Settlement Patterns of Bronze-Age Sites of the Upper and Middle Atrak Basin in Northeastern Iran

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Abstract

In archaeological studies of Southwest Asia, during the period from the late fourth millennium BC to the beginning of the Iron Age (second half of the second millennium BC), phenomena such as growth of settlements in terms of area and population, emergence of early cities, trans-regional trade, formation of government institutions, emergence and spread of gray-and-black pottery, extensive changes in technology, dramatic development of smelting and use of bronze tools were identified. In this process, an extensive communication network aimed at controlling trade routes and access to raw materials across the plateau, by land and sea, connected many areas. Economically, remote trade was established in this period of time, various communities establishing ties with places located thousands of miles away in order to obtain their needed resources. Bronze-Age cultures are well-known in most parts of Iran, but Khorasan culture is an exception since the data are rare and insufficient. Moreover, information about the chronology and distribution of sites during different periods of prehistoric times in different parts of it is minimal. Thirty-eight sites from the Bronze Age have been studied in this research. These sites were identified in archaeological surveys of the upper and middle Atrak basin during the last decade. This study was done using the descriptive-analytic method. GIS and SPSS software and Correlation and Cluster analysis methods were used for data analysis. The settlement pattern in the upper and middle Atrak basin is similar. It consists of two-rank models with a large main site and several small sites around it. The results of this study indicate that due to the lack of water resources in the region, access to constant water resources has been an essential factor in the shaping of Bronze-Age settlements. Most sites were also formed during the Early Bronze Age, and we also faced a decrease in the number of sites in the Middle and Late Bronze Ages.

Rezumat: Studiu asupra tiparelor de aşezăminte din Epoca Bronzului din zona bazinului Atrak din nord-estul Iranului

În studiile arheologice din sud-vestul Asiei, de la sfârșitul mileniului al patrulea î.Hr. până la începutul Epocii Fierului, s-au identificat fenomene precum creșterea așezărilor, apariția orașelor timpurii, comerțul trans-regional, formarea instituțiilor guvernamentale, răspândirea ceramicii gri-și-neagră, schimbări tehnologice și dezvoltarea uneltelor de bronz. S-a creat o rețea de comunicare extinsă pentru controlul rutelor comerciale și accesul la materii prime, conectând mai multe zone. Economic, s-a dezvoltat comerțul la distanță, comunitățile stabilind legături pentru a obține resurse. În Iran, culturile Epocii Bronzului sunt de obicei bine cunoscute, excepție făcând cele din Khorasan unde datele sunt rare. În această cercetare, s-au studiat treizeci și opt de situri din Epoca Bronzului identificate în zona râului Atrak. S-a utilizat metoda descriptiv-analitică și software-uri precum GIS și SPSS pentru analiza datelor. Modelul de așezare în bazinul râului Atrak constă într-un sit principal mare și mai multe situri mici în jurul acestuia. Lipsa resurselor de apă a fost un factor esențial în formarea așezărilor. Cele mai multe situri au apărut în perioada de început a Epocii Bronzului, iar numărul lor a scăzut ulterior.

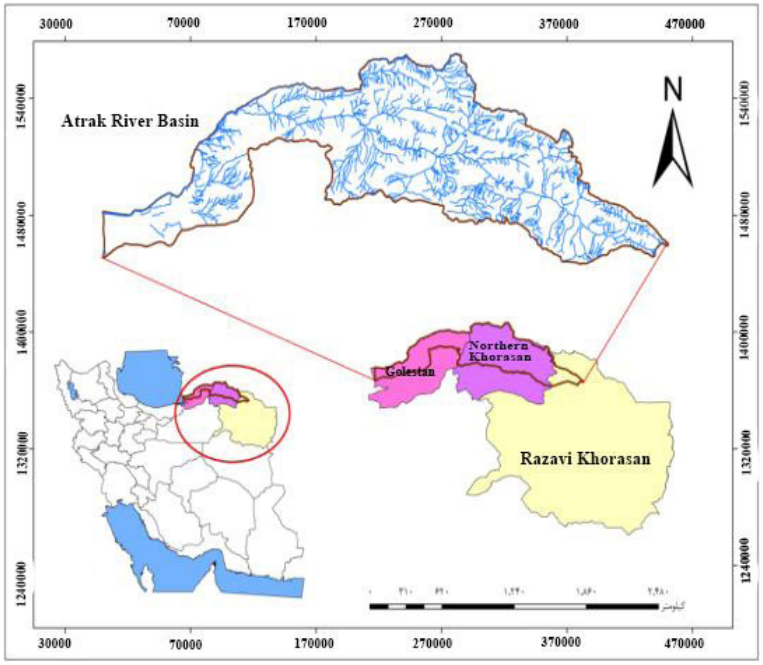
Keywords: Upper and middle Atrak, Bronze Age, Settlement patterns, Correlation analysis

Cuvinte cheie: Atrakul superior și mijlociu, Epoca Bronzului, Modele de așezare, analiză de corelație

1. Introduction

Settlement pattern analysis studies of archaeological sites are one of the archaeological approaches researchers have highly regarded in the last three decades. They examine the reasons that led to the emergence of archaeological sites in specific environmental contexts. Settlement pattern analysis deals with the number, size, distances, and physical/spatial characteristics of sites concerning each other and the relationship of these sites with geographical

features such as roads, rivers, and soil quality or vegetation and consists of four stages: 1) surveying the site to record changes in a settlement, 2) analyzing the relationship between a settlement, its subsistence basis and land use, 3) statistical analysis of density, distance and size of areas and population changes, 4) testing specific hypotheses about the relationship between settlements and natural or cultural variables[1]. The analysis of a settlement model is based on the assumption that the formation of human settlements was not accidental because human behavior is always normative and patterned, and this pattern can be identified through archaeological studies[2].



Map 1. The Location of the Atrak Basin in the political divisions of northeastern of Iran.

The study area is the upper and middle Atrak river basin in northeastern Iran. It is a natural corridor between northern Khorasan and its central regions and, in a broader perspective, between Central Asia and the inland parts of the Iranian Plateau[3] (Map 1). The Atrak Basin during the Bronze Age (second half of the fourth millennium BC) to the beginning of the Iron Age (in the first half of the second millennium BC) was surrounded by three distinct cultural traditions; first, Namazgah culture in the north of the basin, in the oases and foothills of Kopet Dagh in the south of Turkmenistan with its painted buff pottery. The site of Namazgah, Altin, Ologh, Khapouz and Gonorr hills as well as the cemetery of Parkhay are all important sites introducing this culture[4]. Second is the gray/black-pottery culture of Gorgan plain or the eastern Alborz in the western part, which is characterized by landmark sites such as Turang Tappeh[5], Shah Tappeh[6], and Hesar[7]. Third is a local culture known from the southern part of inner Khorasan in Neishabour and Sabzevar plains with ocher painted pottery discovered from sites such as Borj Tappeh[8], Damghani Tappeh[9] and BMAC cultural material from Shahrak Firoozeh of Neishabour[10] and Tappeh Chalou[11]. Based on surface surveys in the upper and middle Atrak basin, 38 settlements have been identified from the Bronze Age. In analyzing settlement patterns of these areas, environmental factors such as altitude, proximity to water resources, distance from communication routes, and type of vegetation and soil were measured.

This study found that due to the region's lack of reliable water, these resources play an essential role in forming settlements. In the Early Bronze Age, we encountered two patterns of settlement in the upper Atrak Valley. The first group includes settlements that, given their area and proximity to the heights, probably represent a subsistence based on a combination of agriculture and animal husbandry. In this pattern, two relatively large settlements in a cluster probably served as the central location. In the Middle Bronze Age, we encounter an interruption of habitation in the upper Atrak region. Two clusters of the settlement patterns are visible in the new Bronze Age. In the first cluster, small areas are distributed in different regions with agricultural/animal-husbandry subsistence economy patterns. In the second cluster, there are two settlements with large areas and locations in the center of the plain or close to communication roads, which probably indicates centers with commercial activities. However, in

1 Hole 1980.
2 Warren and Asch 2000, 6; Conolly and Lake 2006, 3.
3 Mirzaei and Dana 2016; Ricciardi 1980, 51.
4 Sarianidi 1971; Masson 1988; Khlopina 1981.
5 Deshayes 1976.
6 Arne 1945.
7 Voigt and Dyson 1992; Schmidt 1937.
8 Dana *et al.* 2012.
9 Vahdati *et al.* 2010; Francfort *et al.* 2014.
10 Basafa 2011.
11 Vahdati and Biscione 2015; Biscione and Vahdati 2011.

the middle Atrak region, based on cluster analysis, three Early Bronze Age settlement patterns have been identified. In the first group, there are settlements that their subsistence, according to their location on the edge of the plain near water resources and irrigable lands and rangelands, can be assumed as agriculture/animal-husbandry based. All the settlements of this cluster seem to represent small villages with an economy consisting of agriculture and animal husbandry. In the cluster, the two settlements are located at the bottom of the plain and near water sources and irrigable lands. It seems that the areas of this cluster are large towns or villages that have been formed in different parts of the plain such as Tappeh Kohneh of Qala-e-Hassan near the heights. In the third cluster, a site is located on the edge of the elevation belt at the entrance of a gorge to the vast plain of the central Atrak basin. All these characteristics indicate a strategic location, especially a commercial area with high agricultural potential. Unlike the upper Atrak, the middle Atrak was inhabited in the Middle Bronze Age although we see a significant decrease in the number of settlements (Table 2). During this period, nine settlements were abandoned and only two new settlements were formed on the plain. During this stage, two clusters are visible. The first cluster consists of small villages with agricultural/livestock subsistence formed linearly along water resources. Cluster two also consists of large centers with a central location nature. In the Late Bronze Age, we see an increase in the number of settlements though not as flourishing as in the Early Bronze Age; here four settlements were formed for the first time. During this stage, we encounter two clusters. The first cluster is an area with seasonal characteristics and possibly livestock. In the cluster, there are two areas with no regional focus and the nature of the central location, which is located near water resources and irrigable lands. Their subsistence has probably been based on agriculture and mountainous areas exploitation.

2. Geography of the Research Area

The Atrak River is 580 kilometers long, the fifth longest river in Iran and the longest in Turkmenistan, which originates from the mountains of Hezar Masjed (Emarat village of Ghouchan). After passing through the plains of Faruj, Shirvan, Bojnord, Mane, and Samalghan with an east-west extension, it enters the Gorgan plain with a gentle slope. At the village of Chat, the Sombar River joins the Atrak and forms a part of the common border between Iran and Turkmenistan. Then, it enters the country of Turkmenistan and finally flows into the Caspian Sea (Map 1). The Atrak River can be divided into three parts in terms of nature and geography. Upper Atrak is the place of formation of this river with a relatively wide central valley, which is limited by two parallel strips of the mountains of Kope Dagh in the north and Shah Jahan in the south. This valley is about 60 km long and 30 km wide[12].

This section is separated from the Kashafrood River basin at its southernmost point in Ghouchan city. From a political point of view, upper Atrak includes the cities of Ghouchan (Razavi Khorasan Province), Faruj and Shirvan (North Khorasan Province). Middle Atrak is a relatively mountainous land with almost narrow valleys. The river flows in a winding path and includes the cities of Bojnord, Raz, Jarglan, Mane, and Samalghan in terms of political geography (North Khorasan Province). Middle Atrak basin is limited by two parallel mountain ranges, Kope Dagh in the north and Aladagh in the south. These two mountain ranges in the northwest-southeast direction form the middle Atrak basin. Kope Dagh extends from the Balkhan Mountain Ranges in Turkmenistan and its continuation in Iran from the border of Bajgiran village to the southeast is called Hezar Masjed. Aladagh is a relatively long mountain range (with a length of about 170 kilometers), which is connected to the Shah-Kouh of Alborz Mountains in the west by the Kouh-Khord Mountain. It continues to the Binalud Mountain Ranges in the east[13]. The upper and middle Atrak basins consist of two mountainous units and intermountain plains (Map 2).

Map 2 The location of the study area is marked in black.

[12] Ricciardi 1980, 51.
[13] Papoli Yazdi 1992, 31.

2-1. Paleoclimate of the Region

Although there is no accurate paleoclimate record of northeastern Iran in the Bronze Age, studies have shown that, contrary to public opinion, there were stages of sudden climate changes in the Holocene period in this area. There is a consensus that such a phenomenon and its results can be generalized to different parts of the Earth. Factors such as variability in the angle of sun radiation in connection with the variability of the Earth's rotation have played a central role in the climate changes of the Holocene (11500 cal BP) on a global scale[14]. Based on studies[15] in the Greenland region, there have identified and defined at least nine cooling stages with intervals of about 1500 years during the Holocene era[16]. However, Mayewski et al. have identified at least six periods of very rapid climate change in the Holocene era by examining about 50 records of paleoclimate in different parts of the Earth, with intervals of 2000-2800 and 1500 years in the time frames of 8000-9000, 5000-6000, 3800- 4200, 2500-3500, 1200-1000, and 600-150 years BP. Most of the climate change events in these global samples are characterized by polar cooling, dryness of the warm regions, and significant changes in the atmospheric cycle[17]. Later studies by Richard Lee in Greenland have also shown that some of these events, such as the phenomenon of 4200 years ago, which is in the same time frame as the present study, were not cold periods but were even warmer periods than the current temperature of the Earth[18]. The climatic event of 4200 years ago in the Northern Hemisphere was associated with a severe drought whose effects continued until 3900 years ago. Among the paleoclimate records from Iranian lakes such as Zaribar[19], Mirabad[20], Urmia[21], Maharlou[22], Parishan[23] and Arzhan[24] the climatic phenomenon of 4200 BP was not well recorded and defined before. However, in recent studies, the evidence of this climatic phenomenon has been identified with high precision in Neor Lake at the foot of Talesh heights near Ardebil[25]. This lack of recognition of the phenomenon of 4200 BP in some paleoclimate records of Iranian lakes can be attributed to factors such as differences in climate from one region to another and differences in the sensitivity of climate proxies in each record compared to others. These factors prevent all Holocene climatic changes from being detected in each record[26]. Nevertheless, as mentioned earlier, in the comparative studies, it has been determined that the rapid climatic changes of the Holocene era were on a global scale, and its results can be generalized to different regions.

3. Bronze-Age Settlements

Based on the surface findings, 38 sites in the upper and middle Atrak basin may be attributed to the Bronze Age[27], of which two sites have been excavated. One of them is Eshgh Tepe in the suburbs of Bojnourd city where during the construction operations remains of a grave belonging to Late Bronze Age and attributed to the BMAC were identified[28]. The other one is Ghale Khan Tepe in the Samolghan Plain with an area of 6 hectares which contains deposits of the Bronze Age[29].

Out of 38 sites of the Bronze Age, 11 are located in the upper Atrak basin. Of these 11 sites, nine have Early Bronze Age artifacts, and seven have Late Bronze Age artifacts (Table 1). From four sites, only early Bronze Age material was identified, from two sites, only late Bronze Age material, and from five sites, both early and late Bronze Age materials were identified. No site related to the Middle Bronze Age was identified from this basin. Three of the 9

14 Mayewski *et al.* 2004.
15 Gerard *et al*. 2007.
16 Bond *et al.* 1997; Bond *et al.* 2001.
17 Mayewski *et al.* 2004.
18 Alley 2004.
19 van Zeist and Bottema 1977; Wasylikowa *et al.* 2006.
20 Stevens *et al.* 2001.
21 Kelt and Shahrabi 1986.
22 Djamali *et al.* 2009.
23 Safaei-Rad *et al.* 2013.
24 Sadat Hosseini *et al.* 2015.
25 Sharifi *et al.* 2015.
26 Mayewski *et al.* 2004.
27 Since different people with different views have studied the Atrak basin, it was necessary to put all the information homogeneously and in a framework that meets the current research objectives. Accordingly, all the findings obtained from these people's field surveys - kept in the pottery bank of Razavi/Northern Khorasan Cultural Heritage Organization - were visited and studied. In this process, it was found that there is a lack of information in some areas; therefore, to compensate for this lack, those areas were revisited. Then, the pottery findings of these areas were reviewed and compared with the index excavated regions in the neighboring areas and dating was also determined by relative dating.
28 Vahdati 2014.
29 Judy *et al.* 2011.

Table 1. Bronze Age sites in the Upper Atrak Basin.

Bronze Age sites in Upper Atrak		Chronology		
no	**Site Name**	**Early Bronze Age Sites**	**Middle Bronze Age Sites**	**Late Bronze Age Sites**
1	Koozegaran Tepe	Gray, Non-Gray		
2	Daghian Tepe	Gray		BMAC
3	Torkaman Tepe	Non-Gray		BMAC
4	Sangli Tepe	Non-Gray		
5	Yam Tepe	Non-Gray		BMAC
6	Agh Tepe	Gray, Non-Gray		
7	DalanTepe Bozorg			BMAC
8	DalanTepe Koochak			BMAC
9	Tape Chaghe	Non-Gray		
10	Arg Tepe	Gray		BMAC
11	Mal Tape Si	Gray		Gray
		9		7

Early Bronze Age sites contained gray pottery only (Arg Tepe, Daghian, and Mal Tepe Si). Four sites contained non-gray pottery including painted buff pottery (Tepe Chaghe, Tepe Turkmen, Tepe Sangli, and Tepe Yam), and a combination of gray and non-gray pottery was obtained from two sites (Tepe Kuze-Garan and Agh Tepe) (Table 1).

Out of 38 sites identified in the studied basin of this research, 27 are located in the middle Atrak basin. Of this number, 21 sites of Early Bronze Age artifacts have been identified, of which 11 sites only have artifacts from the Early Bronze Age. Out of the mentioned 21 sites, 19 have gray pottery, and only two sites (Monjoqli and Duzhtepe) have non-gray pottery. Out of 7 Middle Bronze Age sites, 6 have gray pottery and one non-gray pottery (Bibi Sanam Hill). It should be noted that only middle Bronze Age artifacts (Shah Tepe) have been identified from one site. New bronze artifacts were identified from 10 sites; only the Shahrava site was inhabited with gray pottery, and the rest with pottery similar to the BMAC. It should be pointed out that only four sites have deposits of Late Bronze Age (Tepe Maidan, Tepe Glor Sarivan, Tepe Dahane Farah and Tepe Eshgh). One site has artifacts from both the Middle and Late Bronze Ages (Bibi Sanam hill), and four sites have artifacts from both the Old and Middle Bronze Periods (Takhte Sir, Kuze Kamer, Ghale-Khan and Gheib-Pari tepe). Four sites also had traces of the Early and Late Bronze Age (West Qanbar Ali, Yavar, Haji Mohajer and Gharegah Tepe 2). Only from the site of Shahrava artifacts from the three periods of the early, Middle, and Late Bronze Ages were found (Table 2).

4. Settlement Patterns

In this research, the statistical method of cluster analysis has been used to obtain the patterns of settlements in the region to understand the distribution of archaeological sites in the region and find a pattern that fits the environmental variables. Accordingly, environmental factors such as altitude above sea level, distance from water resources, distance from communication routes, and distance from modern villages of the region were considered independent variables, while the area of ancient sites was regarded as dependent variables.[30]

Access to a steady and permanent water source is essential in setting up habitation. Settlements in high altitudes and close to temporary water sources probably indicate seasonal occupation, although we know that settlements near permanent rivers are not necessarily fixed and continuous; the soil and altitude above sea level are variables that play a decisive role in habitation, for farming and sedentary life. In the upper and middle Atrak region, the

[30] It is necessary to mention that in the investigations carried out in the Atrak region, sampling of the area of the sites was done randomly, and usually, in multi-period sites such as Yam Tepe, the bounds of settlement during the Bronze Age are unclear. Therefore, in this research, the total area of the sites is included in the analysis. Although, this issue is one of the shortcomings of settlement pattern studies, and the probability of a human mistake in the settlement pattern analysis is very high, the landform of this basin consists of intermountain plains with few permanent water sources. It seems that in every plain, we are faced with big hills and agglomeration of settlements during different prehistoric periods.

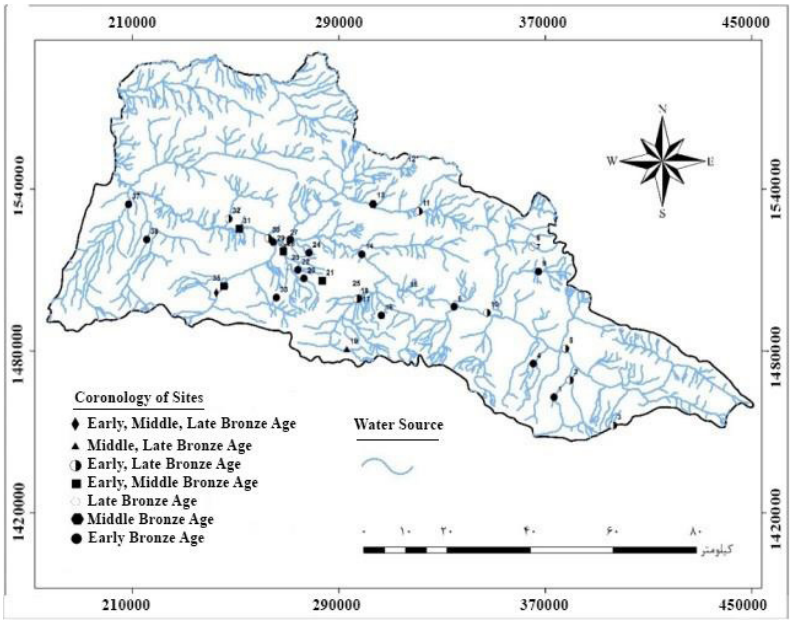
Table 2. Bronze Age sites in the Middle Atrak Basin.

Bronze Age sites in Middle Atrak		Chronology		
no	**Site Name**	**Early Bronze Age Sites**	**Middle Bronze Age Sites**	**Late Bronze Age Sites**
1	Meydan Tepe			BMAC
2	Yengeghale-gharbi Tepe	Gray		
3	Dashad Tepe	Gray		
4	Bibi Sanam Tepe		Non-gray	BMAC
5	Takhte Sir	Gray	Gray	
6	Gelor Sarivan Tepe			BMAC
7	Ghoorch Tepe	Gray		
8	Dahane Farah Tepe			BMAC
9	Tatar tape paein	Gray		
10	Yavar Tepe	Gray		BMAC
11	Shah Tepe		Gray	
12	Monjooghli Tepe	Non-Gray		
13	Khak Tepe	Gray		
14	Eshgh Tepe			BMAC
15	Dashli Tepe	Gray		
16	Koozekamar Tepe	Gray	Gray	
17	Doozh Tepe	Non-gray		
18	Kohneghale-hasansoo	Gray		
19	Gabran Tepe	Gray		BMAC
20	Haji Mohjer Tepe	Gray		BMAC
21	Ghareghanloo Tepe	Gray		
22	Gharegah2 Tepe	Gray		BMAC
23	Gheibpari Tepe	Gray	Gray	
24	Gharib Tepe	Gray		
25	Cheshm-Haji Ali Tepe	Gray		
26	Shahr Ava Tepe	Gray	Gray	Gray
27	Ghale-khan Tepe	Gray	Gray	
		21	7	11

Atrak River played a role as a reliable water resource in the past. Among the Bronze Age sites in the Atrak area, 13 (34%) are at a distance of 0-200 meters, 16 (42%) are at a distance of 200-500 meters, 6 (16%) are at a distance of 500-1000 meters, one (3%) is located at a distance of 1000-1500 meters, one (3%) at a distance of 1500-2000 meters, and one a distance of more than 2000 meters from water resources (Map 3, Diagram 1).

Altitude above sea level is another crucial variable in the formation of human settlements. The altitude factor forms high-pressure and low-pressure thermal centers by creating a thermal gradient. High areas are high-flow centers, and low-lying areas are low-flow areas. The altitude also affects the amount of precipitation by reducing the temperature. In addition, usually in areas with an average altitude of 600 meters above sea level, there are necessary conditions such as rainfall and humidity for rain-fed cultivation[31]. Another factor in the region is the amount of precipitation; usually, 200 mm of precipitation per year is enough for rain-fed cultivation. In the Atrak region, the average rainfall is between 250 and 300 mm annually. Among the settlements of the Atrak basin, 13 sites (34%) are located at an altitude of 450-900 meters, 12 (32%) are located at an altitude of 900-1200 meters above sea level, 5 (13%) are located at an altitude of 1200-1400 meters above sea level and 8 (21%) are located at an altitude of 1400-1800 meters above sea level (Map 4, Diagram 2).

[31] Krikby 1977



Map 3 Location of Bronze Age sites based on distance from water sources.

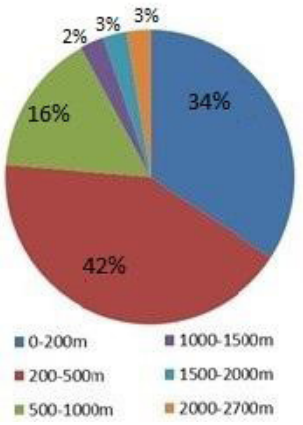
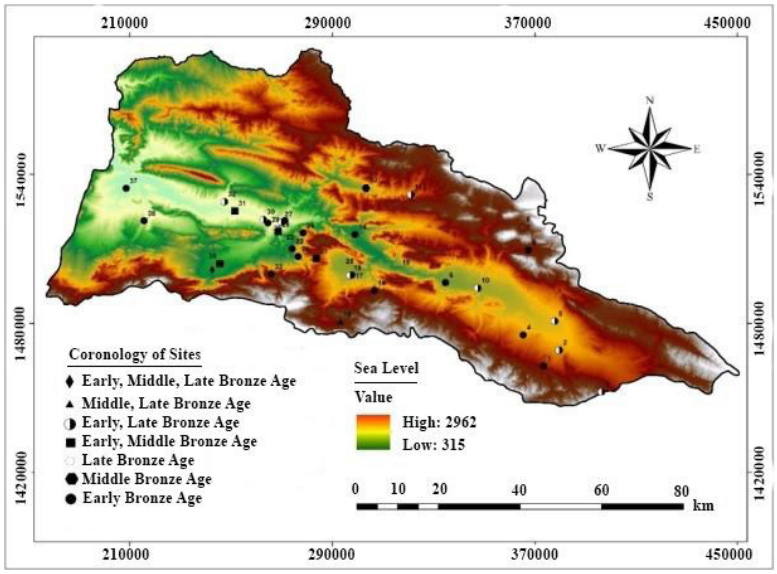


Figure 1. Distance of Bronze Age sites to the water source.



Map 4 Location of Bronze Age sites based on altitude.

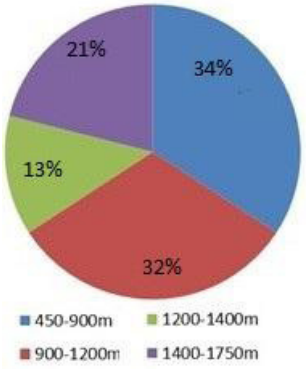
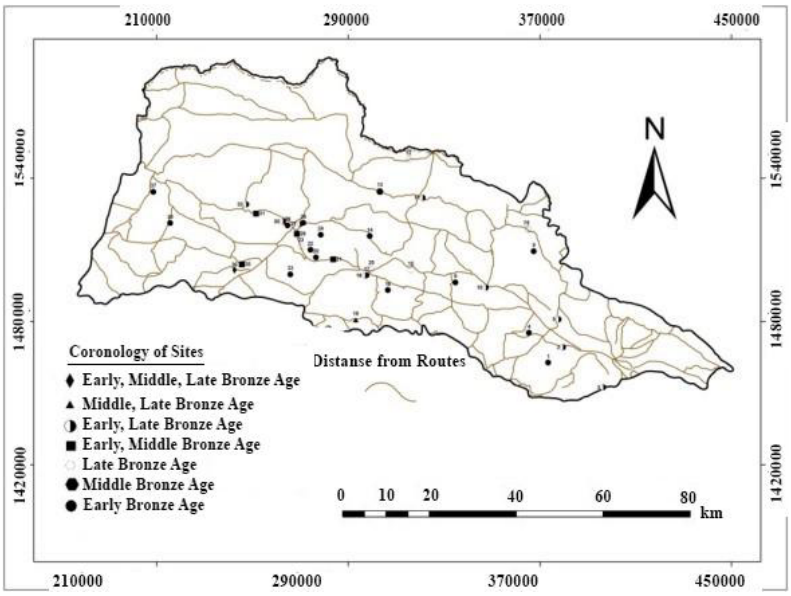


Figure 2. Altitude of the Bronze Age.

Communication ways are another essential variable in the formation of ancient sites. Especially in the Bronze Age, we see the formation of cities with long-distance and trans-regional trade relations in eastern Iran and southern Turkmenistan. Usually, in the past, ancient roads were created based on natural passages and the system of valleys and plains. In terms of distance from communication ?!, among the Bronze Age sites in the Atrak basin, four sites (10%) are at a distance of 0-500 meters, four (10%) are at a distance of 500-1000 meters, and four (11%) are located at a distance of 1000-2000 meters, nine (24%) at a distance of 2000-4000 meters, four (11%) at a distance of 4000-8000 meters, eight (21%) at a distance of 8000-14500 meters, and five (13%) are located at a distance of more than 14500 meters from the communication !? (Map 5, Diagram 3).

Another factor that plays an essential role in the distribution of human settlements is the slope. Establishing settlements on the slopes facing the sun with a lower degree of slope plays a role in the stability of the population, the type of settlement, and the amount of land exploitation[32]. The slope degree of the location of ancient sites is an essential factor that affects their area due to their economic nature. The analysis of Bronze Age sites in the Atrak

[32] Bahraminia *et al.* 2013.



Map 5 Location of Bronze Age sites based on distance from routes.

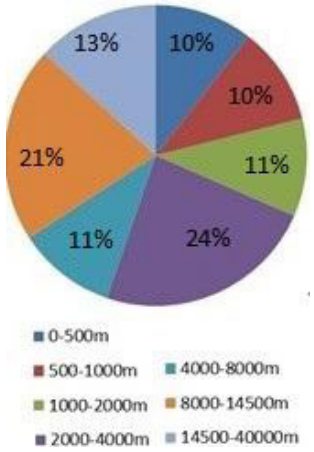
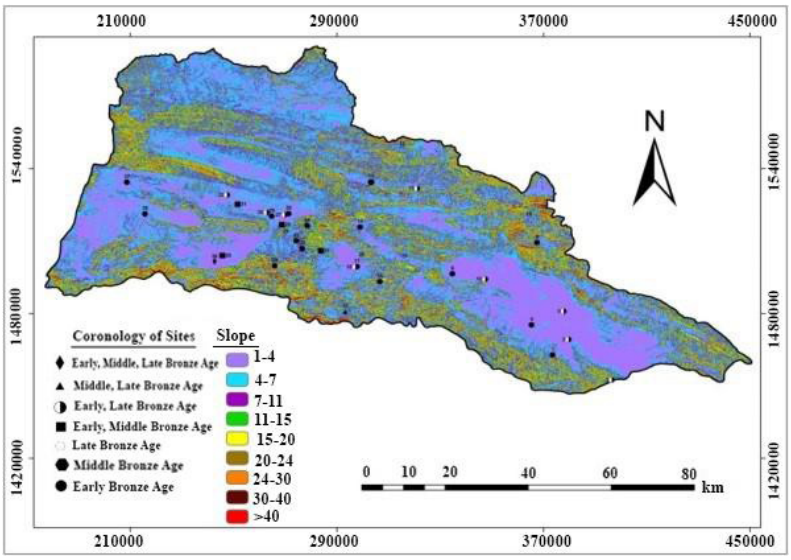


Figure 3. Distance from the routes of the Bronze Age sites.



Map 6 Location of Bronze Age sites based on the slope.

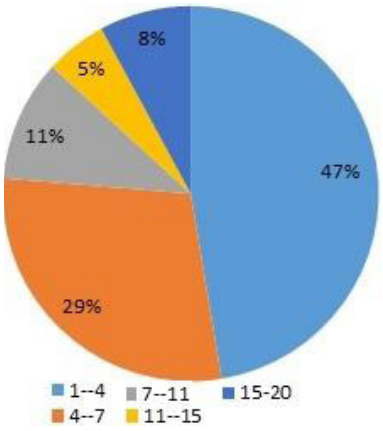
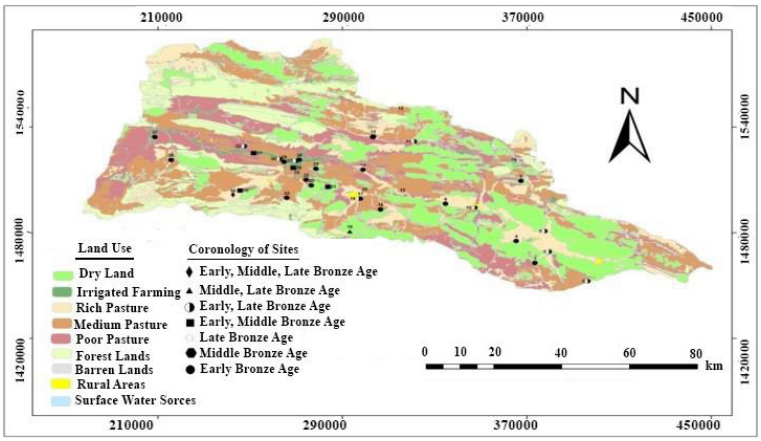


Figure 4. Percentage of slope of Bronze Age sites.

basin clarified that most sites, i.e., 18 sites (47%), have locations characterized by slopes with inclinations in the interval 1-4%, 11 sites (29%) occupy lands characterized by 4-7% inclination slopes, four sites (11%) relate to 7-11% inclination slopes, two sites (5%) to 11-15% slopes, and just three sites are located on a slope of 15-20% (Map 6, Diagram 4).

Land use is sorted into several categories depending on the soil capacity, the slope degree, and the use type. It is necessary to remember that these groups are categorized based on recent studies. According to the studies carried out in the Atrak basin, there are seven types of land use. By the map, about half of the sites are located among agricultural lands, whether rain-fed or irrigated, and the other half are in areas where their current uses is pasture, including the good, medium, and poor. The local difference in the sites can be related to the subsistence of the residents of them. Probably, the sites in the pasture areas were used by people with a pastoral or nomadic subsistence, and the sites in the agricultural lands were inhabited by sedentary farmers (Map 7, Diagram 5).

The last variable discussed in this part is the location of ancient sites compared to modern villages. Suppose we assume that the location of today's villages was formed based on environmental knowledge in access to water sources, communication routes, and agricultural lands. In that case, measuring the distance of ancient sites to modern villages can be a comparison to understand the similarities and differences between the current and past settlement patterns. In the analysis of the distance between ancient sites compared to modern villages, it was found



Map 7 Location of Bronze Age sites based on land use.

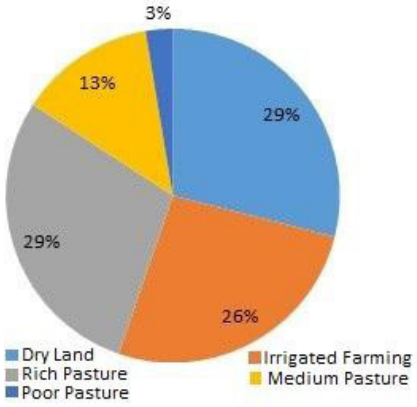
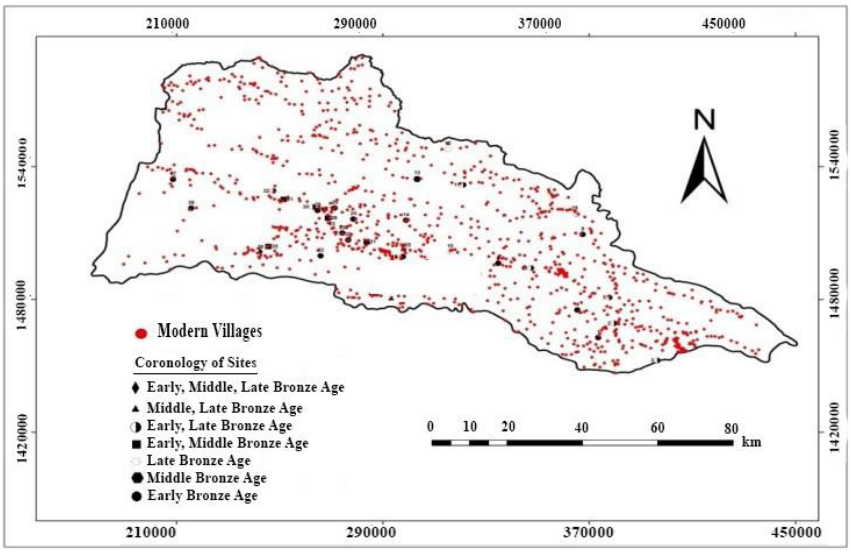


Figure 5. Today's use of Bronze Age land.



Map 8 Location of Bronze Age sites based on distance from modern villages.

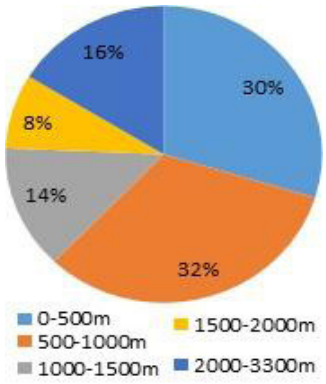


Figure 6. Distance from modern villages of Bronze Age sites.

that 11 sites (30%) are at a distance of 0-500 meters, 12 (32%) are at a distance of 500-1000 meters, 5 (14%) are at a distance of 1000-1500 meters, 3 (8%) are located at a distance of 1500-2000 meters, and 6 (16%) are located at a distance of 2000-3500 meters from modern villages (Map 8, Diagram 6).

The nearest neighbor method and the Euclidean distance have been used in clustering and determining the settlement pattern of the sites of this basin. The critical thing to consider in the analysis of the settlement patterns is the importance of the distance between the settlements compared to the sites of the same period and later period; this is why the role of the settlements is measured concerning each other. When the distance between the settlements is small, it shows the high environmental capability, a close connection between the sites, and strong cultural connections between them. When the distance between the settlements is significant, it indicates a weaker environment and less main potential. Based on this settlement distance, the type of people's subsistence can be studied. The premise is that the smaller the distance between the settlements is, the more the subsistence is based on agriculture and land exploitation. The larger the distance between the settlements (along with the smallness of the sites and being in the foothill belt) suggests the animal husbandry subsistence[33].

4-1. Settlement Patterns of the Upper Atrak Basin

Nine sites have been identified from the Early Bronze Age in the upper Atrak basin. Two patterns were obtained based on their statistical analysis and clustering, which are discussed below. Settlement pattern A: includes seven sites named Kouzegaran Tepe (BAUA01), Torkaman Tepe (BAUA03), Sangli Tepe (BAUA04), Agh Tepe (BAUA06), Chaghe Tepe (BAUA09), Arg Tepe (BAUA10), Mal Tepe C (BAUA11) and it has the most significant

[33] Motarjem and Siasar 2015, 86-87.

number of sites (Diagram 7). The altitude above sea level of this settlement pattern is between 1080 and 1523 meters, and the distance from the communication routes is between 789 and 24471 meters. These sites are located between 45 and 789 meters from permanent water resources and have an area between 1200 and 8000 square meters. These places are located between 538 and 3324 meters from the current villages. In terms of landscape texture and vegetation type, they are located in desert soil type textures with irrigated vegetation, shallow soils with pasture cover, and rocky soils with little cover. Valley and hillside areas have been used more due to good water resources, richer pastures, and sufficient slope for proper land drainage and running water draining. However, overall, the population density in the region is low. According to the location of these types of sites in the landscape of the region and according to the distribution of these settlements in the plains and highlands, little connection with the ancient roads, and their medium size, the subsistence economy of these settlements can be considered something between farming and animal husbandry subsistence.

Settlement pattern B: The sites included in this settlement pattern and cluster are two; Daghian Tepe (BAUA02) and Yam Tepe (BAUA05) (Diagram 8). In this settlement pattern, the altitude above sea level is 1198-1280 meters, and the distance from the communication routes is between 3499 and 3863 meters. These sites are located at a distance of 5653 to 1251 meters from permanent water resources. These have an area of about 6 and 8 hectares, and due to their large size, they are in a separate cluster. Regarding vegetation, the mentioned sites are located in irrigated lands and desert soils. The only difference between them and the previous group is their extensive area and location on the valley floor. These are next to the communication paths; that is why they are placed in one cluster or pattern.

The noteworthy point is that the Arg Tepe (BAUA10) must have been included in this pattern, but it is located in the previous pattern, and that is because of the smaller size of the Arg Tepe compared to the hills of this group. According to the location of these sites in the region's landscape, their large size, and proximity to the communication route, it seems that they were strategic and significant sites, and it is likely that their people were engaged in trade, water agriculture, and animal husbandry. Also, the hills of this cluster are formed next to the main ancient road and right in the middle of the plain, and they can provide services to the surrounding settlements and other distant regions as an important central place. Obtaining more information about the type of services provided, its economic relations with other surrounding habitats, or the possibility of the existence of workshops for production depends on conducting targeted and extensive explorations in this crucial settlement; however, it is inevitable that the location of this wide field sites, on the valley floor and the southern side of the ancient road, could have played an essential role in economic relations within the region as well as with critical trans-regional settlements.

Seven sites have been identified from the Late Bronze Age in the upper Atrak basin; Koozegaran Tepe, Sangli, Agh Tepe and Chagheh were inhabited in the Early Bronze Age and then abandoned. The sites of Yam, Dagian, Torkaman, Arg and Mal Tepe were inhabited in the Early Bronze Age and re-inhabited in this period. Only the Late Bronze Age artifacts were identified from the two sites, Dalan Tepeh Bozorg and Dalan Tepeh Kouchak. Two patterns were obtained from these sites based on their statistical analysis and clustering.

Settlement pattern A: includes three sites named Arg Tepe (BAUA10), Daghian Tepe (BAUA02), and Yam Tepe (BAUA05); It has the least number of sites (Diagram 4). The altitude above the sea level of this settlement pattern is between 1090 and 1280 meters, and the distance from the communication routes is between 950 and 3863 meters. These sites are located between 385 and 1251 meters from permanent water sources and have an area between 33,000 and 80,000 square meters. These places are located between 538 and 2131 meters from the current villages. In terms of the of land use type, there are rain-fed agriculture and irrigated agriculture in the lands with vegetation. Regarding soil type, all three hills are located in lands with desert and dry soil. Considering the location of these types of sites in the landscape of the region, especially at the bottom of the valley or as a kind of passage in the region, and the excellent connection with the ancient roads and their great area, the subsistence of these settlements can be considered as agricultural or even commercial.

Settlement pattern B: includes four sites with the names Torkaman Tepe (BAUA03), Dalan Tepe Bozorg (BAUA07), Dalan Tepe Kouchak (BAUA08), and Mal Tepe Si (BAUA11) (Diagram 10). The distance from the communication routes is between 268 and 24471 meters, which is more than the previous group. This settlement pattern's altitude above sea level is between 1314 and 1523 meters, which is more than the previous group. These sites are between 268 and 3324 meters from the current villages and have an area between 5000 and 12000 square meters; much smaller than the previous group. These places are located between 83 and 268 meters from permanent water sources, which is much less than the previous group. In terms of placement in landscape texture and type of vegetation, they are located in lands with rain-fed vegetation and a combination of rain-fed land and pasture.

Regarding soil type, they are located in textures with shallow soils with pasture cover and rocky soils with little cover. Considering the location of these types of sites in the region's landscape and the heights, little connection

with the ancient roads, their medium area, and the location on the edge of the belt of the heights, it can be assumed that the subsistence of these settlements is between agriculture and animal husbandry. Considering that most of these sites have been identified with pottery related to BMAC, the possibility that some of them are not settlement areas and were used only as cemeteries is not unlikely; an issue that can be checked by conducting exploration in these areas.

4-2. Settlement Patterns of the Middle Atrak Basin

Based on the cluster analysis, two settlement patterns have been identified during the Early Bronze Age in the middle Atrak region.

Settlement Pattern A1: Includes ten sites. These sites are Khak Tepe (BAMA14), Yenge Ghale Gharb Tepe 1 (BAMA17), Lower Tatar Tepe (BAMA20), Dashad Tepe (BAMA24), Gheib Pari Tepe (BAMA28), Gharib Tepe (BAMA29), Gharegah Tepe 2 (BAMA30), Koze Kamer Tepe (BAMA31), Haji Mohajer (BAMA32), Dashli Tepe (BAMA38). The altitude of this settlement pattern is between 467 and 1100 meters above sea level. The distance from the communication routes in these sites is between 87 and 36151 meters. These sites are located between 62 and 950 meters from permanent water resources. The area of these sites is between 0.8 and 2 hectares. These places are located between 200 and 2542 meters from the current villages. In terms of the type of land use, there are rain-fed agriculture and agriculture suitable for irrigation and pasture in the lands with vegetation. In terms of soil type, they are located in lands with shallow agricultural soil along with shallow rocky soils. Due to the location of these sites on the edge of the plain and near water sources and irrigable lands and pastures, the subsistence economy of these habitats can be assumed as agriculture/animal husbandry. The noteworthy point is that all these settlements were formed in the proximity of the foothills and somehow exploited the heights. All the settlements in this cluster seem to be small villages with a subsistence economy of agriculture and animal husbandry.

Settlement Pattern A2: includes 8 sites of Yavar hill (BAMA18), Duzh Tepe (BAMA26), Gabran (BAMA27), the old hill of Ghale Hasan Su (BAMA33), Cheshme-Haji-Ali (BAMA34), Ghale Khan (BAMA35), Shahrava Tepe (BAMA36), and Ghareghanlu Tepe (BAMA37). The altitude of this settlement pattern is between 600 and 1718 meters above sea level, and only one area is located at 1700 meters above sea level. The distance from the communication routes of these sites is between 87 and 36151 meters. These sites are located between 62 and 2642 meters from permanent water resources; in this case, most of them are located at a distance of 100 to 900 meters from water resources, and only one site is located at a distance of 2642 meters. The area of these sites is between 2.5 and 6 hectares. These places are located between 200 and 2542 meters from the current villages. In terms of the type of land use, there are rain-fed agriculture and agriculture suitable for irrigation and pasture in the lands with vegetation. In terms of soil type, they are located in lands with shallow agricultural soil along with shallow rocky soils. According to the location of settlements in the plain and the proximity of water sources and irrigable lands, the subsistence economy of these settlements can be assumed to be agricultural. It seems that the sites of this cluster are large towns or villages formed in different parts of the plain; some of them, like the Ghale Hasan Su Tepe, were formed near the heights.

Settlement Pattern B: In this pattern we included two sites named Takhte Sir (BAMA21) and Ghourch (BAMA22), and the reason for this is the greater proximity to water resources and communication routes, location on the valley floor, lower altitude, and especially its vastness compared to the other sites. These sites, with an area of 12.5-22.5 hectares, are located at 1026 to 1398 meters above sea level. The mentioned hills are located at a distance of 2000 to 2500 meters from the main water sources and communication routes. In terms of location in the landscape of the region, these sites are located in lands with agricultural vegetation and on the belt edge of the heights at the entrance of a gorge towards the vast plain of the middle Atrak Basin. All these characteristics indicate a strategic location, especially the commercial area with high agricultural capability.

Out of 20 sites in the Early Bronze Age, nine were abandoned, and two were inhabited for the first time in the Middle Bronze Age. In the analysis of the establishment patterns of this period, two patterns were obtained by cluster analysis, which is discussed below.

Settlement pattern A: Includes nine sites with the most significant number among the clusters. These sites are Shah Tepe (BAMA13), Bibi Sanam Tepe (BAMA19), Takhte Sir (BAMA21), Gheib Pari Tepe (BAMA28), Kouze Kamar Tepe (BAMA31), Cheshme Haj Ali Tepe (BAMA34), Ghale-Khan Tepe (BAMA35), Shahrava Tepe (BAMA36), and Gharaghanlu (BAMA37) (Diagram 9). The altitude of this settlement pattern is between 320 and 1571 meters above sea level. It should be noted that most of these sites are between 320 and 1100 meters above sea level, and only one site is located 1500 meters above sea level. The distance from the communication routes of these sites is between 2479 and 36151 meters. These sites are located at a distance between 260 and 2642 meters from permanent water resources (mainly at a distance of 260 to 500 meters from water sources and only one area

at a distance of 2642 meters), in lands with rain-fed agriculture vegetation and agriculture suitable for irrigation and in lands with shallow agricultural soil along with shallow rocky soil. These sites are located between 201 and 2542 meters from the current villages. The area of these sites is between 0.42 and 22.5 hectares. According to the location of these sites in the region's landscape, especially since they lack regional concentration and proximity to water resources, the economic method of these habitats can be assumed to be agricultural. What results from the distribution of this group of sites is that these settlements are formed linearly next to water resources.

Settlement pattern B: In this pattern, there is only one site named Takhtsir (BAMA21) (Diagram 9), and as mentioned, the reason for that is its vast size compared to other sites located in a cluster. This site, with an area of 22.5 hectares, is located at 1398 meters above sea level. The mentioned mound is located at a distance of 2642 meters from the main water sources and 2479 meters from the communication routes. In terms of location in the region's landscape, this site is located in lands with agricultural vegetation and on the belt edge of the heights at the entrance of a gorge towards the vast plain of the middle Atrak basin. All these characteristics indicate a strategic location, especially the commercial area with high agricultural capability. Using pastures due to the concentration of better pastures inside the valleys and riversides may be another factor in the distribution of settlements.

Ten sites from the middle Atrak basin have been identified from the younger Bronze Age. Two of these sites have been inhabited since the middle period of the Bronze Age. Four sites were formed for the first time in this period, and four were inhabited in the older Bronze Age and got abandoned in the middle period and re-inhabited in the new bronze period. These sites are grouped into two clusters based on statistical analysis by the cluster method (Diagram 10).

Settlement Pattern A: In this pattern, there is only one site called Meidan Tepe (BAMA12) (Diagram 10). This site, with an area of 6000 square meters, is located at 1645 meters above sea level in one of the northernmost valleys of the region in a mountainous part. This hill was formed in the highest part of the region compared to other sites of the Late Bronze Age in the middle Atrak area. The mentioned hill is located at a distance of 156 meters from the main sources of water and 39713 meters from the communication routes and in lands with poor forest vegetation and poor agriculture on the edge of the highlands. The nearest village to this site is 2266 meters away.

It should be noted that Bibi Sanam hill (BAMA19) could also be included in this group, but due to its large size and lower altitude than Meidan, it is placed in cluster B. All these characteristics indicate a place with seasonal settlement specifications and possibly an animal husbandry subsistence economy. Placement in mountainous areas, low-depth valleys, and steep areas on the edge of the plains, which have stony lands, all indicate the temporary nature of this type of settlement.

Settlement Pattern B: This group includes 9 sites named Dahaneh Farah Tepe (BAMA15), Yavar Tepe (BAMA18), Bibi Sanam Tepe (BAMA19), Gelor Tepe (BAMA23), Eshgh Tepe (BAMA25), Gabaran Tepe (BAMA27), Gharegah Tepe 2 (BAMA30), Haji Mohajer Tepe (BAMA32) and Shahrava Tepe (BAMA36). The altitude of this settlement pattern is between 575 and 1571 meters above sea level. It should be noted that most of these areas are between 575 and 1000 meters above sea level, and only one area is located 1571 meters above sea level. These sites are between 887 and 5435 meters away from the communication routes. These sites are located between 112 and 854 meters from permanent water resources, and in this case, most of them are located less than 400 meters from water resources and only one area is located at a distance of 854 meters. The area of these sites is between 0.08 and 6 hectares. These places are located between 169 and 2531 meters from the current villages. Regarding the type of soil, they are located in lands with inceptisol soil or irrigated and rain-fed agriculture with proper drainage. This category is also formed in mountainous areas and moderately sloping lands. In terms of land use, they are located in lands with vegetation, rain-fed agriculture, and agriculture suitable for irrigation and medium to rich pastures. According to the location of these sites in the region's landscape, especially because they lack regional concentration and are near water resources and irrigable lands, the subsistence economy of these settlements can be assumed to be agricultural along with the exploitation of mountainous areas on the edge of the plain. What can be seen from this group of sites is that these are also formed linearly next to water sources. Mainly, the location of the sites in the center of the plain and close to the permanent water resources and the main road show the subsistence methods of agriculture along with trade[34].

5. Discussion and Conclusion

Based on surface surveys carried out in the upper and middle Atrak basin, 38 settlements from the Bronze Age have been identified. In analyzing the settlement pattern of the sites mentioned earlier, environmental factors such as altitude above sea level, the distance from water sources and communication routes, vegetation type, and soil type were measured. This study found that due to the region's lack of reliable water sources, those that

[34] Motarjem and Siasar 2015, 88.

existed played the most crucial role in forming settlements. We face two settlement patterns in the upper Atrak Valley in the Early Bronze Age. The first group consists of sites which probably represent a subsistence based on agriculture/animal husbandry due to their area and proximity to the heights. Two relatively large sites in the cluster probably functioned as a central place in the region. During the Middle Bronze Age, we were faced with a break of habitation in the upper Atrak region. In the Late Bronze Age, a two-cluster settlement pattern can be seen. In the first cluster, small sites are distributed in different regions with an agricultural/animal husbandry subsistence economy. In the second cluster, large area sites are located in the center of the plain or close to communication roads, which probably show centers of commercial activities.

However, in the middle Atrak region, based on cluster analysis, three settlement patterns have been identified during the Early Bronze Age. In the first group, there are sites that, due to their location on the edge of the plain and near water sources and irrigable lands and pastures, the subsistence economy of these settlements can be assumed to be agriculture/animal husbandry. All the settlements in this cluster seem to be small villages with a subsistence economy of agriculture and animal husbandry. In the second cluster, the settlements are located near water sources and irrigable lands at the bottom of the plain. It seems that the sites of this cluster are large towns or villages formed in different parts of the plain and some of them, like the old Tepe of Ghale Hassan, were formed near the heights. In the third cluster, a site is located on the belt edge of the highlands at the entrance of a gorge towards the vast plain of the middle Atrak basin. All these characteristics indicate a strategic location, especially the commercial area with high agricultural capability. Unlike upper Atrak, middle Atrak was inhabited in the Middle Bronze Age, although we face a significant decrease in the number of settlements. During this period, nine abandoned sites and only two new settlements were formed on the plain. During this stage, two clusters can be seen. The first cluster consists of small villages with agricultural/animal husbandry subsistence economies formed linearly next to water sources. The second cluster also consists of large centers with a central location nature. In the Late Bronze Age, we are faced with an increase in the number of settlements; although it was not as prosperous as those from the Early Bronze Age, four settlements were formed for the first time. During this stage, we are faced with two clusters. The first cluster has a site with seasonal settlement characteristics and probably with an animal husbandry subsistence economy. In the second cluster, there are sites without regional concentration and the nature of the central location, which are located near water sources and irrigable lands. Their subsistence was probably based on agriculture along with the exploitation of mountainous areas.

In general, the Atrak region is a midland in terms of its geographical location. In Early Bronze Age, it was under the influence of the Namazgah IV painted buff pottery culture and the Eastern Alborz gray pottery tradition. However, the distribution area of these two cultures is not the same. In the upper Atrak basin, the preliminary results of the pottery comparison of this research show that this area was dominated by the expansion of Namazgah culture in the Early Bronze Age. However, as we move towards the west and the middle Atrak basin, cultures related to the plain gray pottery appeared. At the same time, there are sites with both types of pottery in the region. It seems that in the general perspective, we are facing a decrease of the settlements in the region during Middle Bronze Age; although there has been a decrease in the number of settlements from 21 to 7 in the middle Atrak basin, some settlements have been established in the region. This phenomenon has also been reported in Central Asia, and two hypotheses have been proposed for it[35]. Stating the absence of significant climate changes in the region of Turkmenistan during the past eight thousand years, some rejected climate change to explain the phenomenon of the decrease in the number and the area of settlements and attributed the decline of urbanization in Turkmenistan to nomadic populations close to Andronovo culture which they were probably identified with the Indo-Iranian immigrants to the south. Andronovo pottery has been identified in almost every site of Namazgah VI, especially in the layers that can be dated to the end of this period. In addition, no traces of war, fire, and other related phenomena have been found[36]. However, Hlopina suggested that the concentration of the population in the areas of the beginning of urbanization was very intense, so the structure of the socio-economic organization of these areas could not withstand the pressure of the population gathering. Production forces and social structure became insufficient; as a result, the population was forced to divide into smaller units and decentralize from residential places[37]. Nevertheless, the situation in the Atrak region is somewhat different from the south of Turkmenistan. First, there are no sites with a large enough area to be considered cities. Up to a point, no extensive excavations have been carried out in the region to gain knowledge about the nature of the settlements of this period. The climatic phenomenon of 4200 BP (which coincides almost with the midway of the Middle Bronze Age of the region (2500-2000 BC) probably was associated with drought and lack of water in the region; the importance of this variable in the settlement patterns has probably caused a decrease in settlements and even abandonment of the region.

35 Biscione 1977.
36 Kuzmina 2007.
37 Hlopina 1972, 213.

Although we are in the first steps of research in the field of Bronze Age studies in the region, it is worth mentioning that the Bronze Age settlement of Ghale Khan, the only site explored with absolute stratification in the Atrak basin, was also around 2200 BC. This time frame is almost simultaneous with the mentioned climatic phenomenon, an issue that should be evaluated in future regional researches. In the younger Bronze Age, settlements decreased with less intensity. From the end of the Middle Bronze Age to the New Bronze Age, the area was influenced by the BMAC, and traces of a burial sample were identified in Eshgh Tepe, Bojnourd. In general, it can be said that although there are no settlements on the scale of cities in the Atrak region, it seems that sites such as Yam Tepe, Arg Shirvan Tepe, Shahrava Tepe, Takh Sir Tepe, and Ghale Khan are important settlements of the region in the Bronze Age.

In the end, it is necessary to mention that since the studies carried out in the area was intensive and did not include field walk, our information about small and temporary settlements with the nature of nomadism is short. Also, archeological surveys usually do not have access to the depth of the layers, and the results of this study should be tested and corrected by carrying out purposive and extensive excavations in some important sites.

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