

Analysis of Spatial-Environmental Bronze Age Sites in Bampur Valley, Iran, with using GIS

Mohammad Mehdi Tavassoli

Associated Professor
Dept. of Archaeology
University of Sistan and Baluchestan
Zahedan-Iran.

Ali Akbar Abtin

M.A. Archaeology
Zahedan-Iran.

Davoud Saremi Naeni

Assistant Prof. of Archaeology
University of Sistan & Baluchestan
Zahedan-Iran.

Abstract

One of the advanced and new tools in archaeology is GIS (Geographical Information Systems) and its relative techniques. This article tries to investigate the application of GIS in spatial and environmental analysis of archeological sites in around of Bampur river, south-eastern Iran. Therefore, all the descriptive and locational information related to archaeological sites and their spatial analysis is collected, categorized and converted to be entered into geographical information systems. To create a database of the above information, related informational layers are formed using the data collection and to illustrate, necessary analysis on the data is performed. The most important parts of spatial database layers are investigated. To reveal with using search and analysis capabilities of GIS is another effort. Eventually, spatial analysis of the area using GIS and also the importance and the role of Bampur river in the formation and demolishing of archeological sites of the third millennium B.C. are investigated. It can be said that Bampur river has played a vital role in making the settlements in 3rd. millennium B.C. in the region. The development of the region and even its collapse has been depended on fluctuations of this river.

Keyword: Geographical information systems, Bronze Age, Bampur Valley, Iran

Introduction

Geographical information system is processing on the georeference location data or geographical information and pays to obtain information in relation to the phenomenon that deals with location. Utilizing the tools available with advantage in the global information networks is most relevant and conducive to power and introduced the country's talents in the world. Widespread network of users of these systems, including basic tips that can added capabilities and system capabilities (Tomlin, 1990). These systems are used for collect and analyze all the information that somehow is associated with geographic location. The main objective justification purpose GIS, is the statement of assessment and review changes geographical locations over time. Since the main role is the speed and accuracy in storage and easy access to information, processing and recycling system, so have has managed a variety of applications in the field of archaeology. According to the above definitions, and finally with regard to ability and capabilities of this system, this article will discuss spatial and Environmental analysis on 3rd. millennium sites of Bampur valley. Using the capabilities of this system is paid to analyze the role and importance of the natural environment, particularly emphasizing on Bampur river formation, flourishing and collapse of ancient sites in 3rd. millennium BC. With providing better picture from the river basin and Bampur river itself, it showed that the greatest impact in shaping the campus buildings and ancient has not so far away from the river were formed and more irrigated agricultural land available in surrounding it.

The article questions are as follows:

- 1- What was Bampur river role in shaping and spatial distribution patterns of Bronze Age settlements in the Bampur Valley?
- 2-What are involved fluctuations Bampur River in demise and collapse of Bronze Age civilizations in the Bampur Valley?

Location

The Bampur Valley is situated in Iranian Baluchistan linking the Iranian plateau settlement with those in Indus Valley (Shaffer 1986, 63). The valley, which links central Iran to Pakistan, is a natural highway (Tosi 1974, 30; De Cardi 1970, 239). This highway was connected to the west along the Bampur Valley, which drains into the marshy Jaz Murrain Basin. Prehistory settlements along the Bampur river were connected to the west through Chah-Hossaini and the Jaz Murrain Basin (Tosi 1974, 30). The largest and most important river in Baluchistan is the Bampur river, which flows from the Karvandar Mountain 120km to the Jaz Murrain Basin. This river is important for farming and is the only permanent river in Baluchistan (De Cardi 1967, 33). When Stein visited this river in 1932, he mentioned that its bed was about 200meters wide, but held water in only about 30 meters width of its bed (Stein 1937, 104). Although the Bampur river is the only permanent rivers in Baluchistan, water and cultivated areas observe along the river bed (Ibid, 195).

Bampur river, which originates in Karvandar Mountains, flows southwards to Damin and Iran-Shahr, and finally westwards to Bampur, and after 120 km, it sinks into the basin itself. Here, the river is absorbed into porous detrital deposits and re-appears irregularly as springs and seepage lower down the valley in the direction of Bampur (Fisher 1968, 109). When Stein visited the area, the Bampur river flowed from Iran-Shahr to Chah-Hosseini in the west before being absorbed (Stein 1937, 105)

Tepe Bampur is located inside the city of Bampur, which is situated 2.5 km north of the Bampur river and is situated at 61° 25" east longitude and 27° 90" north latitude, in Iranian Baluchistan (Garoozi 1995, 9). This city was called the "Traditional Capital of the Persian Baluchistan" by Stein (Stein 1937, 105).

Historical research

Although the first European officials visit Tepe Bampur were Captain Grant and Sir Henry Pottinger in 1809-10 (Stein 1937,105), the archaeology of Tepe Bampur was first study by Sir Aurel Stein in 1932(De Cardi 1968,135 ; Tosi 1974,29; Lamberg-Karlovsky & Schmandt-Besserat 1977,113). Beatrice De Cardi followed him by adding more detailed information in 1966 (Kohl and Pottier 1992,91; De Cardi 1968, 1935). Stein's work in Tepe Bampur was insufficient for the identification of this important site, thus De Cardi started excavate at Tepe Bampur. De Cardi dug two trenches, Y and Z, in an area of 24 square meters, and virgin soil appeared at a depth of about 7 m in trench Z (Tosi 1970, 12). According to information from this trench, which was confirmed in trench Y, the excavator was able to determine six cultural sequences, which will be studied in the next section (De Cardi 1968,138). Six cultural sequences have been observed at Tepe Bampur (Lamberg-Karlovsky & Schmandt-Besserat 1977,114). This chronology is mostly based upon a pottery classification compared with other site in Iran (Tosi 1970,12).Therefore; the excavator reconsidered her final stratigraphic and presented two cultural complexes visible in the sequence, which are Bampur I-IV and Bampur V-VI (Tosi 1970,12; Shaffer 1978, 85). According to De Cardi's chronology, the Tepe Bampur sequence started in mid 3rd millennium BC and ended in the 1st century of the 2nd millennium BC.

Studied Area and Introducing Ancient Sites

Bampur river plays an important role in the agricultural area. Around Bampur river in region between Iran-Shahr and Bampur, is better suitable because of using fertile land. There are many ancient sites in this region that show heavy reliance and need this region to be used water from this vast river. Agricultural conditions in this region, allowed to people that pay more to agricultural activities. Therefore settlements in this region are more permanent from the Damin region. As it is shown in Fig.1, case study area is ancient sites of the 3rd millennium BC along the Bampur river from Iran-Shahr to Chah- Hosseini, which in archaeological fieldworks have been identified. As it was mentioned above, it focused on this part that studied more by archaeologists. Perhaps one of the main reasons for archaeologists to study this part of the valley, are modern environmental conditions and characteristics of the region that more suitable than other regions.

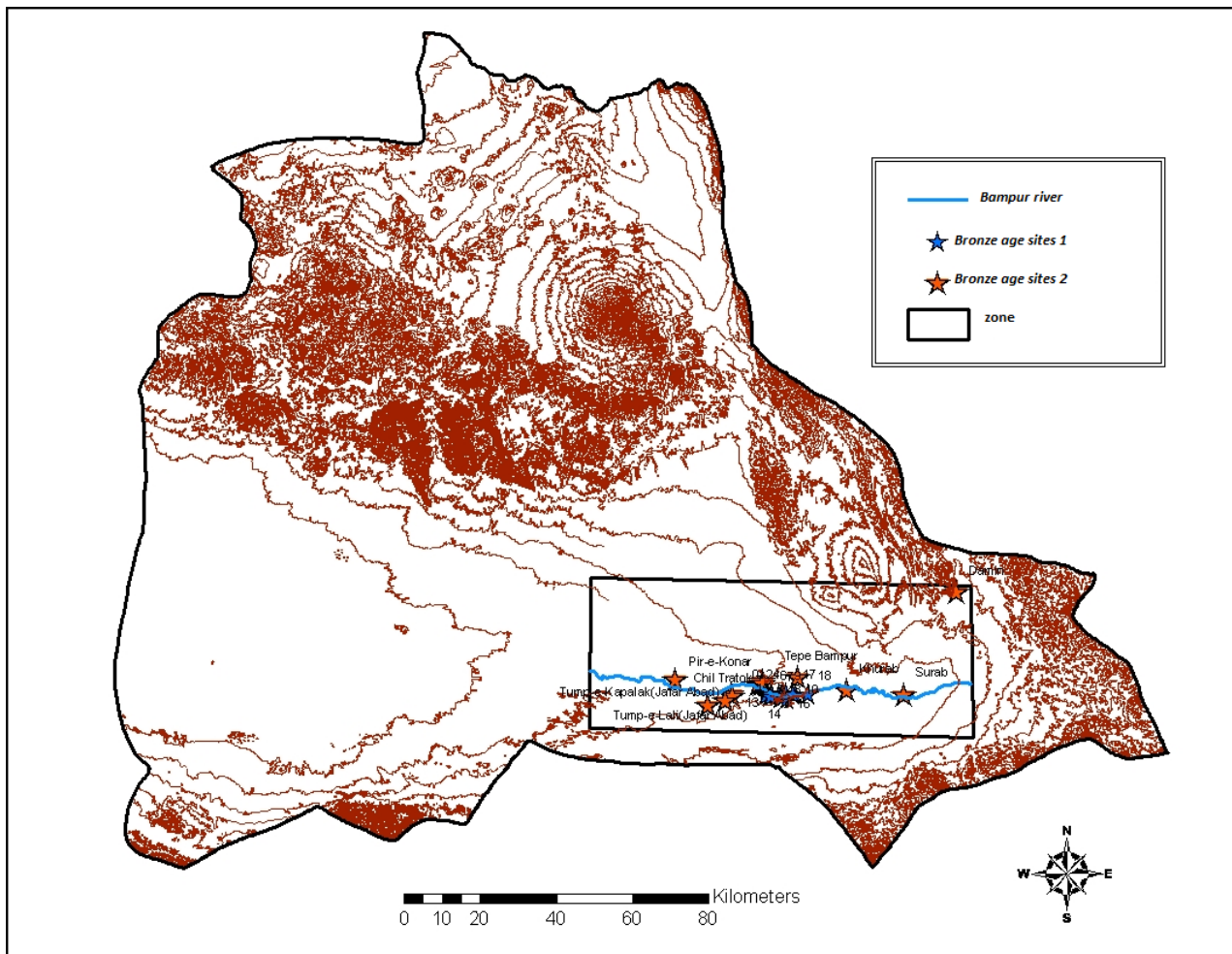


Fig.1. Studied area and Bronze Age sites

Methodology

A methodology which has been applied for this research is GIS to use field studies and existing data such as layers of information and descriptive information of the region. At first with using the digital maps and saves the appropriate descriptive data in GIS database. Then by selecting archaeological sites on the map and determine their range around the Bampur River with using the position taken by the GPS system, has been provided functions using a variety of fields GIS analysis on case study from Iran-Shahr to Chah-Hosseini. In continue, with using layers Iran-Shahr topography, scale 1: 250000 (Fig. 1) produced layers DEM (Digital Elevation Map) of this region. According to distribution sites in the region need to specify case study that according to fieldworks, were marked the boundaries on the map so that includes the main sectors Bampur river in the plains from Iran-Shahr (eastern point) to Chah- Hosseini (western point) in the area it covers in 40 sq. km. Analysis and studies were down after this step.

It also formed the database for GIS, are used from spatial data (Topographic layer Region), descriptive information (Input Information System GIS) and latitude and longitude of ancient sites. To draw maps, digital elevation model (DEM) used in this research (Fig.2). In such a wide range calculated to determine percent slope and aspect, roughness of the ground digital display, the region has visibility been analyzed of which can complete archaeological maps (Sanjari 2007, 112). Other capabilities of GIS used in archaeological analysis, is preparation of Buffer layers (Fig. 3) for determining privacy ancient sites or a specific architecture that are located between the urban fabric, are used. It has also been used in this research to output the operation includes plane and shows Bampur river with privacy set to it. Another feature of geographical information system used in this study is to determine land use classification to determine land value of land and irrigation farming.

These classifications are based on various factors and constraints for agriculture such as: soil texture, slope, erosion, drainage and permeability conditions, and forms. This layer also consists of information using 1:250000 topographical maps have been done, through this analysis, the types of lands genus area irrigated areas has been determined and total region is divided into six categories (Fig. 4).

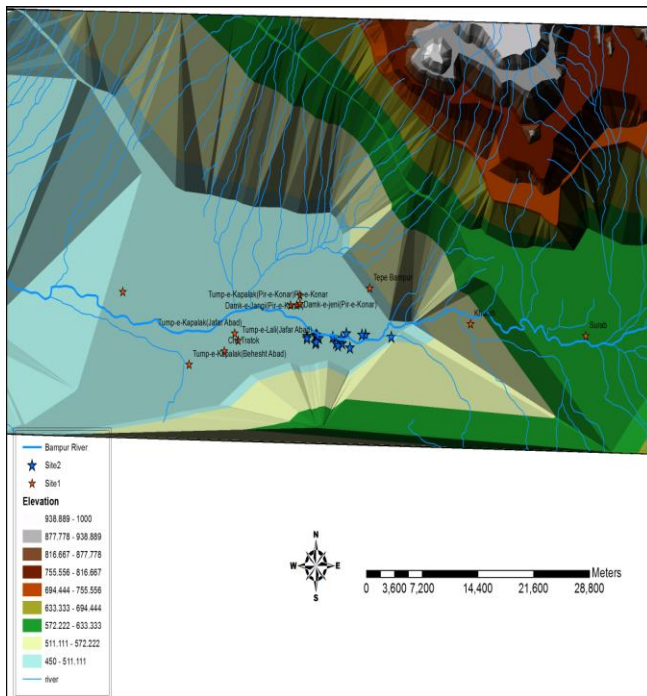


Fig.2. Elevation map of the study area

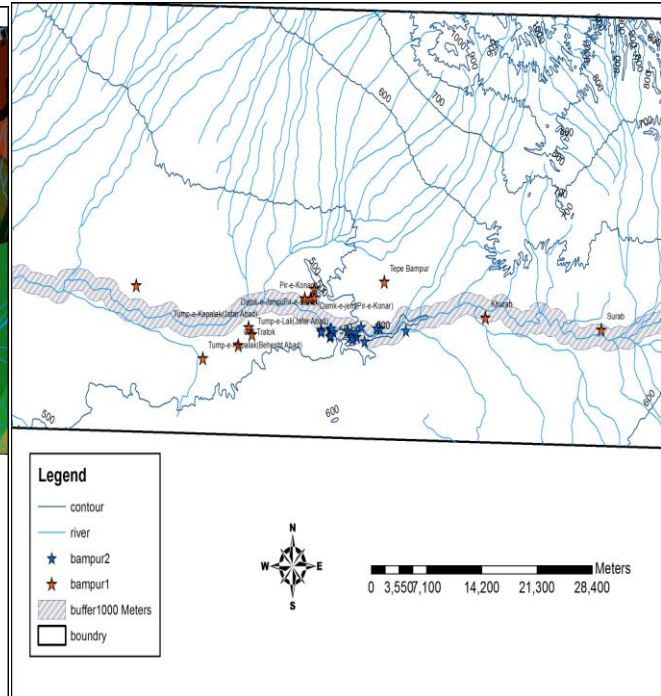
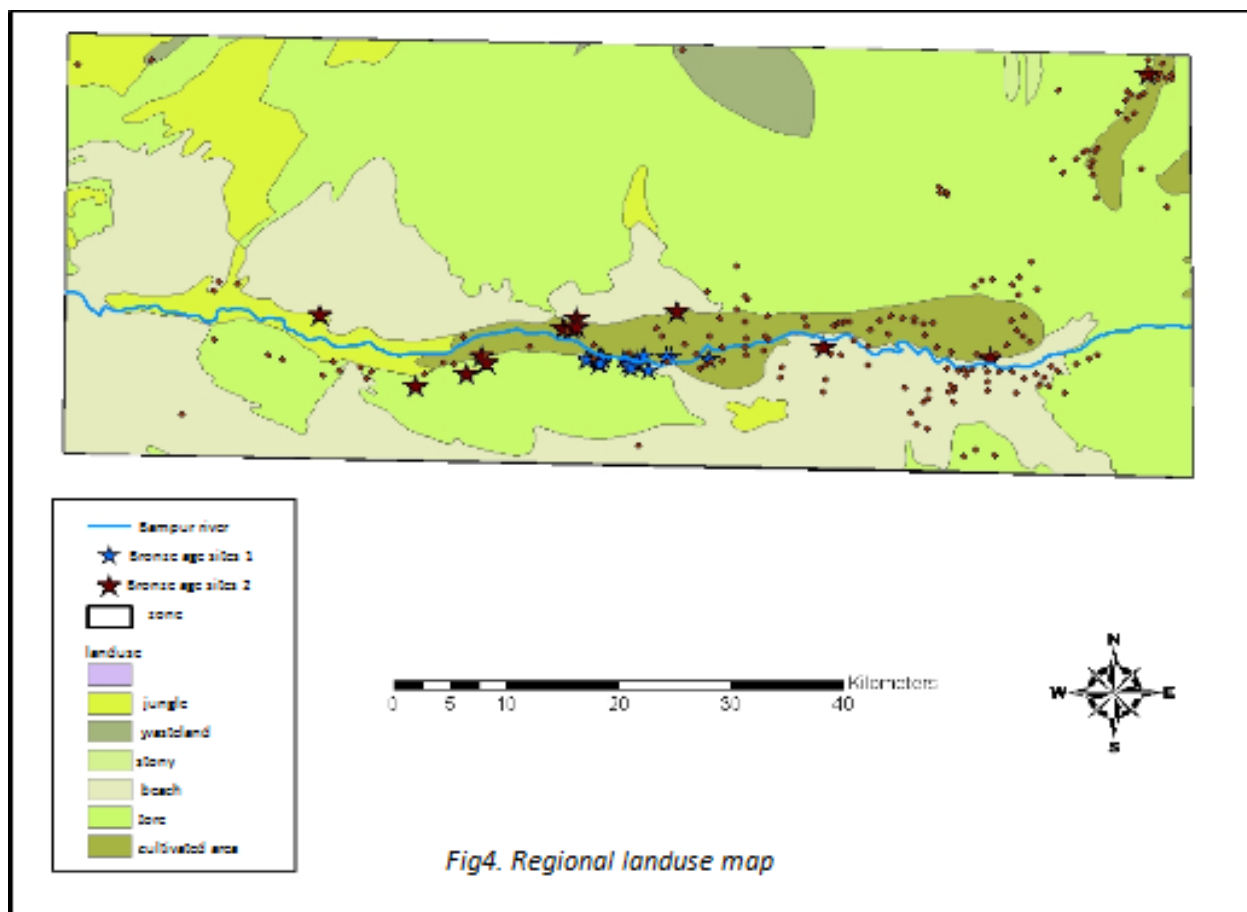


Fig.3. Buffer Bampur River Map

Discussion

As mentioned, for mapping surface elevation of the region is used from 1:250000 topographical maps of armed forces geographical organization and regional maps according to height have been classified to eighth levels. Figure No. 2 and Table 1 has been determined that each of the sites, height and slope have been established. The highest elevation levels of the most sites are located in is the height between 517-450 meters that largest site of the 3rd millennium region, Bampur Tepe and total of sites in the layer 2 in this height (517 -450) are located. Using digital elevation model TIN and the help of analytical functions, slope area has been displayed. One of the natural factors that large influences in the formation sites and distribution settlements of the region are the slope land. Whereas case study is limited area, the ancient sites cover the slope map is classified to five categories with different capabilities (Fig. 5 and Table 1).



For analyzing and discover situation of the Bampur river and other sub-region rivers have been used from the map of slope and aspect. This map indicates that the slope is zero which is the best fit slope for the region. The establishment of settlements and only three of 19 sites in 89/6-89/9 and 16 are located in other areas have been zero degree tilt. Survey of ancient sites in this region shows that the most of them are the best slopes in the area and height for farming using irrigation systems has been scattered.

Table1. Height and slope region of ancient sites

site	slope	Height to meters
Bampur Tepe	89/646-89/999	450-517
Damin	89/646-89/999	755/6-816/7
Khurab	89/646-89/999	633/3-694/4
Surab	0-87/881	572/2-633/3
Pirkonar	0	450-517
Tomp Kapalak Pirkonar	0	450-517
Damk Jangi Pirkonar	0	450-517
Damk Jenny Pirkonar	0	450-517
Tomp Kapalak Jafarabad	0	450-517
Tomp lali Jafarabad	0	450-517
Chill Tratok	0	450-517
Tomp Kapalak Behesht Abad	89/293-89/646	450-517
Tomp Kapalak Chah Hosseini	89/293-89/646	450-517

As the regional land use map shows (Fig. 4) most fertile land in this area also part of the settlement area formed, well located and this shows that due to the living expenses of local people farming in the present day and in the 3rd millennium BC was the best place to live both in terms of access to water resources and the area is fertile land.

The highest density can be said that Bampur river caused not only the emergence and establishment of conditions to settled but also current residence and the old settlement in the area.

Apparently, whenever there was enough water for people (Bampur IV), there were most settlements in the region, while in the driest years there was least residence. It can be concluded that Bampur river had role in formation and prosperity of the establishment.

Also, using Buffer analysis (determining privacy) for Bampur river, privacy 100, 500, 1000, 1500, 2000 and 2500 to 3000 has been drawn (Table 2). So that in Figure 5 it can be seen in the first space 100 meters away from the river, an ancient sites of any premises in the dimensional space 500 meters away from the river, only 2 to 3 grounds has not been greater. Few in Buffer area in distance 100 to 500 meter from river indicate that people to avoid flood were trying to settlement in the area in appropriate distance. It should be mentioned those people who settled near the bank of the river got more difficulties from the flood, like those lived on Daman or Surab. In other words, the establishments in the highest were in safe. For example, the following sites (Table 2) had been more scattered settlements in the area because of being far away from the river.

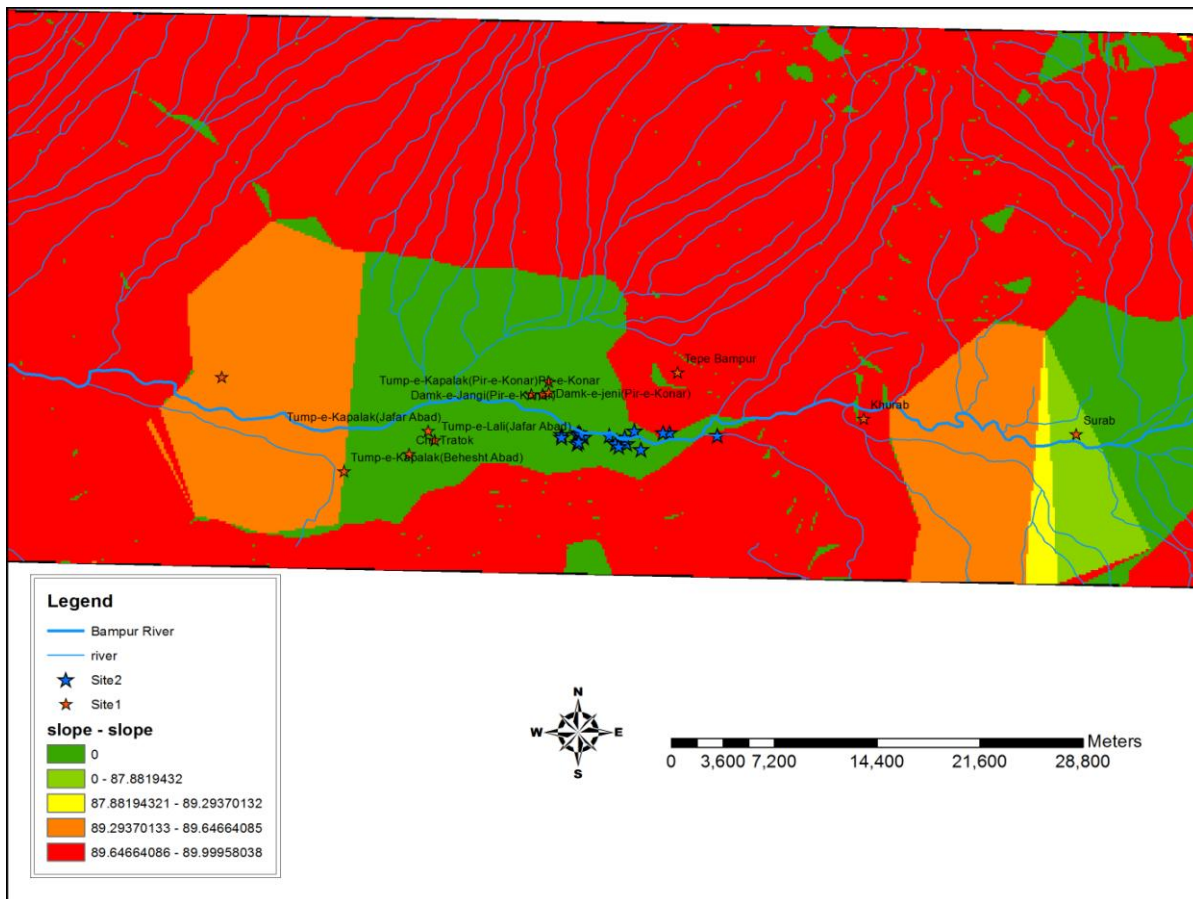


Fig.5. Slope of the study area map and location sites

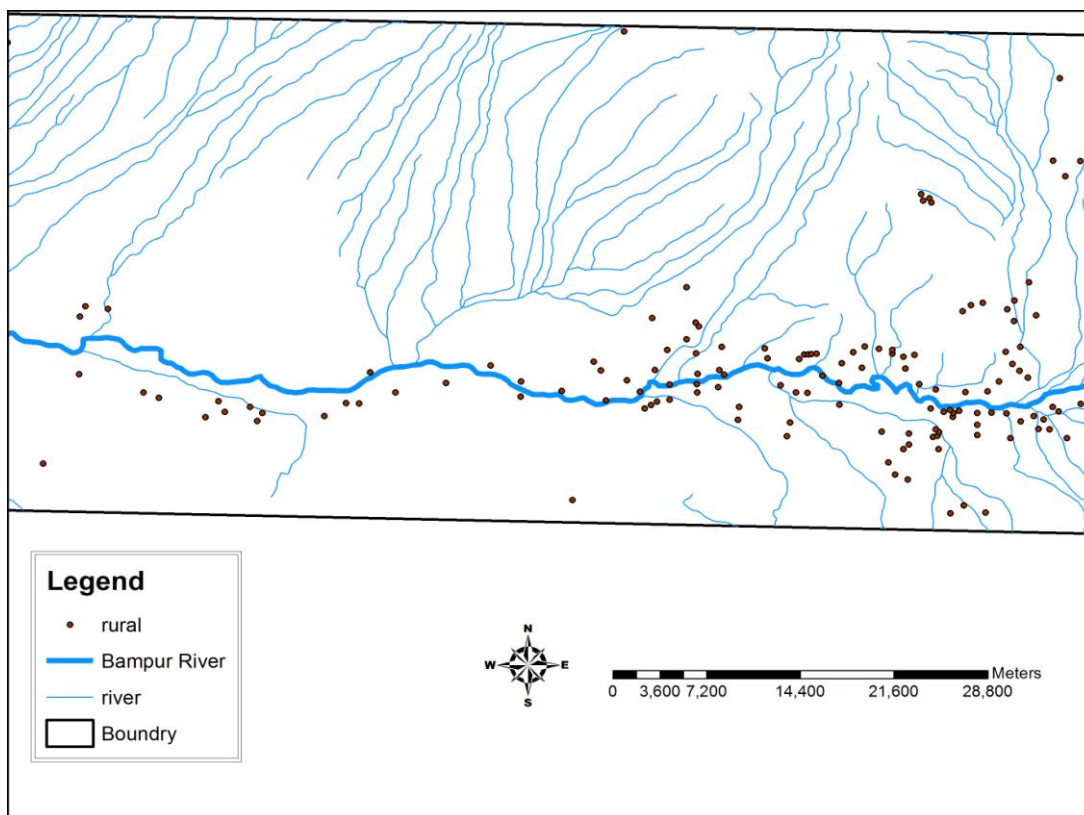


Fig.6. Scattered villages today

Table 2. Distance of Ancient site from the Bampur River

Buffer to meter	Total Sites
Buffer100	In this section, no site has not been .
Buffer500	Surab And 11 sites of the second layer
Buffer1000	Bampur Tepe , Khurab and 9sites of second layer
Buffer1500	Pirkonar , Tomp Kapalak Pirkonar , Damk Jenny Pirkonar
Buffer2000	Tomp Kapalak Jafarabad , Tomp lali Jafarabad
Buffer2500	Tomp Kapalak Chah Hosseini , Damk Jangi Pirkonar , Chill Tratok
Buffer3000	Tomp Kapalak Behesht Abad

As Figure 6 shows, in today's scattered villages in the same region, it can express more villages are scattered in the river margins. The density in the villages around the river in lower privacy is far more less than upper privacy of the river. Distancing from the river villages of the density is lower today. Using this analysis, it can be concluded that ancient sites in around rivers, especially Bampur river are scattered and far away from the river and the density of villages will be reduced as in ancient time. And the large sites, such as Bampur Tepe, dimensions 320 × 350 m, Surab, dimensions 200 × 250 m and Khurab, dimensions 100 × 150 meters, with more population are located near Bampur River to access to water. These sites in Bampur chronology have more residential area, so that Bampur Tepe, the largest and most key area is the area in all periods was populated. Bampur IV while is blooming civilization it developed more and more so that it reached to the highest. When the level of the river reduced not only the density of people was least in Bampur V-VI, but also urbanization got harm so that step by step the area became empty of inhabitation and finally collapsed its civilization. Another factor in the formation process of the settlements has had a significant role in the efficiency of the fertile land in order to achieve this regional landuse map. It is drawn to examine the fertile land distribution shown in its relationship with scattered settlements area (Fig. 4). For this, whole area of the land types is divided into six categories. With this map, the settlements were formed on the bases of the type of the soil area and living style and irrigation. Cultivable land irrigated agriculture is a certain range around the Bampur river is located and density of ancient site and modern villages in this region is far more.

If the Damin region because of its mountainous and because it is without farms were livestock livelihoods region. The other factor to form the process of settlements is using the fertile land in order to get benefit. Drawing the land maps has been provided to gain this goal (Fig. 4). According to the map, whole the land divided into six parts. With interpretation the dividing, inhabitants in Damin were husbandry in Bronze Age, and they do the same today. We can conclude that the worth of land cultivation or irrigation was the same in both Bronze Age and today as well. This difference in environmental conditions in the region has had the same difference in people's living. Although people in the area of the river Damin live with landuse are in comparison with agricultural activities Bampur river basin, Damin is narrower because it is too steep and has a high altitude.

Most settlements are located in an area that has the most appropriate slope, elevation and cultivable farmlands contain the data which has been the based on ancient farming. As the information published by Stein has shown that in the end of 3rd millennium BC, Bampur area and suburbs has been by the farmer family housing (Stein 1937,105). Today the factors such as sufficient water and having a good geographical position for cultivating are significant. Indeed Bampur river has had key role in the establishment and a crucial and vulnerable part of the top area. And also porous features of Bampur river basin threaten the region. The density of areas in each period is different and only the period IV with the vast settlement, has the most development role in the area. Bampur Tepe has had the major role in outside regional trade. Considering archaeological evidence obtained from this period, Bampur river had the highest rate of water that peoples of the region were used. For example, according to what concluded and also is known one of the factors collapse of Shahr-i Sokhta civilizations is environmental factors, particularly drought and dry of Hirman river. According to archaeological evidences this period, it can be said that lack of water resources of Bampur civilization has created drying area, and this factor is played indispensable role in the collapse settlements

Conclusion

To what we said, it can be concluded that the water sources and rivers are the most important factor to form civilization and settlements, while Bampur river is not out of this order. According to the scattering and density of areas ancient and new settlements, this point reveal that the settlements have been formed almost near the river and not go away more than 3km .naturally the number of settlements decrease whenever goes further of the bank. The living of this people was based on agricultural, and it approved that they were completely upon the river. It's because of main factor that Bampur I,II,III and IV there was adequate water and flourished all over the area, it civilization reached to the highest point, but in period V, when water steadily started to decrease and especially the end of period VI, when it completely dried, Bampur civilization collapse.

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