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**Comparative Study Between Geological natural resources  
and its Archaeological importance  
at Bazian, Sulaimaniya and Qusair, Karbala**

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**Abstract**

Ancient human at Bazian and Qusair sites exploited geodiversity and other natural resources for his daily uses such as food, water, building materials and protection himself from nature danger and other enemies. Bazian site is located about 20 km west Sulaimaniya city, northeastern Iraq and Qusair site is located south west Karbala city, near Razaza Lake, middle of Iraq. Rock units exposed near Bazian and Qusair sites are: limestone, dolostone, dolomitic limestone, marly limestone, marl, gypsum, claystone, mudstone, sandstone. Limestone and dolostone were used for building, gypsum was used for manufacturing mortar and claystone for mud bricks, fired bricks and pottery. Many landforms may be used for human demands such as: mountains, plateaus, slopes, undulated hills, fractures, and caves when he chose the place which protects him from nature danger or from any expected enemy. Soil type is composed of sandy, muddy and clayey. Water resources of studied area comprises precipitation of rain and snow, streams, springs and wells which may be used for drinking by animals and human, irrigations and other domestic uses. Soil and water resources play important role on grow and enrich of plant diversity. The plant may be used for human foods, grazing, fuel, and wine products. Some of animals were hunted and used for food, such as: wild goat, wild hare, chukar, see partridge, Persian squirrels, falcon; and others may be considered as a savage or enemies such as: Persian leopard, red fox, jukale, wolf and brown bear. In spite of the far distance between Bazian and Qusair, but there were many similar factors such as : building materials, technology of building, some of land forms, type of soil, water resources, religious beliefs and others which refers to trade or cultural exchanges or both of them.

**Key words:** geodiversity, biodiversity, archaeology, Bazian, Qusair, Iraq.

**Introduction**

Geodiversity is the variety of geologic factors such as earth surface processes, landforms, rocks and minerals, type of soils and water resources (Gray, 2004). It provides the foundation for the life on the earth (Stanley, 2002) and enhance the biodiversity (Parks and

Mulligan, 2010). The bedrock is considered as the foundation of the biological ecosystem. In addition to the resources and natural processes are sustain biotic factors and Biosystems; Many workers try to support mentioned above relationship ( Jackova and Romportl, 2008; Hart, 2012; Petrisor, and Sabro, 2010; Gray *et al.*, 2013) in addition to some Iraqi researchers (Mohammad and Al-Zubaidi, 2014; Al-Zubaidi, *et al.*, 2014).

Archaeology is the science that study ancient human life and his cultures and physical remains, which includes gravels, stone tools, pottery, rock inscriptions and buildings (The American Heritage, 2014). Geo-archaeology is using earth science principles and its techniques to explaining, interpreting and understanding past archaeological record. Ancient human choose his site in which natural resources available to provide himself important daily needed (Eder and Patzak, 2004; UNESCO, 2007). The aim of this study is to compare between geological factors and its importance on ancient human who settled at Bazian and Qusair sites.

### Materials and Methods

The source of data presented in this study depends on the surveys and field trips to the Bazian and Qusair site. Some of biological data were collected from Nature Iraq report (NI, 2011; Afrasyab, 2014) and were documented in Iraq Natural History Museum- University of Baghdad.

**Location:** Bazian site is located about 26 kilometers west Sulaimaniya City (Fig. 1). Tectonically, it is located on an unstable zone, of high folded anticline (Buday and Jassim, 1987). The main topographic feature in the area is Peramagroon mountain which is large asymmetrical, double plunging anticline as well as Qashlagh, Hanjira Mountain and Bazian gorge (Fig. 2). Qusair located south west Karbala City, middle of Iraq (Fig. 1). Tectonicly, it is located on the Abu Jir fault which separates between stable platform on the west and unstable platform on the east. The main topographic features are: wide Karbala- Najaf plateau, mesa, butte and vallies.

**Climate:** Mean annual rainfall of the Bazyan site is 650- 700 mm. Mean annual temperature 16- 20 °C. Mean annual relative humidity is 45%. The climate of the area seems to be semiarid in the general, because the climate always wet for some seven months (October - April), and dry in other five months (May - September). While near Qusair site the annual rainoff is 109-122 mm; mean annual maximum temperature is 43-44 °C, minimum temperature is 6.4°C (IMO, 2000).

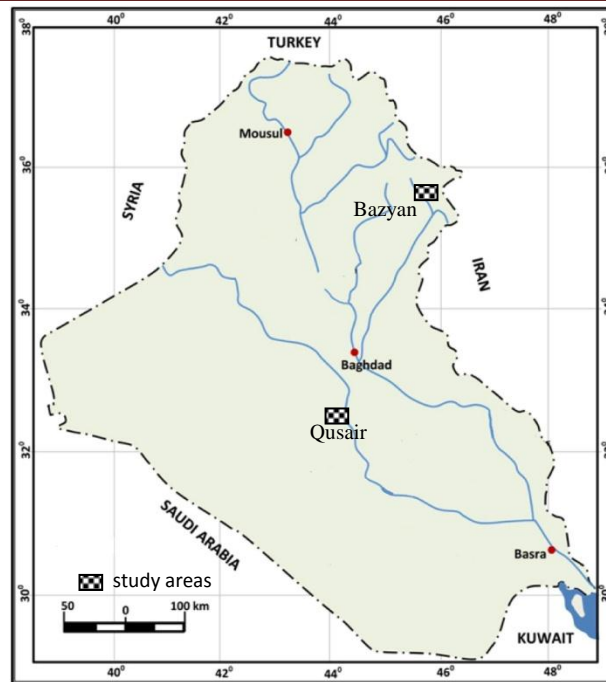


Fig. 1: Location map of study areas, Bazyan and Qusair archaeological site.

## Results and Discussion

There are close relationship between geodiversity and biodiversity which are formed natural diversity. Natural diversity can be provides ancient human by his daily demands such as: food, water, building materials, in addition to protect himself from nature riskiness and any expected enemies.

### 1- Geodiversity:

The geodiversity of the Bazian and Qusair sites comprises rock units of different formations (stratigraphy) exposed in studied area, land forms, type of soil and water resources.

**Rock bed units:** rock bed units are considered as the foundation and framwork of the life and ecosystem that includes abiotic and biotic elements. Rock units exposed near Bazyan site which deposited during Mesozoic and Cenozoic, are: limestone, dolostone, dolomitic limestone, marly limestone, marl, gypsum, claystone, mudstone, sandstone and conglomerates (Sissakian, 2010); while the rock bed units near Qusair site were deposited during Cenozoic, comprises limestone, marl, mudstone and sandstone in addition to Quaternary sediments. The main building materials used at the studied sites were limestone, gypsum and clay (Table- 1). Limestone and dolomitic limestone of Pilaspi Formation (Fig. 2) near Bazyan site may be used as a building stone in which these stones have high hardness and can be easily transported for short distance from the nearer flanks of mountain. Involved stones may be transported from Nfayil, (Fig. 3) Euphrates and Dammam Formations to use it at Qusair site.

Gypsum used by ancient human for building at studied site, as a binder for building stone. Gypsum may be extracted from gypsum bed, within Fatha Formation (M. Miocene), from open bits because it's nearby exposures to the site. Now a day Bazian quarry provides gypsum for plaster and cement factory (Al- Hashimi and Al- Bassam, 1985). While it may be extracted from secondary gypsum (Fig. 4) which exposed on the bedding planes of Injana Formation. Clay may be used to produce clay bricks, fired bricks (Fig. 5) and pottery whereas presence in Bazyan site that preserved at Sulaimaniya Museum and at Qusair site (Fig. 6). High amount of clay found with marl and mudstone interbedded with sandstone of Injana Formation (L. Miocene) near studied sites and may be result from physical and chemical weathering of parent carbonate rocks near two sites.

Table- 1: Potential Sources of building materials used at Bazian and Qusair sites ( Buday, 1980; Sissakian 1995; Hassan, 2007; Sissakian, 2010; Jassim and Goff, 2006) .

Building materials	Function	Bazian	Qusair
Limestone	Building stone and as a mortar	Pilaspi Formation (M. L. Eocene) which is consists of well-bedded and hard limestone and dolomitic limestone.	Nfayil (M. Miocene): is consisting of marl and limestone. Euphrates (E. Miocene): is consisting of medium bedded limestone. And Dammam (M. Eocene): is consisting of fossiliferous and chalky Limestone.
Gypsum	Mortar	Fatha Formation (M. Miocene): is consisting of limestone, marl and gypsum.	Secondary gypsum within Injana Formation (L. Miocene) on the cliff of Kerbala plateau.
clay	Mud brick and / or fired brick	Fatha , Injana and pilaspi Formation.	Injana and Nfayil Formation.





Fig. 2: Pilaspi Formation at the Uppermost mountain near Bazyan site.



Fig. 3: Limestone beds of Nfayil Formation near Qusair.



Fig. 4: Secondary gypsum within within sandstone beds of Injana Formation near Qusair site.



Fig. 5: Fired brick (center) at Bazyan site.



Fig. 6: Pottery shards at Qusair.

Fig. 2, 3, 4, 5 and 6.

**Landforms:** Landforms of study area resulted from both erosion and deposition on structural elements. Field survey and previous studies showed many landforms such as: mountain peaks (Fig. 2), plateaus (Fig. 7), slopes (Fig. 8), fractures, natural (Fig. 9) and artificial (Fig. 10) caves (Table- 2); (Sissakian, 2010; Sissakian, 1995; Maala, 2007).

Table- 2: Land forms of Bazian and Qusair sites

Landforms	Bazian	Qusair
Mountains	the main topographic feature in the area is Peramagroon mountain (2613 m) , while on the both sides of Bazian George there are two mountains : Qashlagh (1440 m) and Hanjira (1120 m) a. s. l.	
Plateaus		there are wide plateau on the west side of site which is extending about 170 kilometers in addition to messa and butte.
Slopes	steep on the top of mountain and gentle on the middle and foothill.	steep slope on the cliff of plateau and gentle slope on the wide flat valley.
Fractures	Two sets of joints and bedding plain may be contributed to isolation blocks of building stone and cave forming .	Two sets of joints and bedding plain may be contributed to isolation blocks of building stone and cave forming .
Caves	natural cave within limestone (Hazar merd).	natural and artificial within mudstone (Al- Tar).



Fig. 7: Plateau dissected by dry vally near Qusair site.



Fig. 8: Steep slope (right side) near Qusair site.



Fig. 9: natural cave near Qusair site.



Fig. 10: artificial cave near Qusair site.

**Fig. 7, 8, 9 and 10.**

**Water Resources:** water resources of studied area comprise Precipitation of rain and snow, Tabin stream (Fig. 11) near Bazyan site and Ubaidh seasonal stream (Fig. 12), Zewa spring near Bazyan and Shithatha springs near Qusair before and after 2003 (Fig. 13, 14), and historic hand dug drilled well near Bazyan (Fig. 15) and recently mechanical wells drilled near Qusair after 2003 (Fig. 16), (Table- 3). Involved water used by plants, animals and human for drinking, irrigations, cultivation of wheat, vegetable and fruit as well as other domestic demands.

Table -3: Water resources of Bazian and Qusair sites.

Sites	Bazian	Qusair
mean annual	650- 700 mm.	109- 122 mm.
streams	Tabin stream N-W Peramagroon Mountain.	Ubaidh seasonal stream, west of Qusair.
springs	Zewa seasonal spring.	Shithatha spring permanent drainage till 2003.
wells	Historic hand drilled well.	Mechanical drilled well after 2003.





Fig. 11: Tabin stream near Bazyan site.



Fig. 12: Ubaid seasonal stream near Qusair site.



Fig. 13: before 2003, one of the Shithatha springs near Qusair site .



Fig. 14: after 2003, one of the Shithatha springs near Qusair site .



Fig. 15: historic hand dug drilled well near Bazyan site.



Fig. 16: after 2003, mechanical drilled well near Qusair site, about 175 meters depth.

Fig. 11, 12, 13, 14, 15 and 16.

**Soil type:** (Refer to Quaternary sediments) It is produced by chemical, physical and biological weathering processes acting to break down exposed rocks on the mountains and flanks. According to field survey the soil of studied area were classified into three types: sandy soil particularly on the Beach of Razazza Lake (Fig. 17) near Qusair site, muddy and clayey soil (Fig. 18), (Table- 4).



Table- 4: Type of soil near Bazian and Qusair sites.

Soil	Bazian	Qusair
Type of soil	sandy, muddy and clayey soil.	sandy, muddy and clayey soil.
Parent rocks	limestone, marl, mudstone, siltstone and sandstone.	limestone, marl, mudstone, siltstone and sandstone.
Formations	Pilaspi, Fatha (carbonates), Kolosh, Gercus, Injana and Mukdadiya Formation (clastic).	Dammam, Euphrates Nfayil (carbonate), Injana and Dibdeba Formation.



Fig. 17: sandy soil on the beach of Razazza lake near Qusqir site.  
Fig. 17 and 18.



Fig. 18: muddy soil , west of Shithatha plain near Qusqir site.

## 2: Biodiversity:

The biodiversity (plant and zoo) near Bazyan and Qusair sites and surrounded areas comprises many species of flora and fauna that have been identified by natural surveys, Natural History Museum documents, (Al-Salihi, 1983), Nature Iraq (2011) and literature reviews. Reptiles, birds and mammals in addition to many kinds of invertebrates, fungi and macro- submacroscopic organisms have also been registered. The biodiversity of sites under consideration composed of plant diversity and zoo diversity.

**Plant diversity:** plants occurred near Bzyan on different habitats: mountain peak vegetation (thoren- cution). Slop mountain vegetation (mountain forest between 1600- 1800 m a. s. l.). Mountain riverine vegetation, while near Qusair occurred on plateau, sabkha, ephemeral streams, undulated hills and wide plains. More than 540 species have been identified in Pira Magrun Mountain near Pazyan Site (Al-Salihi 1983). Some botanical survey of Bazyan and Pira Magrun Mountain has been done in the present study. Wild and cultivated plant may be used for human foods, medical uses, sheep grazing and wine product

and listed some important plants in the perspective of local residents or villagers in (Table- 5).

Table- 5: Wild and cultivated plant may be used for human foods, medical uses, sheep grazing and wine product azyan and Qusair sites.

Plant function	Bazyan	Qusair
Human food	<i>Punica granatum</i> (Ponicaceae) <i>Arum conophalloides</i> (Araceae) <i>Ficus carica</i> <i>Morus alba</i> <i>Morus nigra</i> (Moraceae) <i>Rhus coriaria</i> <i>Pistacia eurycarpa</i> (Anacardiaceae) <i>Pyrus syriaca</i> <i>Prunus microcarapa</i> <i>Crataegus azarolus</i> (Rosaceae) <i>Salix alba</i> (Salicaceae) <i>Grap sp.</i> <i>Juglans regia</i> (Juglandaceae) <i>Bongardia chrysogonum</i> (Leonticaceae) <i>Malva nicaensis</i> (Malvaceae) <i>Gundelia tournefortii</i> (Compositae)	<i>Phoenix dactylfera</i> (Arecaceae) <i>Grap sp</i> (Juglandaceae). <i>prunus sp.</i> (Rosaceae) <i>Ficus carica</i> (Moraceae) <i>Allium sphaerocephalum</i> (Alliaceae), <i>Anisosiadium lanatum</i> (Umbelliferae)
Medical herb	<i>Adiantum capillus</i> (Aceraceae) <i>Aristolochia bottae</i> (Aristolochiaceae) <i>Plantago lanceolata</i> (Plantaginaceae) <i>Rheum ribis</i> (Plunbaginaceae) <i>Tamarix ramosissima</i> (Tamaricaceae) <i>Scaligera assyriaca</i> <i>Smyrnum cordifolium</i> (Umbeliaceae) <i>Mentha longifolia</i> (Lamiceae) <i>Cichorium intybus</i>	<i>Adonis dentate</i> (Ranunculaceae), <i>Asteriacus pygmaeus</i> (Compositae), <i>Astragalus dactylocarpus</i> (Papilionaceae), <i>Cistanche tubulosa</i> (Orobanchaceae) <i>Brassica rapa</i> (Cruciferae), <i>Capparis spinosa</i> (Cappraceae),

	(Compositae) <i>Rubia tinctorium</i> (Rubiaceae)	
Grazing	Spiny herbs, dwarf shrubs, <i>Trifolium spumosum</i> , and other wild vegetations	<i>Typha domingensis</i> (Typhaceae) , <i>Tamarix sp.</i> (Tamaricaceae), <i>Aizoon canariense</i> (Aizoaceae), <i>Astragalus spinosus</i> (Papilionaceae), <i>Atriplex dimorphostegia</i> (Chenopodiaceae), <i>Haloxylon</i> <i>salicornicum</i> (Chenopodiaceae)
Grazing and fire wood	<i>Quercus aegilops</i> (Fagaceae)	<i>Alhagi graecorum</i> (Papilionaceae)
Wine product	<i>Grape sp.</i>	Dates and grapes
Poisonous	<i>Rheum sp.</i> (leaves) <i>Daphne sp.</i> (berries) <i>Ranunculus sp.</i>	<i>Colchicum ritchii</i> (Colchicaceae), <i>Heliotropium digynum</i> (Boraginaceae)

**Zoo diversity:** There are three groups of animals at the studied areas, herbivore, carnivore and omnivore. Some of them useful for human as a food or for beauty and other are wild savage or dangerous animals (table- 6). Ancient human at Bazyan and Qusair sites could get his food and other demands from breeding domestic animals in addition to hunting in addition to protect himself from dangerous animals (table- 6).

**Table- 6:** Some of animals occurred at Bazian and Qusair as an archaeological sites and its relation to ancient human.

demand and relation	Bazian	Qusair
Domestic animals & food source	<i>Ovis aries</i> <i>Capra hircus</i> <i>Capra aegagrus</i> <i>Bos Taurus</i> <i>Oryctolagus cuniculus</i> <i>Gallus gallus</i> <i>Meleagris gallopavo</i> <i>Anas platyrhynchos domesticus</i> <i>Gazzela gazzela.</i> <i>Lepus sp.</i>	<i>Ovis aries</i> <i>Capra hircus</i> <i>Gazzela gazzela</i> <i>Oryx leucoryx,</i> <i>Bos Taurus</i> <i>Gallus gallus</i> <i>Meleagris gallopavo</i> <i>Anas platyrhynchos domesticus</i> <i>Chlamydotis undulata</i> <i>Struthio camelus</i> <i>Cygnus sp.</i> <i>Francolinus francolinus</i> <i>Erinaceus sp,</i>
Beauty	<i>Equus asinus</i> <i>Equus caballus</i> <i>Sciurus anomalus</i>	<i>Upupa epops</i>

	<i>Sus scrofa</i> <i>Oryctolagus cuniculus</i> <i>Eriaceus sp.</i> <i>Sucus murius</i> <i>Columba livia</i> <i>Alectroris chukar</i> <i>Upupa epops</i> <i>Aquila sp.</i> <i>Aquila chrysaetos</i> <i>Gyps fulvus</i> <i>Accipiter nisus</i> <i>Bueto rufinus</i> <i>Falco naumani</i> <i>Bubo bubo</i> <i>Dendrocopos syriacus</i> <i>Galerida cristata</i> <i>Ptyonoprogne rupestris</i> <i>Delichon urbica</i> <i>Motacilla sp.</i> <i>Turdus merula</i> <i>Merops apiaster</i> <i>Corvus corax</i> <i>Sitta europaea</i> <i>Pica pica</i> <i>Passer domesticus.</i> <i>Sturnus vulgaris</i> <i>Neophron percnopterus</i> <i>Cuculus canorus</i> <i>Testudo graeca</i> <i>Asaccusgriseonotus</i> <i>Cyrtopodium scabrum</i> <i>Mabya aurata</i> <i>Ophisops elegans</i> <i>Laudakia nupta</i> <i>Laudakia caucasia</i> <i>Lacerta media media</i> <i>Vipera lebetina Typhlops</i> <i>vermicularis</i> <i>Coluber jugularis</i> <i>Rana sp.</i> <i>Bufo sp.</i>	
Wild or dangerous animals	<i>Panther paradus.</i> <i>Mus sylvaticus.</i> <i>Rattus rattus. Erinaceus europaeu.</i> <i>Hyaena hyaena.</i> <i>Canis aureus.</i> <i>Canis lupus.</i> <i>Canis familiaris.</i> <i>Vulpes vulpes.</i> <i>Felis catus.</i>	<i>Canis lupus,</i> <i>Hyaena hyaena,</i> <i>Cerastes sp.</i> <i>Mallivora capensis</i> <i>Hystrix indica.</i>



	<i>Felis caracal.</i> <i>Mustela nivalis.</i> <i>Hystrix indica.</i> <i>Vormela peregusa.</i> <i>Sciurus anomalus.</i> <i>Mus sylvaticus.</i> <i>Rattus rattus.</i> <i>Erinaceus europaeus.</i>	
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### 3: Archaeology:

Natural resources include abiotic factors (geological diversity) and biotic factors (biological diversity). Study of involved factors are very important to reconstruct paleoecology to interpret the role and impressive of natural environment on ancient human. Many archaeologist and naturalist were believed that the ancient human had chose his settlement in place which provide him natural resources to use it during his daily life, such as: food, water, building stones and protect himself from danger and any expected enemies (Boehler, 2002; Eder and Patzak, 2004; World Heritage Center, 2008). In addition to Church buildings many archaeological evidence and information can be seen in Bazian and Qusair site (table- 7).

Table- 7: archaeological evidence at Bazian and Qusair sites.

Archaeologic evidence	Bazian	Qusair
Location	West Sulaimanyah City, 20 km	South west Karbala City, 70 km
Function	church	Church
Age (Sassanian period)	Before 13 century.	Before 15 century. Oldest church at middle east.
Type of building	basilica	Basilica
Outer wall thickness	Up to 3 or 5 m.	More than 1m.
Naves	3	2 or 3
Jars	12 used to store grains and possibly wine.	Pottery shreds. 143 poor artifacts
Artifacts	copper incense burner, copper and plaster crosses.	Painted crosses on the inside walls.

## Conclusions

Geodiversity of Bazyan and Qusair provided ancient human by his daily demands such as:

Rocks: carbonate rock for building stones. Gypsum, limestone and marly limestone to prepare mortars and plaster crosses. Claystones to prepare mud bricks and fired bricks in addition to ceramic manufacturing's.

Ancient human chose his sites according to topography which has flat area, gentle slope, far enough from ephemeral streams and were located on the caravan passages.

Historic B.C. cave, natural Hazar Merd near Bazyan and artificial Al-Tar cave near Qusair, which may be used for residential, pray and others.

The main water resources of studied areas are: ephemeral streams, springs and man digging wells. Soil of surrounded areas composed of sandy, silty of clayey soil. Soil and water resources helped to grow and cultivated many plants which provide food, medical herb, woods, wine for humans and grazing.

In spite of the far distances between the two sites about 400 km, but they are using the same natural resources which refers to cultural, technical and traditional exchanges.

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دراسة مقارنة بين الموارد الطبيعية الجيولوجية وأهميتها الأثرية  
في موقع بازيان في السليمانية  
وموقع القصير في كربلاء

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الملخص:

استفاد الانسان القديم من التنوع الجيولوجي والموارد الطبيعية في المواقع الأثرية المدروسة وهي بازيان في شمال العراق ، والكصير في وسط العراق ، لتلبية احتياجاته اليومية مثل الغذاء ، والماء ، ومواد البناء ، وحماية نفسه من اخطار الطبيعة او اي عدو محتمل . تقع بازيان على بعد ٢٠ كم غرب مدينة السليمانية شمال شرق العراق ، والكصير قرب بحيرة الرزازة ، الى الجنوب من مدينة كربلاء في وسط العراق . والصخور المنكشفة في مناطق الدراسة هي : لايمستون ، ودولوستون ، و مارلي لايمستون ، والمارل ، والجبسم ، والصخور الطينية ، والصخور الوحلية ، والصخور الرملية ؛ والتي تعد مصدرا مهماً لصخور البناء في الموقعين ، وتم استعمال حجر الكلس والدولوستون في البناء ، وحجر الجبسم في صنع المادة الرابطة (الجبص) ، والصخور الطينية في تحضير الطابوق الطيني (اللبن) ، والطابوق المفخور ، والالواني الفخارية . ان وجود الاشكال الارضية المتنوعة ، ربما قد تم الاستفادة منها من قبل الانسان القديم مثل : الجبال ، والهضاب ، والمنحدرات ، والتلال المتموجة ، والكهوف ، لاسيما في اختيار المواقع التي تحميهم من السيول الجارفة في المواسم المطيرة ، او السيطرة على طرق النقل البرية . وتلعب التربة (الرملية ، والغرينية ، والطينية) والموارد المائية المجاورة للموقعين ، دورا مهما في نمو واغناء التنوع النباتي الطبيعي او المستزرع ، الذي ساهم في توفير الغذاء للانسان ، والنباتات الرعوية ، وغذاء الحيوانات العشبية التغذية ، والوقود ، و انتاج المشروبات . قام الانسان بصيد بعض الحيوانات لغذائه مثل : الماعز البري ، والارنب البري ، والقبيج ، والحجل ، والصقر ؛ والبعض الاخر التي ربما كانت متوحشة او خطرة عليه كي يتخلص منها مثل : الفهد الفارسي ، والثعلب الاحمر ، والذئب ، والدب الاسمر . وعلى الرغم من المسافة البعيدة بين الموقعين المدروسين ، التي قد تصل الى ٤٠٠ كم ، فقد لوحظ وجود عناصر مشتركة في مواد البناء ، والاساليب التقنية في البناء ، وبعض الاشكال الارضية ، ونوع التربة والموارد المائية ، والمعتقدات الدينية ، وغيرها ، مما يشير الى وجود تبادل تجاري او ثقافي وربما الاثنين معاً .

الكلمات المفتاح : التنوع الجيولوجي ، التنوع البيولوجي ، علم الآثار ، بازيان ، كصير ، العراق .