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[1] Associate Professor, Department of Archaeology, Shahrekord University, Shahrekord, Iran (Corresponding author)
E-mail:sarikhani.majid@sku.ac.ir

[2] Associate professor, Department of Archaeology, Shahrekord University, Shahrekord, Iran.

[3] PhD Student, Department of Archaeology, Tarbiat Modares University, Tehran, Iran.

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RESEARCH ARTICLE

The Effects of Inundation on Archeological Materials: The Case Study of Jamalo Village/Archeological Site in Zayanderoud Dam, Chaharmahal and Bakhtiari Province, Iran

Majid Sarikhani[1], Mahmood Heydarian[2], Mahdi Alirezazadeh[3]

Abstract: This paper, reflecting on the village and archaeological site of Jamalo located on the top of the Zayanderud dam, aims to explore the circumstances human settlements would have encounter with the construction of the dam and when its reservoirs were flooded. About 30 years ago, as the images from Google Map showed, the water strip emerging from the Zayanderud dam, wherein the left riverbank hosted the village and archaeological site of Jamalo. This site had been occupied for much of the sixth and fifth millennium BC until the beginning of the Early Bronze Age. In the Middle Bronze Age, it had been dominated by the Proto-literate, historic, and Islamic periods. Archaeological evidence from surface surveys also indicated that pottery shreds were similar to those of Sialk III and Bakun A. Now, Jamalo is exposed to the waters of the dam reservoir. Therefore, the main objective of this paper is to provide an overview of what would have happened to archaeological sites with the construction of the dam, its reservoirs were flooded, and when landscapes were radically altered. Another question was: "What would have happened to archeological sites as floods made it inaccessible?" Based on the excavation at Jamalo and the comparison of images taken from the region before and after the construction of the dam, it was observed that the reservoir had destroyed the village, and the slopes of the site, especially on the eastern and northeastern parts, had been covered with a layer of deposits.

Keywords: Jamalo Archaeological Site; Zayanderud Dam; Reservoir; Jamalo Village; Central Iran.

Introduction

Large dams are constructed for electricity generation, water storage for irrigation, industry, or human consumption, flood control, navigation, as well as recreational activities (Snyder *et al.,* 2004: 2). However, the problem is that dams and their reservoirs can naturally have direct impacts on the environment, populations living nearby, as well as the cultural heritage. Moreover, changing sediments in aquatic ecosystems, greenhouse gas emissions, evaporation, and seismic activities are some of the environmental effects and even forced displacement and risks to human health (Lindström and Granit, 2012; Timofti*, et al.,* 2013; Houqun *et al.* 2010), together with the inundation of archaeological materials are among the social effects of such constructions.

Dams have been invariably constructed around river basins, where people have been living for long periods, often from the prehistoric period to the present time. They can also influence very large areas, encompassing some cultural regions and tribal or indigenous groups (Brandt and Hassan, 2000: 12). No one knows the impact of those dams on archaeological sites especially when their reservoirs are flooded, and landscapes are radically altered. Even when much attention is paid to cultural resources before or during the construction of dams and reservoirs, long-term impacts are seldom anticipated or realized (White, 2000: 21). After such occurrences, human and natural processes are damaged or many archaeological sites are destroyed. Among some other effects, one can cite looters' access and increased recreational and commercial traffic. In low-elevated areas, they may be buried deeply and cannot be located by traditional hand excavation. In addition, some studies have shown that the freshwater reservoir can seriously corrupt radiocarbon dating of materials acquired from inland sites. These include human bones, whose subsistence was based on freshwater fish, and the pottery in which fish was cooked (Philippsen, 2013: 1).

The construction of the Zayanderud dam in central Iran also constrained several local settlements to be displaced in its surrounding areas (Figure 1). A total number of five villages, i.e., Yancheshmeh, Abadchi, Murah or Baba Aghdaghan, Jamalo, and Ghaleh Raeis, along the Zayanderud River were displaced in Isfahan and Chaharmahal and Bakhtiari provinces. Some sites like Jamalo, Ashna, and Koganak also went under water (Kosari, 1968). Jamalo contains the Chalcolithic, Early Bronze Age, and Proto-literate, historic, and Islamic periods. The reservoir dropped in recent years. Moreover, the occurrence of drought over recent years reduced the capacity of the dam from 1.6×109cm to 150mcm and had harmful impacts on different water resources systems of the area such as dryness of the Gavkhouni swamp as well as a reduction in agricultural and industrial water availability (Shafiee and Safamehr, 2011: 29). A few years ago, satellite imagery showed the water of the lake of Zayanderud dam, where the left bank of the river hosted the village and archaeological site of Jamalo. Figure 2 is reproducing the images on Google Maps, illustrating 2006 and 2020 extents of the water reservoir behind the dam. In the lower-right part of the image, the region after the emergence of the flood and the delta deposits as found in the images on Google Maps in 2019 can be seen for comparison purposes. The main objective of this paper was thus to discuss the role of the dam reservoir on Jamalo village and archaeological site based on the satellite imagery and trial excavations. The main research question addressed was what happened to this village and archaeological site after the dam was flooded. This contribution represented one of the first published attempts to study the sedimentary contents of a medium-sized reservoir on an ancient site in Iran, by proposing a comparison of images before and after the creation of the reservoir. It is hoped that many similar studies will be conducted in the future.

Characteristics of the Research Object

Tepe Jamalo: Topography, Landscape, and Archaeology

The site of Tepe Jamalo (Universal Transverse Mercator [UTM] 39S; 459655 E; 3619848 N; 2068 m above sea level) is located 25km to the northwest of the city of Ben and 5/6km north of Heydari village in the north of Chaharmahal and Bakhtiari province (Fig. 1). There is a rocky hill near the site, 150m in height, extending along the eastern part. The surrounding landscape consists mainly of fertile fields, and the Jamalo plain can be seen to the east-west of the site. The archaeological site has an area of about 220×180m and is approximately 20m in height, above the surface of the nearby plain. The site lies to the northeast of the Jamalo plain, adjacent to the Zayanderud River, running 150m to the north, as a major attraction to occupation in the surrounding area. Since the site is adjacent to the river, surface materials have been trodden by local people and their herds, resulting in their breakup. Tepe Jamalo was first identified by Kosari in 1968, following short visits to Esfahan and Chaharmahal and Bakhtiari provinces (Kosari, 1968).

The Chaharmahal and Bakhtiari region has remained relatively unexplored in terms of both chronology and settlement patterns. Due to the limited chronological data from this region, a comparative approach with Khuzestan and Fars regions as well as the central and western Iranian Plateau was utilized, which could have diagnostic chronological traits. Pottery production in the Chaharmahal and Bakhtiari region is characterized by arising factors due to the influence of neighboring cultures. This influence can be attributed to the transfer of potters or technologies as well as knowledge of pottery-manufacturing processes to the area, perhaps through nomadic activities and movements (Heydarian *et al.* 2020). Based on the surface findings (Fig. 3 and Table 1), it seems that Tepe Jamalo was first settled in the second half of the sixth millennium BC, after the invention of pottery. The site then continued to be dominated for much of the sixth and fifth millennium B.C., until the beginning of the Early Bronze Age. In the Middle Bronze Age, it had been also dominated by the proto-literate, historic, and Islamic periods. Some pottery shreds on the surface were similar to those of Khuzestan and Fars regions, and the central and western Iranian Plateau.

Early Chalcolithic potteries can be classified into two main types of buff and red-slipped (Fig. 3A). Some are painted with dots at the end of a line, parallel and curved lines, crisscross lines, filled squares with crossed lines, and vertical ladder designs on the body and rims. These potteries correspond to

Ga'far-Abad, levels 3 m-n (Zagarell, 1982: 27) in Khuzestan. The large vat forms can be also found at Ga'far-Abad, Govi, Choqa Mish, Choqa Sefid (Ibid, 1982: 28). Some motifs can be further paralleled at Ga'far-Abad, level 6-4 (Dollfus, 1975 Fig. 20_8) and Tepe Sabz, Sabz phase (Hole *et al.* 1969 Fig. 50h).

Many ceramic shreds in the Middle Chalcolithic phase (Figures 3A and B) have revealed a very close relationship in terms of parallel bands and lines, undulating lines, hanging triangles, checkerboard patterns, ladders, and dot motifs with those from Tall-i Bakun in the Fars region, Iran (periods, A and B ca. 6th BC), from Choqa Mish in the Khuzestan region, Iran (Middle and Late Susiana ca. 5200-4000 BC), and to some extent from the central and western Iranian Plateau (Khosrowzadeh, 2012; 2015; Yousefian Darani, 2017). A raised base of similar ware is paralleled at Ga'far-Abad (Dollfus, 1975, Fig. 145). "Much of the material shows a closer relationship with the Fars variant of black on buff wares, rather than with that of Khuzestan, particularly in the later Afghan phase" (Zagarell, 1982: 39). In the Late Chalcolithic phase (corresponding to Early and Late Uruk and the Ghamdat Nasr periods of Mesopotamia and Khuzestan); the pottery can be divided into four major groups, i.e., painted buff ware, red, red-slipped ware, and unpainted buff ware. Parallels can be also found at Godin VI/V and Yahya level IVc, and less certain parallels at tall-Gazir and Susa (Zagarell, 1982: 40).

Alongside these wares, many other forms appear on the site. Several examples of a small bowl or large tumbler were also found on the site (Figure 3C). Some of these wares might be classified as beveled rimmed bowls, but the extended rim is much less pronounced than the forms discussed under beveled rim bowls. This form appears among the wares of Godin VI (Young, 1969: Fig. 8_9) and at several lowland sites, including Susa (Zagarell, 1982: 44). A small number of chipped stone pieces (including, 15 blades, 9 bladelets, 3 cores, 2 flake cores, and 28 flakes) have been additionally collected from the site (Fig. 3D). Chert was further used as a raw material, varying in color from yellow to pink, dark brown, grey, dark grey, red, and reddish-brown. No obsidian tools were found.

Zayanderud River, Dam Reservoir, and Archaeological History

Zayanderud (means in Persian, “life-giving river”), also spelled as Zayanderood, is the largest river in central Iran, stretching over a distance of 355 km and passing through the historic city of Isfahan before ending in the Gavkhouni swamp, as a seasonal Salt Lake, in the southeast of the city (Ahmadi and Shamsai, 2009: 26). The Zayanderud river basin has an area of 45,000 km^2 (16,000 m^2), altitude from 3,974 m (13,038 ft) to 1,466 m (4,810 ft), an average rainfall of 110 mm (5 inches), and a monthly average temperature of 3-29°C (Sarhadi and Soltani, 2013: 28). The lake of Zayanderud dam, known as Chadegan reservoir, with a capacity of 1.6×10^9 cm is also located 115 km from the city of Isfahan in central Iran. The dam project was a major hydroelectric one between 1965 and 1970 to help stabilize water flow, generate electricity, and provide drinking water to Isfahan, Chaharmahal and Bakhtiari, and Yazd provinces (Shafiee and Safamehr, 2011: 29). The River Basin Surveys, developed by the Department of Archaeological and Popular Culture, were also operated from 1968 to 1969. A total number of five villages of Yancheshmeh, Abadchi, Murah or Baba Aghdaghan, Jamalo, and Ghaleh Raeis along the Zayanderud River in Isfahan and Chaharmahal and Bakhtiari provinces were thus displaced. Some sites like Jamalo, Ashna, and Koganak then went under water (Kosari, 1968). After the water dried out, the archaeological research picked up again on the west bank of the river in 2015, recorded over 65 sites in Ben County (Arab, 2015). The archaeological record extended from the prehistoric period up through the Islamic one. “The earliest evidence of human occupation along the river is found in a cave site, called Qaleh Bozi, near Dizicheh in the southwest of Isfahan. More than 40,000 years ago, groups of Paleolithic hunters had used Qaleh Bozi caves as a shelter for seasonal or temporary occupations and had left their stone tools and the bones of hunted animals” (Biglari, *et al.,* 2007; Elhami, *et al.,* 2004; Jaubert, *et al.,* 2006). Reducing rainfalls and droughts over the past 15 years have accordingly caused the decline of water in the reservoir of Zayanderud dam and the size of the lake is decreasing year by year. The event also led to the emergence of the Jamalo site from the water. Due to the limitations of archaeological studies in 1968, as well as the special condition of the site due to the richness and expansion of evidence (Neolithic to Islamic period), and the probability of falling under water again, the arena and the proposed privacy to the site towards the mid of 2018 have been thus far determined (Heydarian and Sarikhani, 2018).

Materials and Methods

As previously mentioned, the main objective of this paper (i.e. discussing the role of the dam reservoir on Jamalo village and archaeological site) was based on satellite imagery and trial excavations. In the first section, the comparison of images before and after the creation of the reservoir was thus employed. The use of satellite images, in particular of the free service connected with Google Maps, could be also helpful. To make a proper comparison between the images, the original ones on Google Maps were rotated and resized with the GNU Image Manipulation Program (GIMP). In the next section, test trenching, as a rapid and inexpensive method was practiced. The collected materials consisted of potsherds and stone tools from different parts of the site. Survey methods, from close inspection to trial trenches, were further utilized for the excavation of subsurface tests. The field strategy here was to locate higher densities of pottery and stone tools on the surface of squares, and then place test trenches around such clusters in the hope that they would yield the materials in situ. The survey and excavation teams also covered 396 10×10 m squares for systematic sampling, and recorded the digging of 13 trenches, measuring 1×1 m except for J.A 09, which was 1.5×1.5 m (Heydarian and Sarikhani, 2018).

Results

The flooded area used as a reservoir, was cleared of the human population. A total number of five villages, i.e., Yancheshmeh, Abadchi, Murah or Baba Aghdaghan, Jamalo, and Ghaleh Raeis along the Zayanderud River in Isfahan and Chaharmahal and Bakhtiari provinces were displaced. So far, no research has been done, to the best of the authors' knowledge, on "mitigating relocation damage, such as the loss of home and livelihood, to protect both populations that are being displaced and the ones that accept them" (Brandt and Hassan, 2000: 2). At the time of the construction of the dam, there had been no attempt to reflect on "the cultural resources of living populations like their mode of subsistence, social organization, religion, ideology, political organization, language, and the material expression of their ideas and practices, ranging from sacred elements of the natural landscape to artifacts and buildings, and even archaeological resources, which may or may not be an integral part of the cultural heritage of the local inhabitants" (Brandt and Hassan, 2000: 2). Moreover, Jamalo, Ashna, and Koganak sites went under water.

Satellite Imagery Comparisons

Figure 4 illustrates the site locations. The left image accordingly indicates the distribution of the village and the site near the Zayanderud River. For some parts of the riverbank, there are high potentials for the localization of archaeological remains. The blue marker in the image on the right side represents the enhancement of the dam reservoir. The underwater buildings have all been destroyed but those remained out of the water are less damaged (such as a big house in Figure 4, the green oval). Anything such as doors, windows, carpets, etc., which can be moved or are expensive, have been also collected from this big house. A similar activity was further done for other houses in Jamalo village. The villagers had taken what they could carry with them. This included anything portable or economically viable. In the right image, around the site, there are areas where the ground is covered by small bulges, round with flattop or with depression as a whole. In the front riverbank, the strip of land, suitable for settlements, is so narrow that the river is supported, and is supporting the cultivated fields.

There have been considerable debates whether submerged archaeological sites will be preserved for the future or not. This argument has been thus used to prevent any cultural heritage management activity from taking place at dam projects. While this can be conceivably true for stone structures, it is not the case for mud-brick architecture, which forms the vast majority of ancient constructions. Experience in the Zayanderud reservoir area showed that the mud-brick architecture had simply melted away as soon as the reservoir water had made contact. At this reservoir, a large village with massive stone underpins had been submerged for consecutive years. By comparing the buildings that were out of the dam water, this issue was more visible. When exposed in recent years, nothing of the village was preserved apart from the stones. The fact is that once submerged, the site is lost forever.

Archaeological Evidence

The first reservoir effect on the Jamalo site was erosion, exposure, or inundation due to fluctuating water levels. As shown in Fig. 2, various water levels occurred in the dam reservoir in different years. For example, the water level in 2006 and 2020 could be a model compared with Figure 5-2, and the water level in 2019 was similar to Figure 5-9. As a result, the contour line of Tepe Jamalo changed (Fig. 5) due to erosion. The rise and fall of water level could also put the dam deposit on the village and site surface, of course in different thicknesses (Figs. 5, 7, 8, 9). However, this was not the only variable in site deformity, since another variable was looters' activities, damaging the site. Site vandalism and looting was also the second. Because of the wealth and the density of the artifacts, this site was the prime target of looters in this region, especially when low reservoir levels could expose previously inundated layers.

In trial excavations, the digging of 13 trenches, measuring 1×1 m except for J.A 09, which was 1.5×1.5 m, was further recorded. The trenches were counterclockwise, created from the southern side of the site, based on the main and secondary geographic directions, named with mathematical numbers, including J.A. 01, J.A. 02, to J.A. 13 (Fig. 6). In Table 2, there are also specific descriptions of the location, stratigraphy, and artifacts found at each trench. The trenches are usually dug out by a shovel to determine whether the soil contains any cultural remains that are not visible on the surface. The soil was thus sifted or screened through 1/4" or 6 mm wire mesh to recover the artifacts. The excavation was conducted with the method of exposing 5-10 cm layers. The interval at which the trenches were placed was further determined by the conditions in the field. The usual space between the trenches and the site arena was 15 m, and the depth of the trenches depended on the depth at which either the bedrock or the sterile subsoil had been found. All the trenches were designed to record stratigraphy (Fig. 6).

The depth of the trenches excavated, depending upon local soil types and an expected maximum depth of them, varied widely from 30 (J.A. 02) to 375 cm (J.A. 06). The test trenches also showed that the reservoir sediments could survive to a height of about 25-175 cm from the surface down to virgin soil or the surface of the village before going under water. The trashes and deposits at different levels and in all trenches were also identical. A total number of eight trenches (namely, J.A. 05, J.A. 06, J.A. 08, J.A. 09, J.A. 10, J.A. 11, J.A. 12, and J.A .13) were accordingly excavated to the bedrock or virgin soil and thus used to obtain the site extension. However, significant numbers of surface artifacts were not matched, considering the preservation of the materials in situ, and hence the test trenches were logged after excavation, but not extended (Fig. 6, in yellow). The excavations at other trenches (viz. J.A. 01, J.A. 02, J.A. 03, J.A. 04, and J.A. 07) also resulted in the discovery of structures, implements, and so on (Figure 6, in blue). The presence of the materials in this test trench also led to its enlargement to recover more artifacts and the extent of the site.

In all trenches, after the surface soil, the dam deposits were identified. This part was distinguished by an orange deposit, which had recent various materials such as later Islamic pottery, plastic, and glass implements in all parts of the site (Fig. 8). The orange soil had been further deposited over the riverbank bed and then buried by sedimentation in the Jamalo plain surface before dewatering the reservoir. Along with the bed slope and plain, both archaeological and natural sediments showed varying thicknesses in different areas. For example, the natural deposition was often 50 cm thick in the north (J.A. 05), whereas it reached up to 75 cm in the east (J.A. 07). According to Figure 7 (J.A. 06), it seems that the silts first fill the dentures and then bring a homogeneous level.

Silt deposited in the reservoir was covering the slop of the Tepe Jamalo (Figure 9). Moreover, the water had covered a region that contained significant but little-studied archaeological sites.

Discussion

It will be impossible to avoid the construction of dams. Instead, there is a need to learn from past problems and mistakes to minimize future losses to cultural heritage. This is not a dilemma restricted to Iran but is virtually common in all developing countries.

Studies on inundation processes, produced by dam reservoirs, are fundamental, firstly, for the safety of people and animals, and secondly, for the conservation of monuments as well as archaeological and historical places. The main objective of this study was to explore the role of a reservoir on damaged or destroyed Jamalo site and village. In this village, cleared of the human population, mud-brick architectures had simply melted away as soon as the reservoir water had made contact. Massive stone underpins had also submerged for consecutive years. Comparing the buildings out of the dam water, nothing of the village had been preserved apart from the stones. The fact is that once submerged, the human settlements had been lost forever. The trenches were a resounding success about the ancient site, and numerous samples could be securely retrieved from all of the features. A further increase in the water level could provoke the inundation of this old site. In such lakes, siltation could also occur; for example, in the heavily alluvial valley in the east and northeast of the site, some layers had been very deeply buried, and not located by traditional hand excavation tests. In all the trenches, after the surface soil, the dam deposits were also identified. Therefore, the artifacts in the silt deposits in terms of collection and storage of the artifacts in this silt zone needed certain plans. Remote sensing could be a viable option, such as side-scan sonar and vibrating-sample magnetometry. In the future, the temporal changes of the radiocarbon reservoir effects in Tepe Jamalo will be probably discussed.

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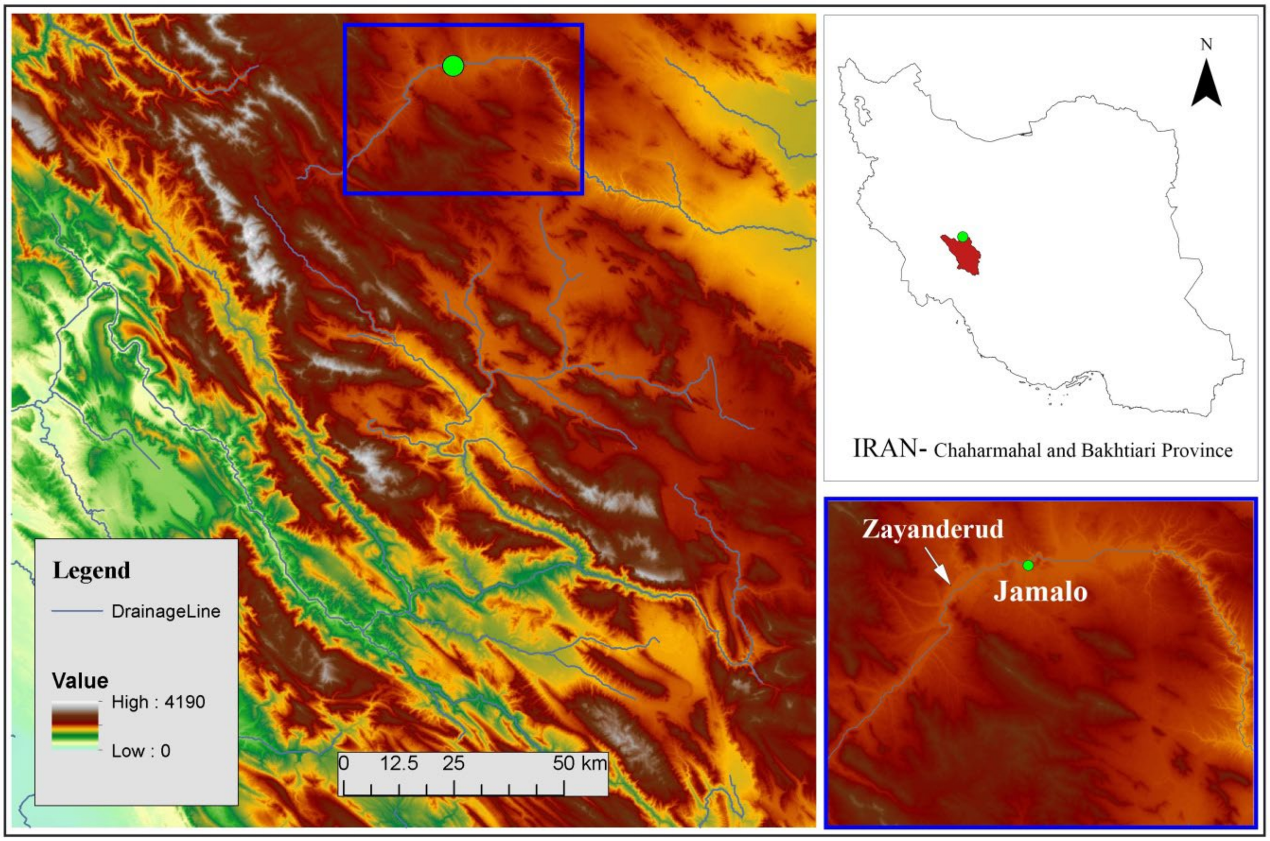


Fig. 1. The map of the Zayanderud River basin, showing the study location. The shading here indicates relative elevations (light green means lower and white is higher). The box displays the region around the upset of the Lake.

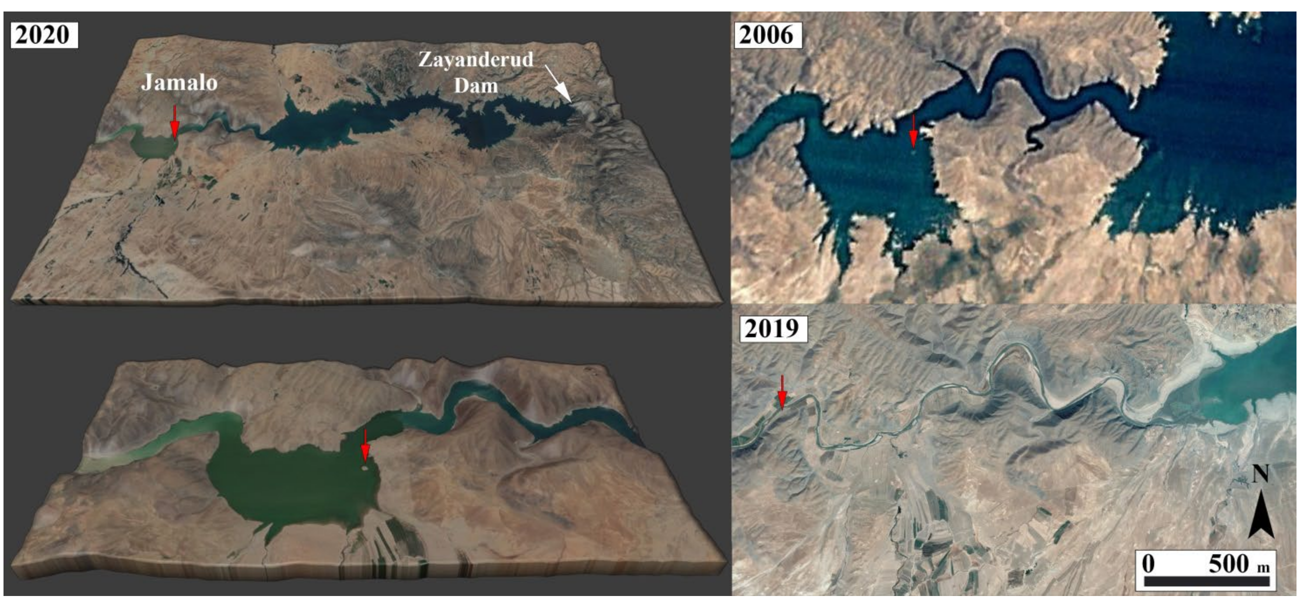


Fig. 2. The reservoir of Zayanderud dam on Zayanderud river and Jamalo village in some years

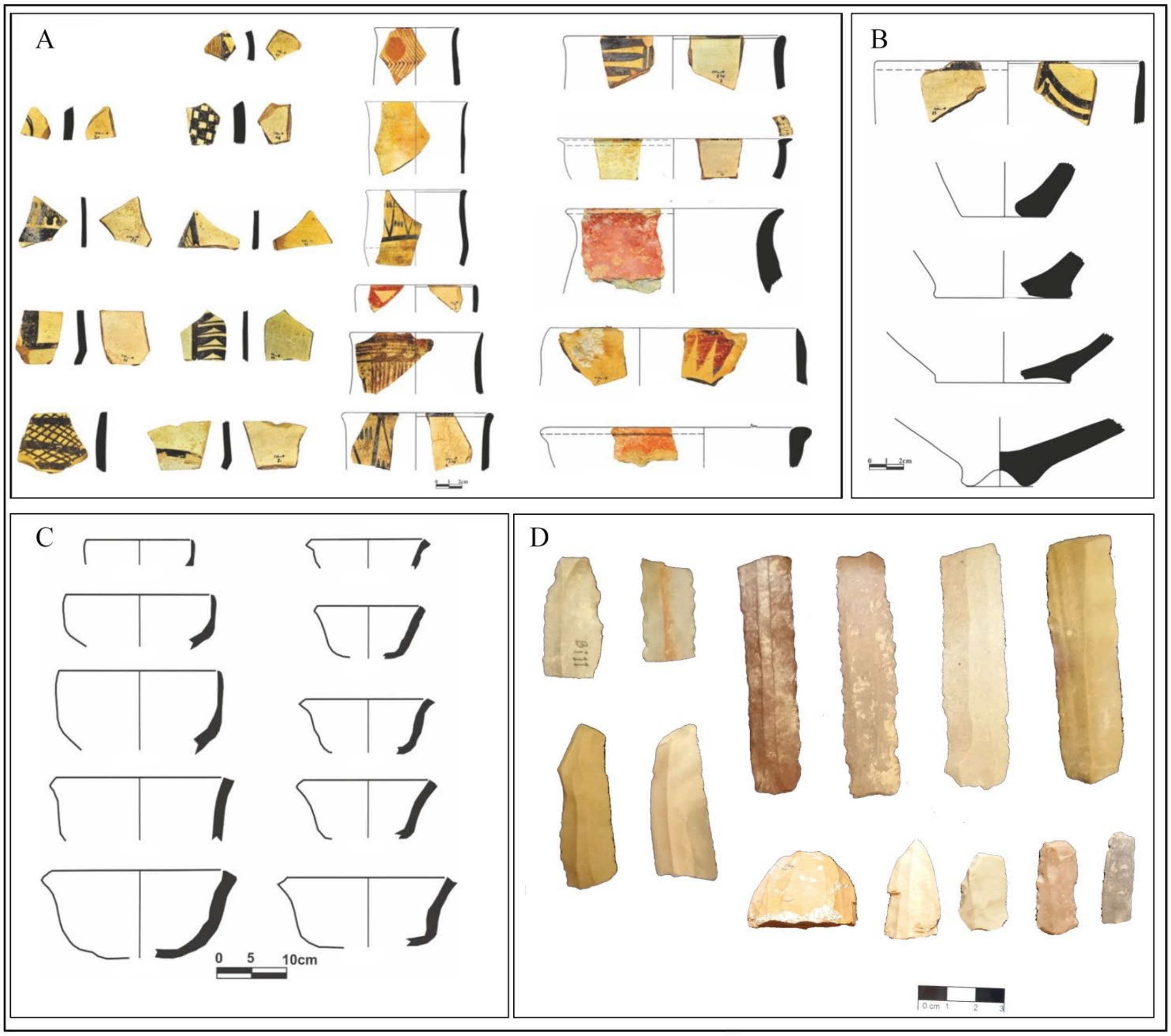
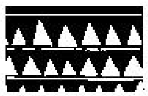
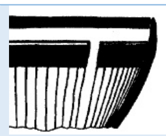
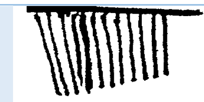
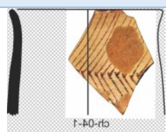
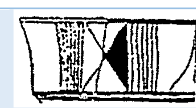
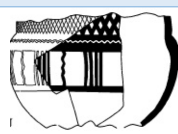
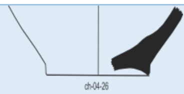
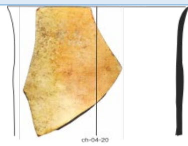
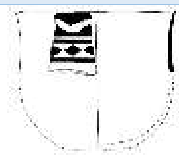
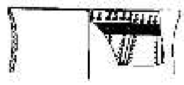
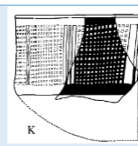


Fig. 3A. Early and Middle Chalcolithic pottery; B: Middle Chalcolithic pottery; C: Beveled rim bowls and other Late Chalcolithic pottery; D: Lithics from squares

Table 1. Typological comparison of Mesopotamian pottery samples (after Yousefian Darani, 2017)

No	Samples	Comparison				
		South-West	Bakhtiari Region	South-Central	Central Plateau	Central Zagros
1				 Langsdorff and MC Cown, 1942: Fig, 26 (Bakun A)	 Ghirshman, 1938, Pl. 4, B10	
2		 Hole et al., 1969: 156, Fig: 61, Pl: H (Sabz)	 Zagarell, 1982: fig, 19: 5 (Čogāt Eskandari and Afġān)		 Malek Shahmirzadi, 1977: 299, Pl, III, No, 84	 **Henrickson, 1983: 91, Fig, 17**
3		 Alizadeh, 1996: 160, F. 319 (Choqa Mish)			 Malek Shahmirzadi, 1977: 327, PL, XI, No.7	
4		 Alizadeh, 2003, 189: G. G145		 Alizadeh, 1984: 179, Fig, 23, Pl: AA, (Bakun B)		 **Abdi, 2002: 56, Fig, 14, Pl: 7, (Tuwah Khoshkeh)**
5		 Talai, H., 2011, Fig. 3 (Bandbal)			 Majidzadeh, 1976: Fig. 38, No. 5	
6		 Delougaz and Kantor, 1996: 319, Pl: 55, Pl: J (Choqa Mish) Late Susiana		 Alizadeh, 1984: 179, Fig, 23, Pl: L, (Bakun B)	 Kaboli, 1999, Pl. 40: 10	
7				 Alizadeh, 2006: 179, Fig, 23, (Bakun B)	 Ghirshman, 1938, Pl. 67, 105 (Silak III6)	

8		 Alizadeh, 2003, 125: O G33-III Middle Susiana	 Zagarell, 1982: 186, Fig, 18: 7 (Afğān)		 Alimohammad Esfandiari, 1999, 56: 3: 8	
9			 Zagarell, 1982: 175, Fig, 17: 7 (Afğān)			
10		 Alizadeh, 2008: 279, Fig, 40, Pl. C, (Choqa Mish) Late Susiana	 Zagarell, 1982: 182, Fig, 24: 2 (Shahrak)			
11		 Alizadeh, 2008, 341, Fig, 66. K (Choqa Mish)	 Zagarell, 1982: 173, Fig, 15: 4		 Burton Brown, 1979: Pl. VI, No. 54	

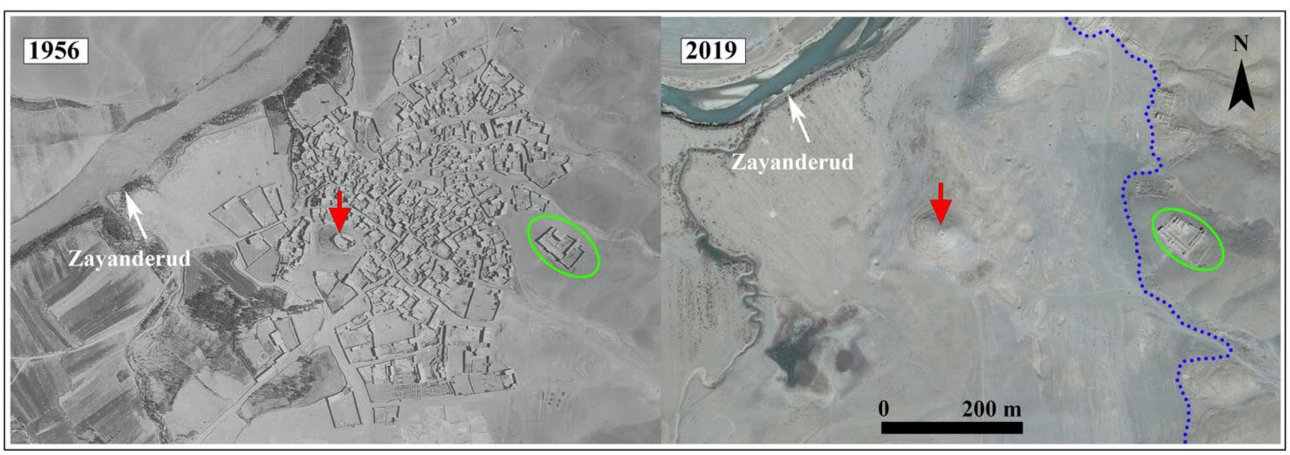


Fig. 4. The images on Google Maps, showing the location of Jamalo village and archaeological site. The red markers indicate the distribution of the site adjacent to the river in 1956 and 2019. The blue marker also depicts the enhancement of the dam reservoir.

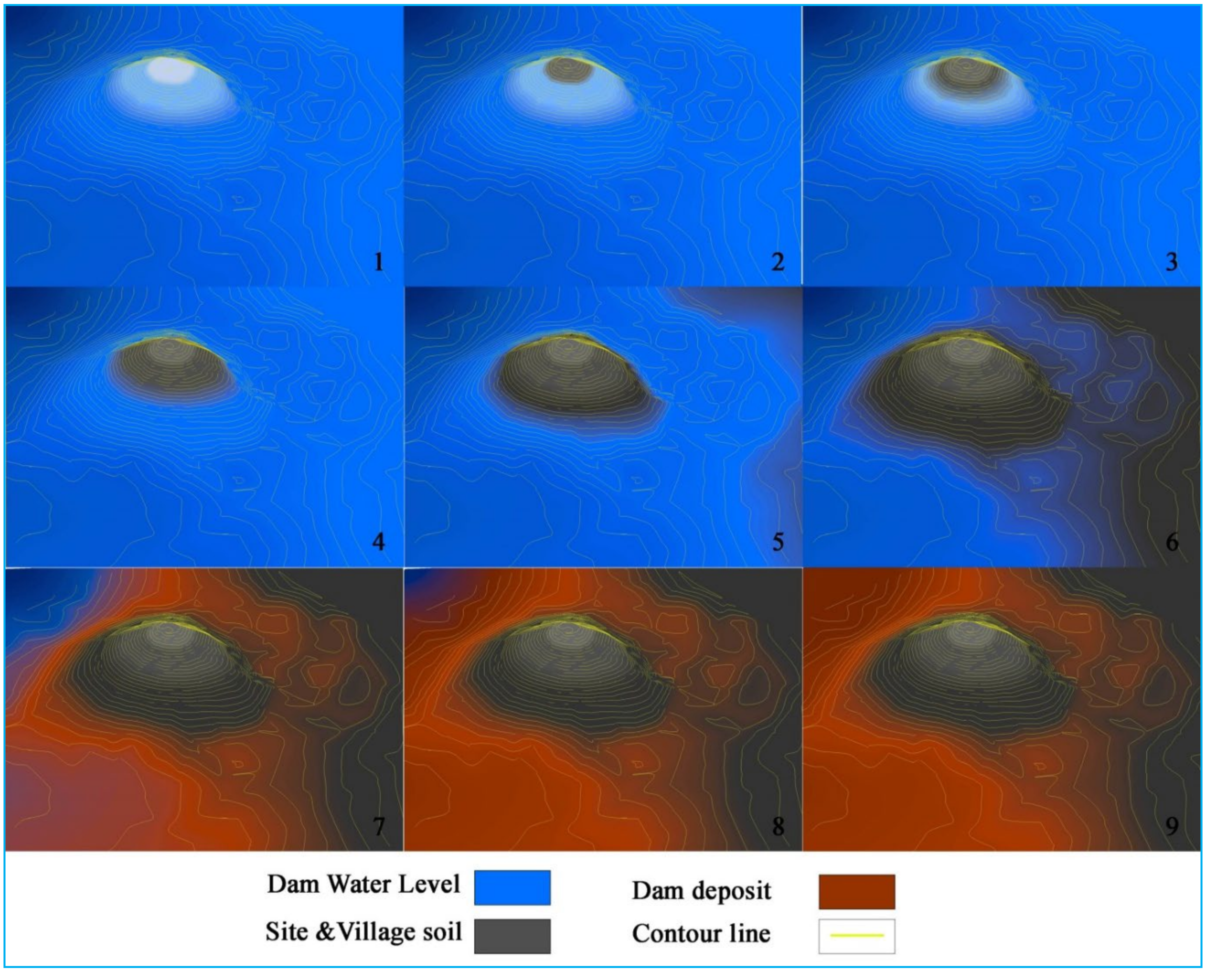


Fig. 5. Different water levels and their effects on Tepe Jamalo

Table 2. Information about trenches

Trench No.	UTM (39 S)		Position	Stratigraphy			Artifacts	
	E	N		Dam	Village	Ancient times	Ancient times	Modern time
JA. 01	459659	3619773	S	*	*	*	*	-
JA. 02	459599	3619796	SW	*		*	-	-
JA. 03	459577	3619860	W	*	*	-	*	*
JA. 04	459606	3619915	NW	*	-	*	*	-
JA. 05	459670	3619930	N	*	*	-	*	*
JA. 06	459718	3619895	NE	*	*	-	*	*
JA. 07	459706	3619834	E	*	-	*	*	-

JA. 08	459697	3619799	SE	*	*	-	*	*
JA. 09	459657	3619749	S	*	*	-	*	-
JA. 10	459570	3619760	SW	*	*	-	*	-
JA. 11	459562	3619869	W	*	*	-	*	*
JA. 12	459590	3619935	NW	*	*	-	*	*
JA. 13	459729	3619826	E	*	*	-	*	*

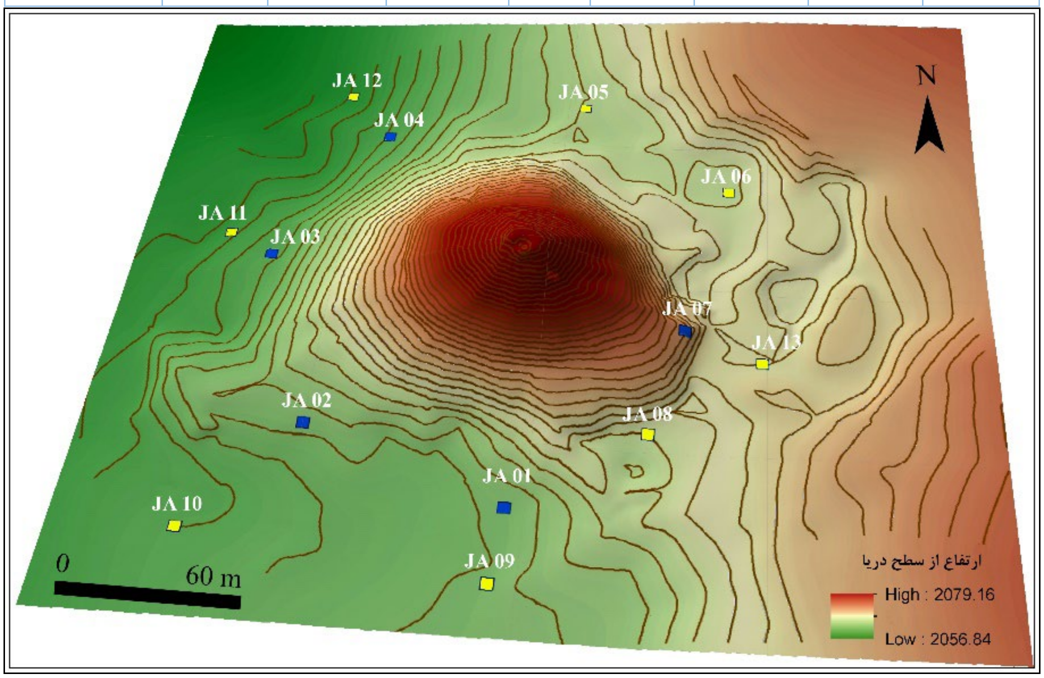


Fig. 6. Trenches excavated in Tepe Jamalo. They are located at intervals across a site leaving the rest untouched. The apparent area of the enclosure is an area of c. 9.1 hectares. The yellow markers show eight trenches excavated to the bedrock or virgin soil and the blue markers indicate trenches resulted in the discovery of structures, implements, and so on.

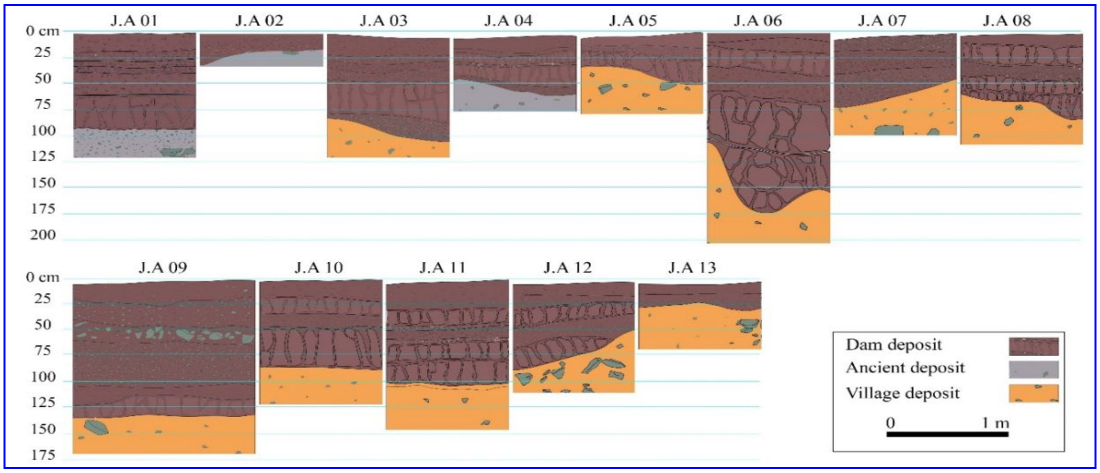


Fig. 7. Part of the eastern section of all trenches and their stratigraphy

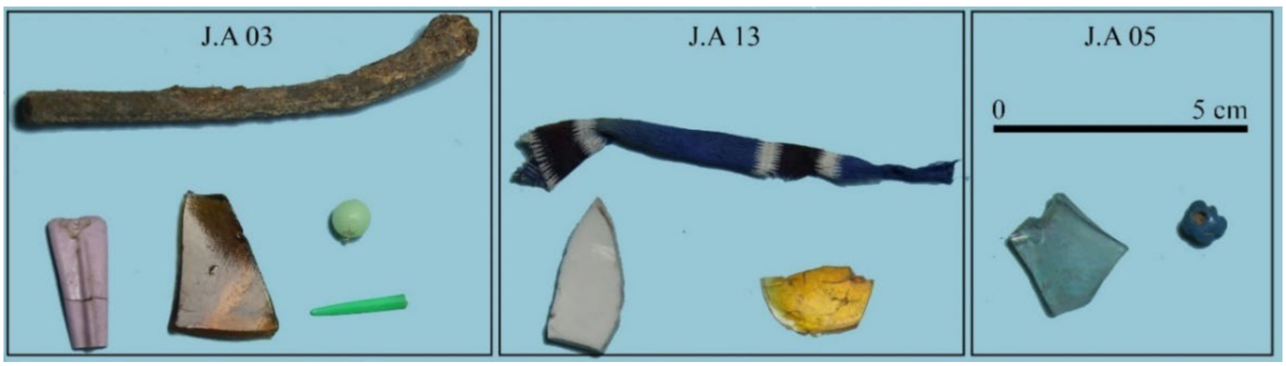


Fig. 8. Modern things from trenches

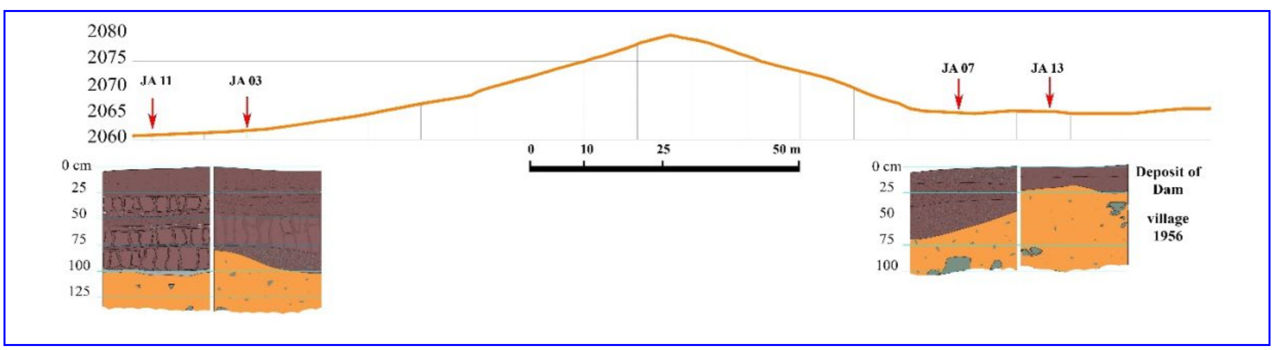


Fig. 9. The position of trenches (viz. J.A. 11, J.A. 03, J.A. 07, and J.A. 13) relative to the site and the number of dam deposits in them

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اثرات آب‌گرفتگی بر مواد باستانی: مطالعه موردی روستای / محوطه باستانی جمالو در سد زاینده‌رود، استان چهارمحال و بختیاری، ایران

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مجید ساریخانی[۱] ، محمود حیدریان[۲] و مهدی علیرضازاده[۳]

[۱] دانشیار گروه باستان‌شناسی، دانشگاه شهرکرد، شهرکرد، ایران (نویسنده مسئول).
E-mail:sarikhani.majid@sku.ac.ir

[۲] دانشیار گروه باستان‌شناسی، دانشگاه شهرکرد، شهرکرد ایران.

[۳] دانشجوی دکتری گروه باستان‌شناسی، دانشگاه تربیت مدرس، تهران، ایران.

چکیده: مقاله پیش‌رو با تأکید بر روستا و تپه باستانی جمالو واقع در انتهای سد زاینده‌رود، به بررسی شرایطی که سکونتگاه‌های انسانی به هنگام ساخت سدها و پر شدن مخزن آنها با آن مواجه می‌شوند، می‌پردازد. همان‌طورکه تصاویر Google Map نشان می‌دهد، حدود ۳۰ سال پیش، آب‌گیری سد زاینده‌رود، کرانه سمت چپ رودخانه، جایی که روستا و محوطه باستانی جمالو در آن واقع بود را تحت تأثیر قرار داد. این محوطه بیشتر در هزاره‌های ششم و پنجم پیش از میلاد تا آغاز عصر مفرغ قدیم مسکونی بوده و استقرار در دوره‌های مفرغ میانی، آغاز نگارش، تاریخی و اسلامی نیز استمرار داشته است. شواهد باستان‌شناختی حاصل از بررسی‌های سطحی نشان می‌دهد که قطعات سفالی آن شبیه به نمونه‌های Sialk III و Bakun A است. در سال‌های اخیر، به‌خاطر کمبود بارش و آب مخزن سد، تپه جمالو از آب بیرون آمده است. بنابراین، هدف اصلی این مقاله ارائه نمای کلی از اتفاقاتی است که برای محوطه‌های باستانی به هنگام ساخت سد، آب‌گیری مخازن آنها و زمانی که چشم‌انداز اطراف محوطه به‌طور اساسی تغییر می کند، رخ می‌دهد. سؤال دیگر پژوهش این است که چه اتفاقی برای محوطه‌های باستانی که آب‌گیری، آنها را غیرقابل دسترس می‌کنند، می‌افتد؟ براساس کاوش در جمالو و مقایسه تصاویر گرفته شده از منطقه قبل و بعد از ساخت سد، مشاهده شد که مخزن سد، روستا و دامنه‌های محوطه را تخریب کرده و به‌ویژه در قسمت‌های شرقی و شمال‌شرقی، لایه‌ای از رسوبات سطح محوطه را پوشانده است.

واژه‌های کلیدی: محوطه باستانی جمالو، سد زاینده‌رود، مخزن، روستای جمالو، ایران مرکزی.