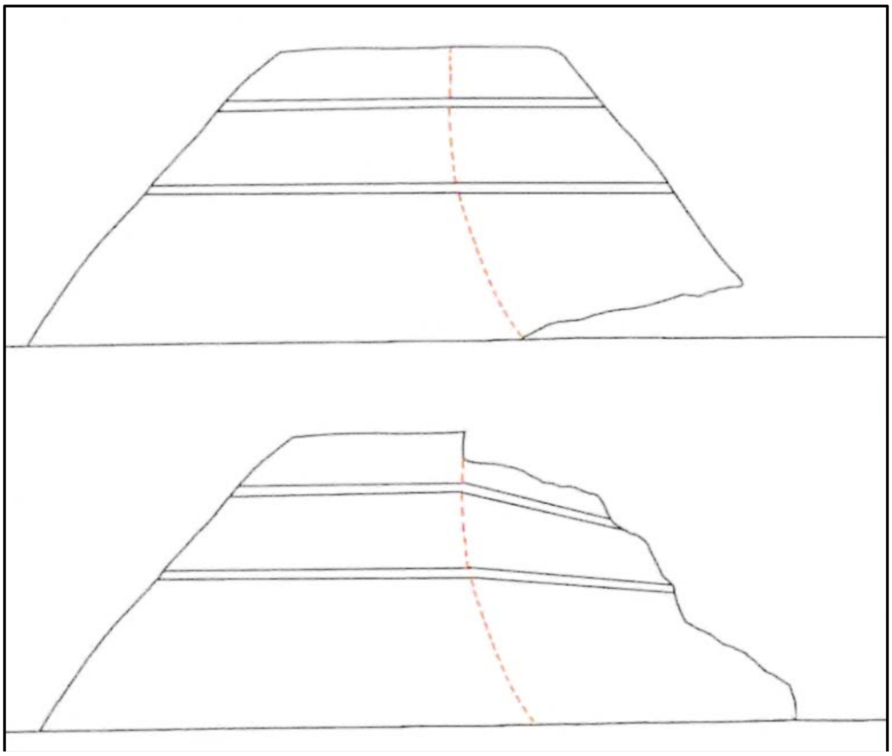

Fig. 5 Schematic Design of Landslides Occurrence Mechanism, Water Permeation on Southern Slopes of Tepe

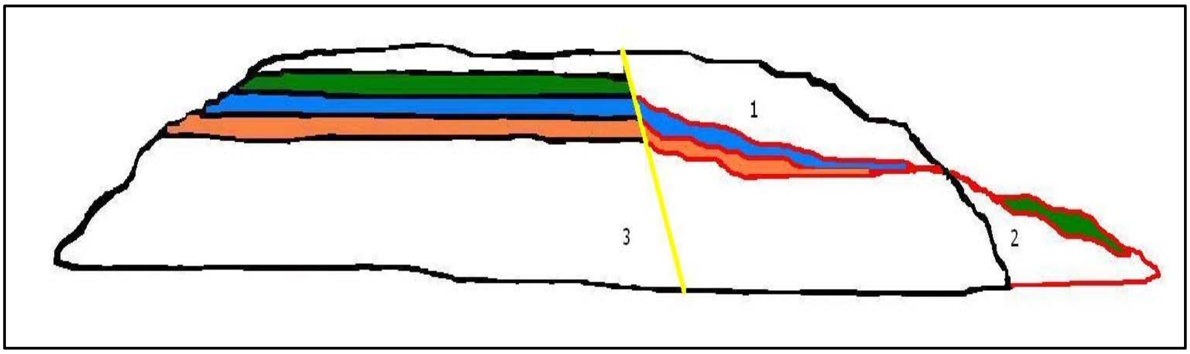

Fig. 6 Schematic Design of Landslides Occurrence Mechanism,1: Empty Zone,2: Accumulation of Displaced Material, 3: Boundary Level of Rupture.

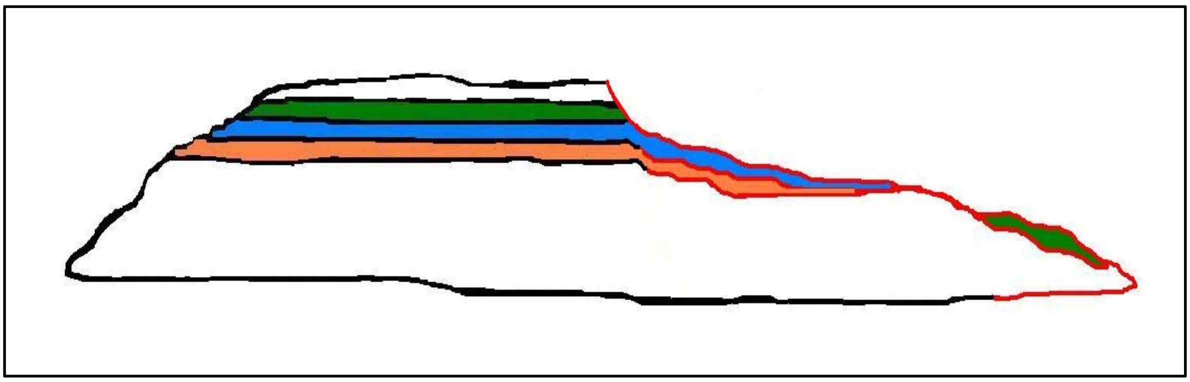

Fig. 7 Schematic Design of Landslides Occurrence Mechanism

Fig. 8 Trench F 10, Top: Brick layers that are Crooked in an Abnormal Shape

Fig. 9 Trench F11, View of Eastern Wall of Trench, Brick Layers that are Crooked Abnormally

Investigating the cultural layers of Trench F11 indicates settlement of a rocky wall (Fig. 10) on the landslide ruins. This rocky wall, which was the first archaeological layer, obtained from excavations and horizontally settled on the destroyed walls of the Lapoi period, which belongs to the ancient Banesh period. Based on the settlement of this wall on the underlying ruins and its horizontal shape, it can be inferred that it was established after the landslide. Therefore, the estimated time for the landslide occurrence could be some time toward the end of the Lapoi period, which was before the start of the Banesh period.

According to the evidences from the parallel layers in other trenches, it can be stated that this subsidence happened toward the end of Lapoi period. A one to three meters' surface difference had extensive effects on the territory. As noted earlier, the time of landslide occurrence is estimated to be toward the end of the Lapoi period, around 3500 B.C. From that time on and after destroying the settlement, except for its southern part in the ancient Banesh period we can see people's inhabitancies on the whole territory of this mound. Trench D11 is an evidence for this claim. This trench is the only one whose excavation resulted in access to untouched soil. We can see a cultural development since the pre-Lapoi to Lapoi periods. But after the landslide, there is no sign of settlement on this mound. The only investigated layers and obtained data after this phase show many cumulative and sedimentary layers of soil and ash and structures like garbage pits. It seems that the next period inhabitants will use this mound as a place for cumulating garbage.

Fig. 10 Trench F 11: The Rocky Wall, Which was the First Archaeological Layer, Obtained from Excavations and Horizontally Settled on the Destroyed Walls of Lapoi Period

6. Conclusion

This study has investigated an ancient landslide occurrence through discriminating archaeological data and geological evidence. If it was possible to do more case studies on this phenomenon, certainly, more rich and precise conclusions could be accomplished though such a claim is possible with the available data. In satellite pictures, Balangan River direction toward Tepe Mehr Ali in different eras has been completely shown (Fig. 11). This change of direction of Balangan River and finally, drowning and cutting southern areas were the main causes of the Tepe Mehr Ali landslide. But it was not the only cause. In addition to destructive torrential undercutting that caused the southern hillside to rupture because of the gravity and are still continuing, some other factors can also be referred to as triggers such as high levels and flow of underground waters through the mound, heavy snow weight on the hillside, permeation of snow melting waters and abundant amount of clay minerals in between the ancient layers. Among these factors, the water permeation in clay minerals caused them to act as lubricant and decrease soil-cutting resistance and play an important role in landslide occurrence. The most obvious archeological evidences of this phenomenon are the crooked layers and their falling in Trenches F10 and F11 showing the extensiveness of the landslide on the mound. From these trenches toward the north of the mound, there is no sign of landslide. Investigation of cultural layers obtained from Trench F11 shows the settlement of a rocky wall on the landslide ruins. This wall, which is found while excavating the first archeological layer, belongs to the ancient Banesh period and is settled horizontally on the ruins and destroyed walls of that period.

According to horizontal settlement of this wall on the ruins, it can be deducted that its structure belongs to the post-landslide era. Therefore, the landslide might have occurred toward the end of the Lapoi period and the beginning of the Banesh period. More precisely, if we consider the above settlement as the last one on Tepe Mehr Ali, based on the experiments on sample coal pieces, the estimated time of the landslide occurrence can be at 3500 B.C. In Picture 18, the form of rocky wall settlement on ruins is shown in the western cut of Trench F11. The length of the wall in northern and southern sides indicates that it is horizontal.

Fig. 11 Aerial Map of the Tepe in the Balangan River

References

[1] Ahmad, R., and J. P. Mc Caplin, (1999). “Landslide Susceptibility Maps for the Kingston Metropolitan Area Jamaica”. http//www.oas.org/en/cdmp.

[2] Alayi Taleqani, M., (2003). *Geomorphology of Iran*, Second Edition. Tehran: Ghoomes Publishing Company Ltd.

[3] Ambraseys, N. N., and C. P. Melville, (1982). *A History of Persian Earthquakes*. London: Cambridge University Press: 219.

[4] Angeli, M. G., P. Gasparetto, and E. Bromhead, (2004). *Strength-regain Mechanisms in Intermittently Moving Landslides*. Rio de Janeiro, Vol. 1. London: Taylor and Francis: 689-698.

[5] Berberian, M., (1994). Master "blind" Thrust Faults Hidden under the Zagros Folds: Active Basement Tectonics and Surface morph tectonics. *Tectonophysics*.

[6] Berberian. M., S.Malekshahmirzadi, J. Nokandeh, and M. Djamali, (2012). Archeoseismicity and Environmental Crises at the Sialk Tepe, Central Iranian Plateau, since the early Neolithic; *Journal of Archeological Science*; Elsevier.

[7] Bromhed, E. N., (2010). *Landslide Slip Surfaces: Their Origins, Behavior and Geometry*. London: Kingston University.

[8] Conforth, D. H., (2005). *Landslides in Practice*, John Wiley & Sons, Inc.

[9] Dai, F. C., and C. F. Lee, (2002). Landslide Characteristics and Slope in Stability Modeling using GIS Lantau Island Hong Kong. *Geomorphology*, H2: 213-228. (In Eng.).

[10] Ekramirad, S. A., A. Eslami,and J. Razag hI, (2012). Dashtegan-Rudbar Huge Landslide (Rasht- Qazvin, Freeway Route): Investigation and Method of Stabilization, *Sharif Journal* (Civil Engineering), Vol. 2-28, Issue 1: 119-127.

[11] Feiznia, S., H. Ahmadi and M. HassanzadehNafuti, (2001). Landslide Hazard Zonation in Shalmanrood Basin in Gilan Province, *Iranian Journal of Natural Research*, Vol. 54, Issue 3 (873): 207-219.

[12] Fonouni Al-asl, B., (1997). 'Structural Study Tang-e Boraq for Assessment of Engineering Properties of Mullasadra Dam in North of Fars', Master of Science Thesis, Shahid Beheshti University, Tehran, Iran.

[13] Giannecchini, R., (2006). Relationship between Rainfall and Shallow Landslides in the Southern Apuan Alps (Italy), *J Nat Hazards Earth Syst Sci* 6, 357-364.

[14] Harison, J. V. and N. I. Falcon, (1936). An Ancient Landslide at Saimareh in Southwestern Iran, *Geo*, Vol. 46.

[15] Harrison, J.V., and N. L.Falcon, (1934). Collapse Structures (Kuhgalu District, Persia). *Geol. Mag.* 71 (846), 529-539.

[16] Johnson, R. H., (1987). Dating of ancient, deep-seated landslides in temperate regions. In: M. G. Anderson and K. S. Richards (Editors), *Slope Stability*, New York: John Wiley and Sons: 561-600.

[17] Jones, G. D. B., and F. H.Thompson, (1965). Excavations at mam Tor and Brough-en-Noe. *Derbyshire Archeol. J.*, 85: 89-93.

[18] Kumac, M., and F. Gerald, (2006). A Landslide Susceptibility Model using Analytical Hierarchy Process Method and Multivariate Sratisticsim Perialpine Slovenia Geomorphology, Vol. 74: 17-28.

[19] Lydia, E. E., and D. Bengochea, (2002). Landslide Hazard and Risk Zonation Mapping in the Rio Grande Basim, Central Andes of Mendoza *Argentina Research and Development*. Vol. 22: 177-185.

[20] Mc Burney, C. B. M., (1970). Paleolithic Excavation in Zagros Area, *Iran*, Vol. 8: 185-186.

[21] Mohammadi, M. and H. Tavakoli, (2008). Determination of Pre-Sliding Geometry in Landslides Considering of Mohammad Abad-Jiroft, *Sharif Journal* (Civil Engineering), Vol. 24, Issue 44: 59-63.

[22] Sardari Zarchi, A. R., (2009). Report of the Second Season Rescue excavations of the TappehMehr Ali, Eghlid Fars, Archive Center for Archaeological Research Documents, Cultural Heritage, Handcrafts and Tourism Organization.

[23] Sardari Zarchi, A. R., and A.Rezaei, (2007). Report of the Rescue Archaeological Investigations on the Tepe Mehr Ali, Eghlid Fars, in Archaeological Reports (7): the 9th Annual Symposium on Iranian Archaeology, Iranian Center for Archaeological Research, Tehran, Vol. 2: 155–72 (in Persian).

[24] Shariat Jafari, M., (1996). *Landslide (Basics and Principles of Stability of Natural Slopes*), TehranL Sazeh Publishing Company Ltd.

[25] Shayan, S., (2004). Geomorphologic Evidences in the Large Age Landmark of Samarra (KabirKouh) Zagros, Southwest of Iran. *The Moderator of Humanities*, Spring 2004, Vol. 8, Issue 1 (32): 45-70.

[26] Shoaei, Z., and J. Qhayoumian, (1998). Seimareh Landslide, the Largest Complex Slides in the World, Proc. Eighth International Congress.

[27] Sidle, R. C., and H. Ochiai, (2006). *Landslides Processes, Prediction, and Land Use,* Water Resource Monograph: 18, AGU books, ISSN: 0170-9600.

[28] Stein, A., (1940). *Old Routes of Western Iran. London*, 1940. Reprint New York, 1969.

[29] Taheri, K., (2007). Reviews the History of Geoarcheology in Iran, 26th Symposium of Geosciences, Tehran, Ministry of Industries and Mines, Geological and Mineral Exploration of Iran. For more information: http://www.civilica.com/Paper-GSI26-GSI26_363.htm.

[30] Talebi, A., R.Uijlenhoet, P. A. Troch, (2007). Soil Moisture Storage and Hill Slope Stability, *J Nat Hazards Earth syst Sci* 7: 523-534.

[31] U. S. Geological Survey, Landslide Type and Processes, Fact Sheet 2004 -3072, July 2004.

[32] Van Zeist, W. V., and S. Bottema, (1977). Palynological Investigations in Western Iran. Palaeohistorial, XIX, 20-85.

[33] Varnes, D. J., (1958). Landslide Types and Process. In Special Report29: Landslide and Engineering practice (E.B. Eckel, Ed.) HRB, National Research Council, Washington, D. C: 20-47.

[34] Wieczarek, G. F., (1996). Landslide Triggering Mechanisms, In: Landslides: Investigation and Mitigation, Washington DC: Transportation Research Board, National Research Council, Special Report: 76-90.

[35] Wu, S., L. Shi, R. Wang and R. Xu., (2001). Zonation of the Landslide the Fore serviorvegion Engineering Geology, Vol. 74: 17-28.

[36] Zezere, J. L., (1999). Landslide in the North of Lisbon Region (Portugal): Conditioning and Triggering Factors, Phys. chem. Earths (A), Vol. 24: 925.

استقرارهای انسانی و نقش عوامل طبیعی؛ مطالعه موردی زمین لغزش تپه مهرعلی فارس

محمود حیدریان[۱]، مجید ساریخانی[۲]، علیرضا سرداری زارچی[۳]، یاسر مردانی[۴]، محسن مردانی[۵]

تاریخ دریافت: ۱۳۹۴/۱۰/۲۸ تاریخ پذیرش: ۱۳۹۷/۴/۱۴

چکیده

حوادث و بلایای طبیعی همواره تأثیرات مخربی بر سکونتگاه‌های انسانی وارد آورده و با تخریب ساختمان‌ها و زیرساخت‌ها، عوارض اقتصادی و اجتماعی بی‌شماری بر جوامع انسانی تحمیل می‌کنند. از جمله این پدیده‌های مخرب که از دیرباز فعالیت‌های بشری را تحت تأثیر قرار داده، پدیده زمین‌لغزش است که در نقاط زیادی از کره زمین خصوصاً کشورهای کوهستانی مانند ایران خسارت‌های وسیعی به جوامع انسانی، مراتع و جنگل‌ها، خطوط ارتباطی، بناهای تاریخی و ... وارد کرده است. امروزه اطلاعات زیادی در مورد علت وقوع و آثار ریخت‌شناسی برخی از نمونه‌های بارز این پدیده در دست است. مطالعات مربوط به این لغزش‌ها بیشتر در پی توصیف ابعاد، آثار ریخت‌شناسی و عوامل مؤثر در رویداد آنها بوده است. کمتر کسی به تأثیر مخرب آن‌ها بر استقرارهای انسانی تأکید کرده و تاکنون ویژگی‌ها، مشخصات، عوامل رخداد و مخاطرات این پدیده که در لایه‌های باستانی یک استقرار انسانی به وقوع پیوسته باشد، مورد مطالعه قرار نگرفته است. پژوهش حاضر با تلفیق داده‌های باستان‌شناختی حاصل از دو فصل حفاری نجات‌بخشی تپه مهرعلی فارس واقع در استان فارس و مطالعات میان‌رشته‌ای مرتبط، به بررسی پدیده‌ای نادر از یک زمین‌لغزش باستانی می‌پردازد. نتایج حاصل از حفاری‌های باستان‌شناسی، شواهد زمین‌شناسی و نیز ریخت‌شناسی تپه گویای وقوع تغییراتی در لایه‌های باستانی است. دامنه جنوبی تپه که با شیب تندی (درحدود ۳۵ درجه) به رودخانه بالنگان می‌رسد، نشانگر رویداد یک زمین‌لغزش باستانی است که منجر به ترک استقرار در دوره‌ای از دوره‌های استقراری موجود در تپه شده است.

واژه‌های کلیدی: زمین لغزش، مهرعلی، بالنگان.

۱. استادیار باستان‌شناسی، دانشکدهٔ علوم انسانی، دانشگاه شهرکرد، ایران. madel@ut.ac.ir (نویسندهٔ مسئول).

۲. استادیار باستان‌شناسی، دانشکدهٔ علوم انسانی، دانشگاه شهرکرد، ایران.

۳. استادیار باستان‌شناسی، پژوهشکدهٔ باستان‌شناسی پژوهشگاه میراث فرهنگی و گردشگری، تهران، ایران.

۴. دانش‌آموخته کارشناسی ارشد و کارشناس ژئوتکنیک شرکت آزمایشگاه فنی و مکانیک خاک استان البرز، وزارت راه و شهرسازی.

۵. دانش‌آموخته کارشناسی ارشد و کارشناس ژئوتکنیک شرکت آزمایشگاه فنی و مکانیک خاک استان البرز، وزارت راه و شهرسازی.