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The Role of Environmental Factors in Settling Neolithic Sites in Luristan, Iran

Mohammad Bahrami[1], Rahmat Abbasnejad Seresti[2]

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Abstract

During the last decade, researchers embarked on several archaeological surveys and excavations in Luristan and they could unearth 29 Neolithic sites there. The current paper, taking into accounts the Geographic Information System (GIS) and Settlement Analysis, tries to analyze the role of environment on the aforementioned Neolithic sites. The study indicates that Neolithic communities chose foraging as the most important way of their livelihood. Water and food resources, wild plants, and animals were found impressive in the site-catchment process. All of the 29 Neolithic settlements are located at the altitudes between 500 and 2000 meters above sea level. These altitudes cover the southern, central, and northern parts of Luristan, the region that enjoys semi-arid climates, cool winters and hot summers, where pastoral livestock has been common. There are many rivers at these heights, but locals often disposed of using springs water. The distance from 26 sites to the springs is about 300 meters.

Keywords*:* Settlement Pattern, Environmental Factors, Nomadic Pastoralism, Neolithic, Luristan.

1. Ph. D. Student, Department of Archeology, University of Mazandaran, Mazandaran, Iran.
Email: mohamadbahrami57@gmail.com.
2. Assistant Professor, Department of Archeology, University of Mazandaran, Mazandaran, Iran.
Email: r.abbasnejad@umz.ac.ir (Corresponding Author).

Introduction

Settlement patterns in archaeological studies reconstruct the history of technology and economy of the past societies and know their social and political developments through analyzing the data related to the interaction between human and environment. This type of research emphasizes the way human beings interact with the environmental surrounding and how they are influence by the past communities and site-catchment. Some variables such as size and function of the settlements and their inter-regional and long-range interactions, as well as the distance between the sites and water resources, natural reserves, and roads are involved in implementing this method. On the basis of environmental studies, we can understand the demographic changes in one region, modifications of settlement patterns, their distribution, the relationship between social environments and environmental landscapes, and the forms of socio-economic patterns of the past societies (Schreiber, 1996; Greenfield *et al.*, 2008; Kowalewsky, 2008).

Some archaeologists began the study of the interaction of ancient societies with their environments since the 19th and during the first half of the 20th centuries (Steward, 1937; Willey, 1953; Vogt, 1956). The researches by Adams (1965) in Iraq's Diyala region, Sanders (1965) in Mexico's Teotihuacan, Chang (1958) about the Neolithic farmer societies of North China, and Volta (2007) on the settlement patterns in the Maya region within the framework of social, political and ideological organizations are the most important ones. Some results of these studies include: a) determining of the relationship between social organization and settlement patterns; b) designing of specific analytical models for assessing the interior and exterior relations of settlements; c) explaining the cultural changes process in the mentioned regions; and, d) identifying the interaction between culture and environment.

The environmental, socio-economic, and political variables have influenced the ancient settlements and their sizes and plans. In other words, the size and capacity of a prehistoric settlement depend on the environment and economy. The collection of foods and technologies related to their transportation, processing, and maintenance have played a significant role in permanent or temporary condition of the past societies. Natural and water resources, along with the level of technology as well as social and ideological conditions, were effective for the population size and the way communities were distributed in each region. The Central Place Theory which is used to explain the distance between settlements and recognize their function is regarded as a profitable method. It enables us to understand the interactions among the residents of the ancient sites and recognize the socio-economic hierarchy (Christaller, 1933 trans. 1966; Darvill, 2002).

The implementation of the Regional Systematic Survey and Field-by-Field Surface Survey results in drawing an integrated and extensive settlement pattern, and determining how the regional policy cycle and the interaction among centers and sites are. The Geographical Information System (GIS) is one of the most useful tools for analyzing the collected data and identifying the settlement patterns. The present study has investigated the role of the environmental variables in settling Neolithic settlements and their sizes and distributions in the Luristan region (see Map 1), by using the settlement analysis, the settlement pattern method and the GIS.

Map 1 Locations of Luristan and its Counties in Western Iran

Background of the Study

After Braidwood's 1959 prehistoric project in western Iran and Central Zagros, Asiab and Sarab were excavated (Braidwood, 1961). Guran, which was excavated by Mortensen in 1963, is located in the Hulailan valley and represents Neolithic pottery culture (Thrane *et al.*, 1964). Excavation of the Ganj Dereh which was conducted during the five seasons from 1965 to 1974, led to the identification of 5 settlement layers. The date of the first layer (E) was determined between 8500 B.C. and 7500 B.C. and other layers (D-A) were determined at the end of the 8th millennium to the middle of the 7th millennium B.C. (Smith, 1990). Abdolhosein in the northwest of Luristan province is another Neolithic site in the west of Iran, which was excavated by Pullar in 1978. It was inhabited between the 7th and 5th millennia B.C. on the basis of radiocarbon dating samples (Pullar, 1990).

Mohammadifar and Matthews excavated Tepe Sheikh-e Abad and Tepe Jani in Kermanshah in 2008. These are regarded as a turning point in the beginning of Neolithic studies in Iran. Based on the dating of the C^{14} samples, Tepe Sheikh-e Abad was dated between 9500 and 7500 B.C. (Mohammadifar *et al.*, 2011). In recent years, Darabi (2009) and Hesari (2010) have excavated East Chia Sabz during two seasons. This site is located on the east coast of the Seimareh River in the catchment basin of the Seimareh Dam. Based on the chronology which has recently been proposed for Central Zagros (Darabi, 2012), the cultural strata of East Chia Sabz are placed at the

early 9th millennium B.C. to the early 7th millennium B.C. representing pre-pottery and pottery Neolithic (Darabi, 2013). Tepe Chagha Golan, which is located in Ilam province, was recently excavated by a joint Iranian-German team led by Zeidi. The study of the discovered plant remains indicated that the inhabitants of this site had been the pioneer of the cultivation of barley, lentil and chickpea (Riehl *et al.*, 2013).

The most important archaeological surveys in Central Zagros which was conducted during the last decade in Luristan (Bahrami *et al.*, 2012; Abbasnejad Seresty & Bahrami, 2015; Bahrami, 2013; Mohammadian 2015), led to the identification and recognition of 17 new settlements.

Neolithic Settlements of Lorestan

Until recently, the Neolithic of Luristan known by data has been resulted from Abdolhosein Tepe. However, during the last decade, several Neolithic sites were identified, and among them four settlements were excavated including Eastern Chia Sabz, Kapargah 5, Kelek Asad Morad, and Mar Boz Cave. Through archaeological surveys, 29 settlements have been identified and investigated in Luristan so far, dating from 10,000 to 5,500 B.C. In the same vein, 12 settlements in past decades, 13 settlements during the authors' survey, and 4 settlements are included in the review program (see Table 1). The Neolithic settlements discovered in archaeological studies of Luristan, using the GIS method, in this article, are located on separate maps containing variables such as roads, water resources, plant and animal coverage, height from sea level, climate, earth slope, and the distance of settlements from each other. Then, an analysis is made as why and how these settlements are located and distributed in the studied area.

Table 1 Neolithic Sites of Luristan

Sites	Code	Old Surveys	Authors' Surveys	Altitude from Sea Level	*Period
Abdolhosein	01	*	-	1820	PPN
Deh Sefid	02	-	*	1895	PPN
Nematollahi	03	*	-	1940	PPN
Golbaghi	04	*	-	1780	PPN
Cheshme Hajimohammad	05	-	*	1838	PPN
Aziz Koshteh	06	*	-	1380	PPN
Kharmanja haftchesmeh	07	-	*	1292	PPN
Houdar	08	-	*	1353	PPN
Sorkhdom Laki	09	-	*	1312	PPN
Chia Pahn	10	*	-	990	PPN
East Chia Sabz	11	*	-	680	PPN
Kapargah 5	12	*	-	665	PPN
Ghar Mar Boz	13	*	-	662	PPN
Kallek Asadmorad	14	*	-	825	PPN
Kotal si	15	-	*	1705	PPN
Kargona	16	-	*	1230	PN
Zoran Cham	17	-	*	1070	PPN
Chalab	18	*	-	1300	PN
Kohla	19	-	*	1715	PPN
Merijelo	20	-	*	1063	PPN

Darkakouli	21	-	*	977	PPN
Varezard Shelter	22	*	-	725	PPN
Eshkaft Sorkhelizeh	23	*	-	1370	PPN
Eshkaft Gilvaran	24	*	-	1225	PPN
Dada	25	*	-	1550	PPN
Sarabe Kotlah	26	-	*	1853	PPN
Roahol	27	-	*	1258	PN
Deyma	28	-	*	1570	PPN
Afrina	29	-	*	1320	PPN

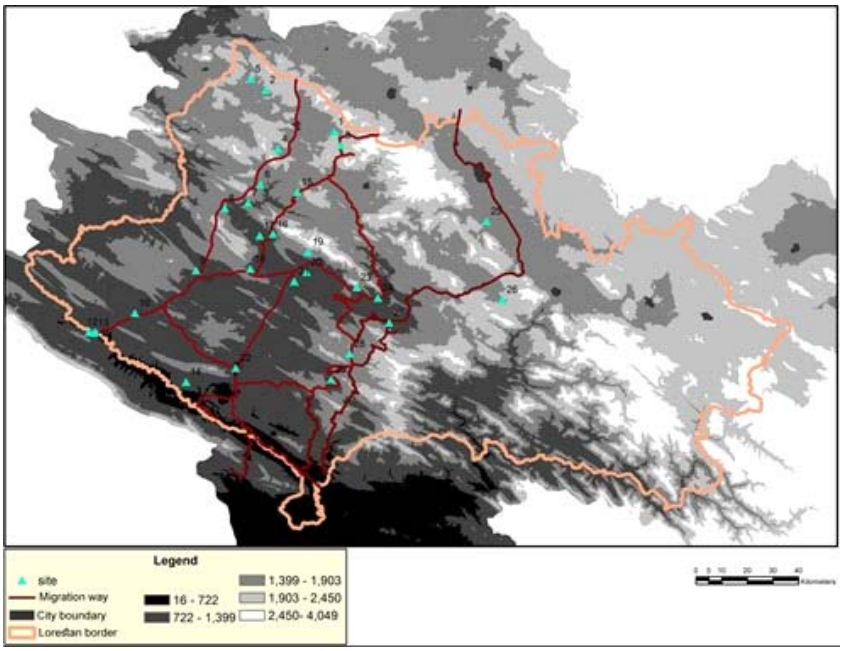
- Pre-pottery Neolithic= PPN; Pottery Neolithic= PN

Analyzing Environmental Factors for Neolithic Sites' Settlements

- **Communication Routes**

Tribal Roads

Most of the Neolithic settlements are adjacent to nomadic roads of cold regions like highlands of Luristan and tropical regions like plains of Khuzestan province. Therefore, these tribal roads were mapped using the comprehensive information of the Nomadic General Office of Luristan Province and some archaeological studies (Map 2). These are the triple roads utilized by nomadic groups until several decades ago. If the nomad routes are considered effective in settling the Neolithic sites, those communities were likely to be shepherds that selected the pastoralism livelihood to maximize the use of natural and food resources and enjoy favorable weather conditions in Luristan mountains during spring and summer, and Khuzestan plains in autumn and winter seasons.



Map 2 Locations of the Neolithic Settlements at the Vicinity of Nomadic Roads

Discovering a large number of goat and sheep bones from the Neolithic sites of Central Zagros and Southwest of Iran including Ganj Dareh (Smith, 1976; Hesse, 1978), Asiab (Bökönyi, 1977), Abdolhosein (Pullar, 1990), Guran (Mortensen, 1963, 1972), Sarab (Braidwood, 1960), Chogha Sefid (Hole, 1977), Alikosh (Hole *et al.*, 1969), East Chia Sabz (Darabi, 2012; Haji

Mazandarani *et al.*, 2014), Sheikh-e Abad (Bendrey *et al.*, 2013), Chagha Golan (Naderi *et al.*, 2008) and Kelek Asad Morad (Moradi *et al.*, 2016), have emphasized the prevalence of nomadism and pastoralism livelihood patterns in these areas. Based on some evidence, the process of domesticating goat began in the 9th millennium B.C. in this region. Some experts believe that goat and sheep were domesticated in the foothills of Zagros-Taurus (Hole, 1989; 1996; Zeder, 1999; Bar-Yosef, 2000). Braidwood (1961) has introduced the Tepe Sarab, located in Highlands of Kermanshah, a seasonal settlement and has described its relationship with Jarmu. Mortensen (1974) considers Tepe Sarab as the summer settlement of the Guran's residents. Smith (1976) proposes the settlement of Phase (D) in Ganj Dereh as a seasonal settlement in which occupancy lasted from spring to autumn, and its shepherd inhabitants migrated to the lowland areas during the cold season. Alizadeh (2003) has introduced Ganj Dereh and Asiab as the origin of people of Ali Kosh.

Based on the studies conducted by Eeilberg and Edelberg in 1935 and 1964 in Luristan, a relationship can be established between prehistoric and contemporary societies on the basis of the pastoral livelihood (Mortensen and Nicolaisen, 1993). Similar nomadic patterns and temporary settling have been common during the two aforementioned periods in the West of Iran, and mountainous roads and natural resources played a major role in adapting the nomadic patterns (Mortensen, 1993). This pattern, in addition to Luristan and Central Zagros, was reported in other Southwest Asian regions (Savard *et al.*, 2006). Hole, based on ethno-archaeological studies conducted on the tribal roads of Deh Luran to Luristan, proposed that the pioneers of food producers have had nomadic and pastoral livelihood during the Neolithic period of this region (Hole, 1979, 1989). Further, the present study confirms the hypotheses, which have made the settlement pattern of nomadism and pastoralism in the Neolithic period of Luristan.

Current Roads

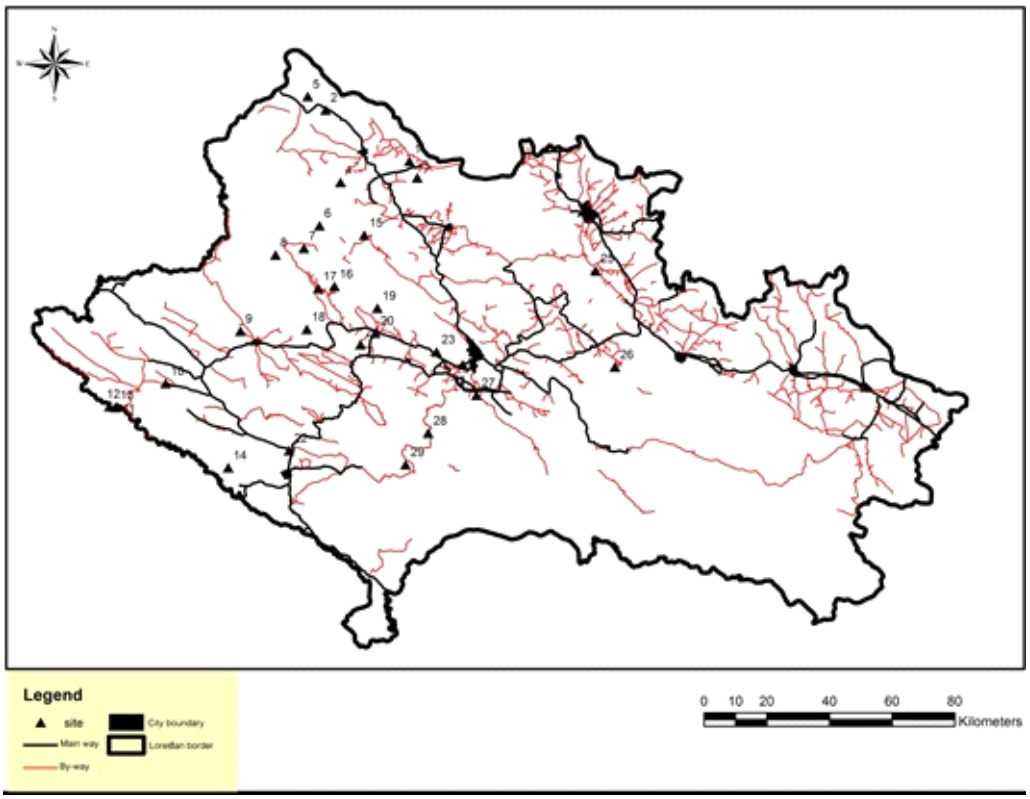
Except for nine sites that are relatively distant from the current roads, 20 other settlements are located closer to the aforementioned roads (Map 3). The comparison of Maps 2 and 3 demonstrates that most settlements are close to current and tribal routes, due to the existence of certain passages where both roads should inevitably cross them; as the passages of Sefid Kouh, the Mahleh and the Henjes mountains have this feature and many Neolithic sites exist near them.

Distance and Closeness of Sites

Calculating the distance and closeness of settlements from each other is considered as an appropriate spatial variable to understand the settlement pattern of Luristan area better. However, the settlement pattern in this region is incompatible with the Central Place Theory, due to its environmental and geographical features. Factors such as environmental obstacles, the function of each site, the location of sites in relation to communication routes, accessing to water and food resources, wild animals and plants, and pastures have influenced the distance and closeness of the Neolithic settlements of Luristan. Further, cold and tropical factors, used seasonally by

nomadic group, have affected the settlements' distance from each other. Although it was a function of natural covenants, social conditions, and water and environmental resources based on the ethno-archeological research, the distance for traveling between the sites within the shortest possible time, for example, takes one or two days.

Some settlements were probably used for short time, due to poorer biological conditions and the others with more favorable environmental capacities were utilized for a longer period, where naturally have more area, wider site-catchment, and more rigorous archaeological evidence. In general, the least distance between two Neolithic seasonal settlements is 800 meters, which are between East Chia Sabz and Mar Boz Cave and the most is 45 kilometers, which are between Roahole and Sarab-e Kotelah. The distance between the main settlements is between 10 and 20 km, regardless of small and dependent settlements. Nomadic groups traversed this route within a day. According to Hole (1979), traversing the distance of 15km between two settlements within a day, on the roads of the Deh Luran to the highlands of Luristan, during the Neolithic periods is appropriate.



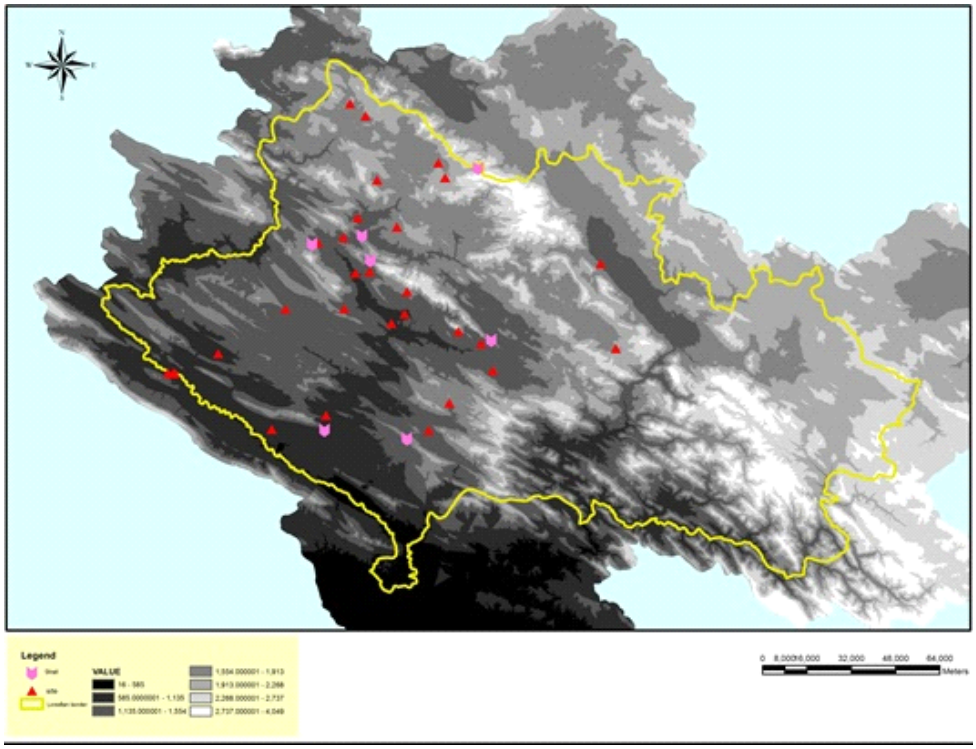
Map 3 Locations of Neolithic Sites toward Current Roads

Altitude from Sea Level

Luristan province, with a total area of 28560 square kilometers located in the west of Iran, is a high and mountainous land with an average height of 1,400 meters. Oshtoran Kouh and the southern parts of Pol-e-Dokhtar with more than 4000 meters and about 300 meters height above sea level are the tallest and lowest area in Luristan, respectively. The climate

variation in there is evident due to the severe height difference. In the winter, when northern regions of Luristan experience extreme cold weather, the city of Pol-e-Dokhtar and the northern areas of Khuzestan have a mild and springy weather. In the summer, when the southern areas of Luristan and the city of Pol-e-Dokhtar have hot weather with over 50^{o} C, northern regions have a favorable and moderate climate.

All of the 29 Neolithic settlements are located at an altitude of 500 to 1,000 meters, 1000 to 1500 meters, and 1500 to 2000 meters, forming the southern, central, and northern areas of Luristan, respectively. The share of each of these areas is 7, 12 and 10 Neolithic sites, sequentially (Map 4). Therefore, based on the present study, the nomadic life style was common in the Neolithic period in these three regions of Luristan. So far, any specific Neolithic site has not been reported at a height below 500 meters and above 2000 meters.



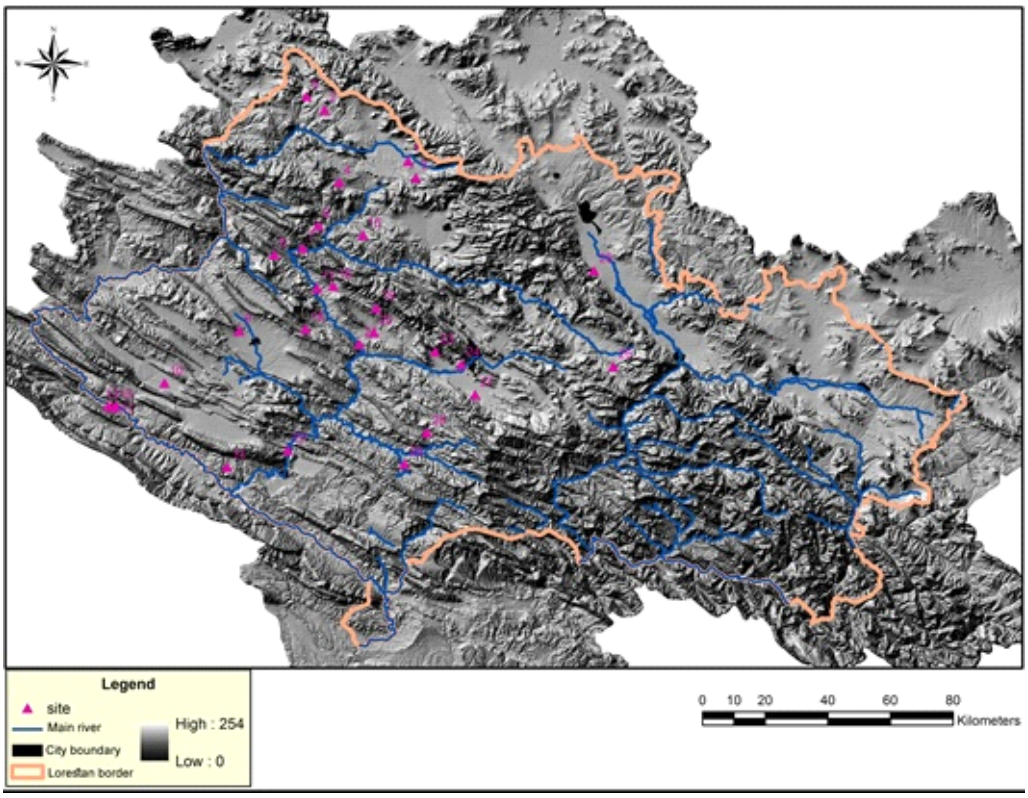
Map 4 Locations of Neolithic Sites at Altitude from Sea Level

Geomorphology of the Region

Quaternary is a period of the Cenozoic, the 3rd era of Geology, which is also known as the 4th era of Geology due to its importance and place in human life. Alluvial fans, which form at the bottom of the valleys and near the rivers, are related to this period. These factors are appropriate for agricultural activities due to their rich alluvial soil and superfine contexts, and have played an important role in attracting human groups during the Neolithic period. 26 sites, about 90% of them, are formed on the soil layers of the quaternary (Map 5).

Based on the variable of the geomorphology of the region, the location of the sites is classified into two groups. The first includes 15 sites which are located in the highlands with rough landscapes. The second group consists of 14 sites formed at the final skirt of the

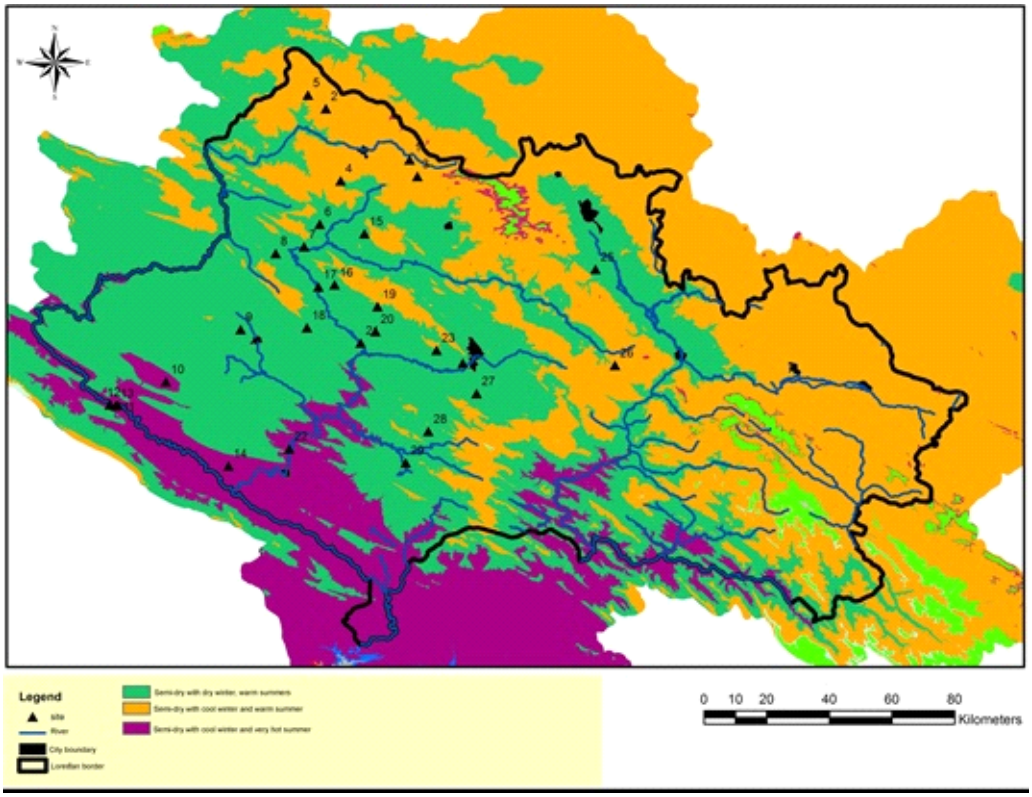
highlands and at the outskirts of the plains. The nutritious resources have been available in the mountain and plain simultaneously for the settlements of the second group, which are the significant features of the settlement patterns in Luristan and Central Zagros.



Map 5 Geomorphology of Luristan and Neolithic Sites

Weather

In Luristan province, from the second half of the autumn to the winter as well as in the early spring season, the precipitation of rain and snow ranges from 400 to 500mm, which is often irregular and with high fluctuations. In addition to three distinct climatic regions of cold mountainous, moderate central, and warm south, Luristan has three semi-arid climate zones, each having cold winter and warm summer, cool winter and warm summer, and semi-arid with cool winter and very hot summer, respectively. In each of these climate zones, there are 7, 16 and 6 Neolithic sites, respectively (see Map 6). The distribution of settlements in these three climate zones is consistent and compatible with their settling at three aforementioned altitudes, located between 500 and 2000 meters. This situation can be analyzed by the combined livelihood of the Neolithic nomadic communities relied on livestock, hunting, vegetable seeds gathering, and agriculture.



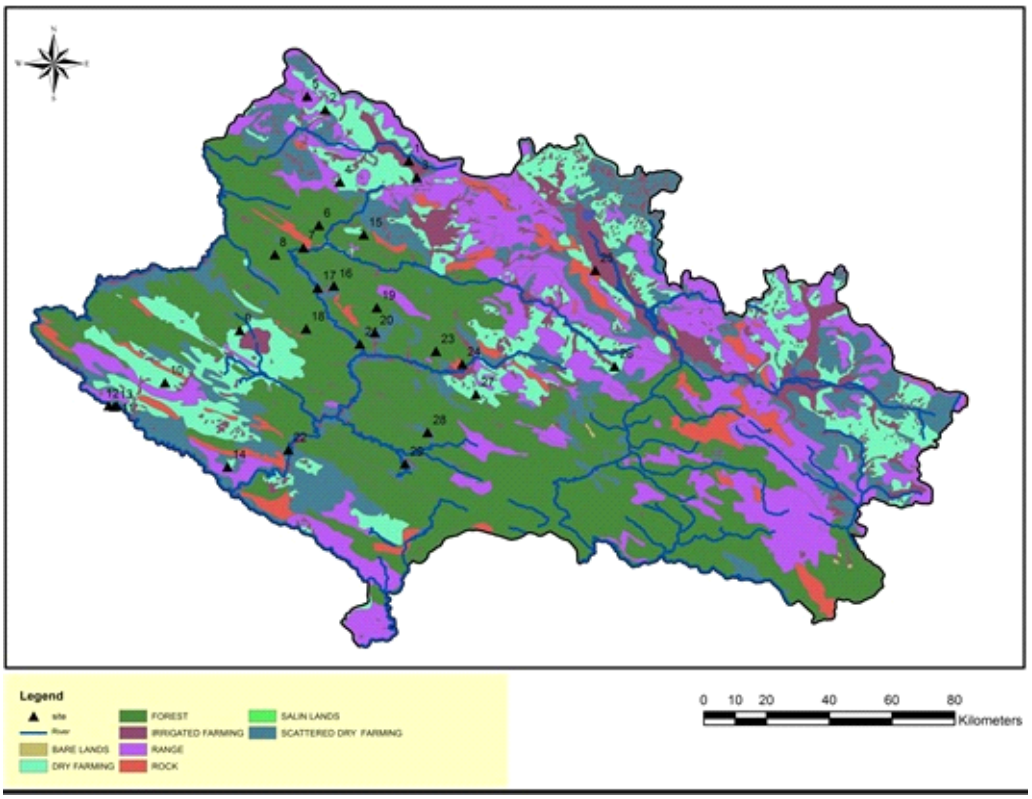
Map 6 Weather of Luristan and Neolithic Sites

Vegetation Coverage

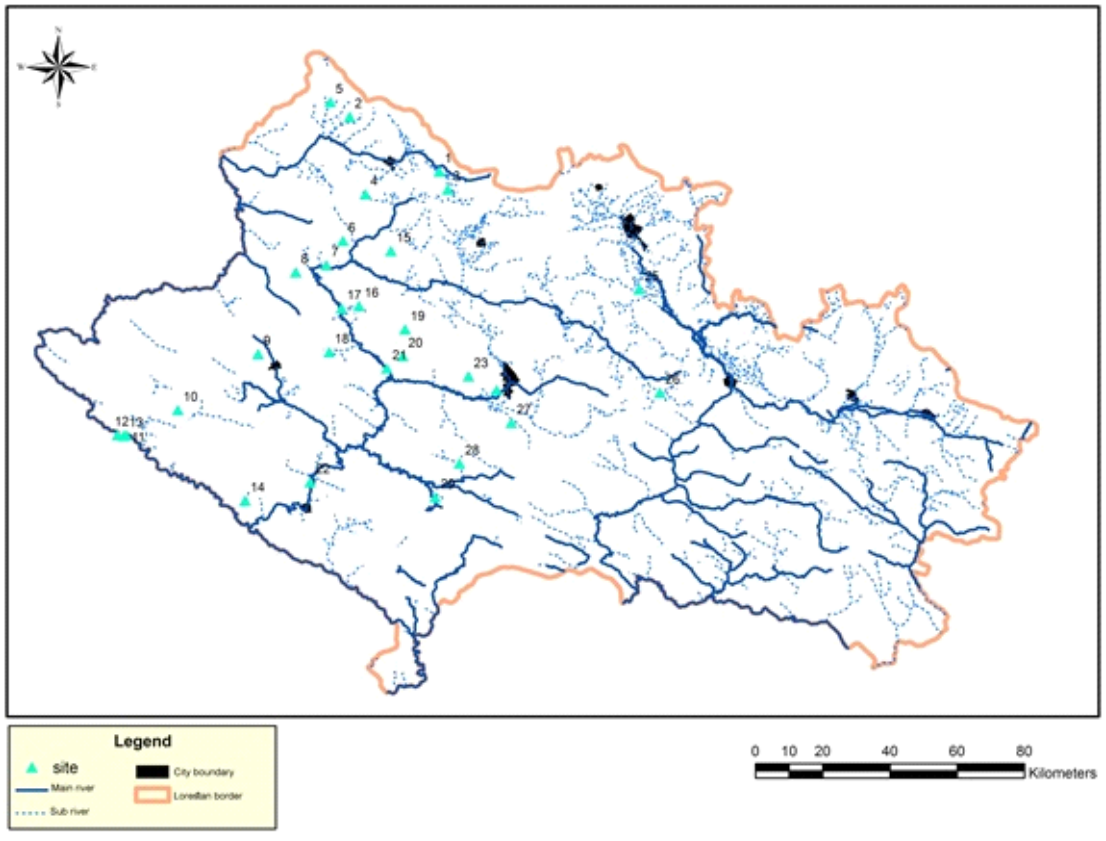
Oak forests cover a large part of the Luristan region. Hole, with an ethno-archeological approach, highlighted the role of the oak trees in feeding livestock and nomadic communities (Hole, 1979). Luristan is appropriate for livestock and herding, due to its suitable rainfall, favorable weather, and rich vegetation cover. The type of vegetation coverage influences animal's ecosystem, land use, and soil type of an area. Due to the dependence of human livelihood on these factors, they are effective in settling, expanding and sustainability of the settlements. The life of plant ecosystem of the Luristan with relative sustainability, has led to the survival of animal species belonged to the Neolithic period of Luristan and even before that period (Hole, 1996). This region contains two main vegetation coverage including plains and hillside without forest cover with 10 Neolithic sites and the area covered with oak forests covering most of the Luristan territory and has 15 Neolithic sites. Two settlements are located on the borders between the two mentioned vegetation coverage (Map 7).

Water Resources

Luristan has a mean rainfall of 400 to 500mm per year due to its high mountains and its location on the precipitation system of the Mediterranean and Sudanese plains. For this reason, more than 130 small and large rivers flow continuously and seasonally. Seimareh, Kashkan and Sezar are the most important rivers in Luristan. The spatial analysis of settling and localization of the Neolithic settlements, done based on a survey of the base map, indicates that Neolithic people were highly dependent on spring water sources.



Map 7 Vegetation Coverage and Neolithic Settlements of Luristan



Map 8 Locations of Neolithic Sites beside Water Resources of Luristan

26 settlements are located at a distance less than 300 meters from water sources, in other words, about 90% of the total discovered sites. This high percentage reflects the importance of safe water. The dependence of the sites on springs is interesting, as in some cases, where river was available to them, they could settle in the vicinity of sustainable springs. Among the 26 aforementioned sites, 23 were located in the proximity to the rivers such as Seimareh, Kashkan, Chulhul or small rivers like Ab Gheshlagh, Dureh, Reftkhan, Houdar and the Bozazna, as well as in the closest possible position to springs. Three settlements were stuck to the springs, and three other settlements were located between 1 and 2km from the rivers and in the hillside (Map 8), and their residents may use the seasonal springs of the hillside. In addition, it is likely that stockbreeders or hunters used such sites throughout the day.

Conclusion

The settlement pattern has been probably influenced by the movement of hunting animals and the place of wild plants before domestication. The water and food resources played a major role to adapt a type of settlement pattern during the Neolithic. Nomadism was commonly used in most areas of the Southwest Asia during the Neolithic period. Seasonal movement, which is called *Kouch* in Persian, is a movement or temporal migration, which takes place at a certain time interval between two natural environments relatively different in nature. Changes in temperature, the amount and time of the rain precipitation, and the location and time of plants growth play a decisive role in determining the *Kouch* time. Human dependence on animals, the use of pastures, human and animal displacement in order to utilize the pastures, and the avoidance of extreme cold and heat weather are considered as the most important aspects of the nomadic life.

The analysis, which has been done in this study, demonstrates that the nomadism and pastoralism have been the social structure of Neolithic communities in Luristan. In this pattern, Neolithic settlements were formed on the paths used by nomad groups over the past few decades to traffic through tropical regions like North of Khuzestan and Deh Luran and cold regions as highlands of Luristan. The existence of these settlements on regular and distinctive nomadic roads indicates that these people were stockbreeder and shepherd. In addition, based on the evidence of Archaeo-zoology, discovered from Sheikh-e Abad, Ganj Dereh, Ali Kosh, Abdolhosein, East Chia Sabz and Kelek Asad Morad, the goat's domestication process can be tracked in Central Zagros and Luristan in the 9th millennium B.C.

The distribution pattern of the Neolithic sites from the northern areas to the central and southern parts of Luristan and in the vicinity of the routes leading to southwestern lowlands of Iran indicates that these settlements belong to the unit communities that had turned into nomadic livelihood strategy based on bio-necessities, air temperature difference, and more exploitation of the nature. Since these nomadic groups had relied on breeding goats and sheep, they were in transit between high and low lands for more utilization of natural resources and pastures. Further, they settled in places that in addition of being on main roads had healthy and sufficient water resources and rich pastures.

The proximity to wild resources has been another influential factor in settling the Neolithic sites. All of the settlements identified in Luristan are located at altitudes between 500 and 2000 meters. These altitudes, including mountains, mountainous skirts and land close to the plains, have alluvial fans, appropriate water resources, and favorable vegetation coverage, as well as the wild animal resources, and self-growing plants seeds. This site-settling pattern at the biological boundaries, which was discovered from some areas of the Southwest Asia, has been a common pattern in the Neolithic period of Central Zagros and Luristan.

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نقش عوامل محیطی در مکان‌گزینی محوطه‌های نوسنگی لرستان

محمد بهرامی[۱]، رحمت عباس‌نژاد سرستی[۲]

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چکیده

تحقیقات یک دههٔ گذشته در لرستان، شمار محوطه‌های نوسنگی آن را به ۲۹ رسانده است. مقالهٔ حاضر بر اساس داده‌های پژوهش‌های مذکور، به تحلیلِ نقش عوامل محیطی در مکان‌گزینیِ محوطه‌های نوسنگی لرستان با روش تحلیل زیستگاهی، باستان‌شناسی الگوی استقرار و سامانهٔ اطلاعات جغرافیایی پرداخته است. متغیرهایی چون منابع آبی و غذایی، مراتع، گیاهان خودرو و حیوانات شکاری در تعیین حوزهٔ گیرش هر محوطه مؤثر بودند. همهٔ ۲۹ استقرار نوسنگی در ارتفاع ۵۰۰ تا ۲۰۰۰ متر از سطح دریا واقع شده‌اند. در این سطحِ ارتفاعی که بخش‌های سه‌گانهٔ جنوبی، مرکزی و شمالیِ لرستان را در برمی‌گیرد و از آب و هوایی نیمه‌خشک با زمستان خنک و تابستان گرم برخوردار است، الگوی استقرارِ مبتنی بر دامداریِ کوچ‌گری متداول بوده است. رودخانه‌های دائمی و فصلی و چشمه‌های زیادی در این سطحِ ارتفاعی جریان دارند؛ اما، وابستگی استقرارها به چشمه‌ها بیشتر بوده؛ به‌طوری‌که فاصلهٔ ۲۶ محوطه با آنها حدود ۳۰۰ متر است.

واژه‌های کلیدی: الگوی استقرار، عوامل محیطی، دامداری چراگردی، نوسنگی، لرستان.

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۱. دانشجوی دکتری باستان‌شناسی دانشگاه مازندران، مازندران، ایران.

۲. استادیار گروه باستان‌شناسی دانشگاه مازندران، مازندران، ایران r.abbasnejad@umz.ac.ir (نویسندهٔ مسئول).