Analysis of the Genesis and Decline of the Cheshmeh Ali Period
Based on the Palaeoclimate Research

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Abstract

The Cheshmeh Ali (CA) cultural period (ca. 5300-4300 B.C.), followed by the Sialk I culture, not only covers the North of Central Iran region (NCI), but also it is evidenced in neighboring regions. The genesis of this culture has coincided with the consolidation of sedentary-farming in this cultural region. This research is based on the paleoclimatology of the Mid-Holocene and archaeological data of prehistoric sites belonging to the CA period in NCI. The paleoclimate research indicates that climatic condition of the 2nd half of the 6th mill. BC is indicative of a moderate and humid climate that can well explain the cultural flourishing of NCI. However, in the early 5th millennium BC, the occurrence of a warming period probably caused the difficulty of living conditions and the gradual cultural decline of CA societies. According to absolute dating, archaeological sites of Northern Sialk, Cheshmeh Ali, Pardis and Ibrahim Abad collapsed between 5000 and 4700 BC. During the next phase, which coincided with a relatively favorable climatic period, the number of settlements in this region increased but with the onset of another severe warm-dry climatic change at ca. 4400/4350 BC, many settlements again declined, and consequently, the CA period ended. Therefore, the result of this study shows that the CA period can be divided into two optimal phases, Early (ECA) 5300-5000 BC, Late (LCA) 4700-4300 BC, both of which are between dry periods.

Keywords: Mid-Holocene, climate change, Cheshmeh Ali (CA), the North of Central Iran (NCI).

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Introduction

According to Global Atmospheric Research Programme (GARP), climate is influenced by the Atmosphere, Hydrosphere, Cryosphere, Lithosphere, biosphere and the interaction and feedback between them in different temporal and spatial scales within the atmosphere, which, of course, we must consider human effects on the environment that causes such changes. These components are interconnected with each other (Ghaemi et al. 2012, 13). Climate change is due to the continuous change of climate oscillating elements over a long-time period (Moghimi 2012, 103). Climate change can be caused by several factors that include variations in solar radiation received by earth, oceanic processes (such as oceanic circulation), plate tectonics, and volcanic eruptions, as well as human-induced alterations of the natural world (Balato et al. 2013, 135).

Understanding climate conditions and the gradual and sudden climatic changes in ancient time can be beneficial in reconstruct of the environmental conditions of different regions and human subsistence. The main objective of climatology and atmospheric dynamics analysis is the use of climate data and atmospheric analysis to study the issues and aspects of the natural environment that affect the environment and human (Mohammadi et al. 2016, 133). In order to understand climate change and its possible impacts on human cultures, it is now explored using a wide array of data types, through multi-proxy records such as ice, lake sediment and pollen cores, tree rings, rodent and other animal nests/middens with their associated plant macrofossil and microfossil/pollen remains, paleosol and geoarchaeological evidence, and archaeological and paleobiological deposits (Anderson et al. 2007, 1). The most important conclusions to be drawn from our compilation of proxy records are that Holocene climate has been highly variable, and that there are multiple controls that must have been responsible for this variability (Mayewski et al. 2004, 252).

The first Neolithic settlements of NCI appeared after the end of the 8.2 kyr cal. BP cooling event (ca. 6200 BC), and gradually developed from ca. 5400 BC. The rise of CA culture, ca. 5300 BC, was a turning point in the flourishing of the settlements in this region. This period began with the advent of a favorable climatic period, and ended after 1000 years at ca. 4300 BC. Fazeli has named this long-time cultural period as “Transitional Chalcolithic” period (Fazeli 2001a). Although this term seems to diminish the originality of this period, it is quite correct in this regard that it is the passageway of the two primary and advanced cultural periods in this region. The decline of this important cultural period has probably also been linked to a severe climatic event. However, the evolution of the CA culture into the Sialk III culture is evident from the study of the material culture of the excavated and surveyed sites of the region (Valipour 2008, 45-72).

Research Methodology

The results of paleoclimate studies, along with OSL, C14, TLD etc., can not only be useful for more accurate dating of archaeological sites, but also can explain the causes of changes in the settlement patterns, many migrations and displacements of human
societies as well as the changes in their lifestyle and diet. This research is based on the results of paleoclimatology of the Mid-Holocene period in the northern hemisphere, combined with information obtained from archaeological surveys and excavations of prehistoric sites belonging to the CA period in NCI. It is also discussed about impacts of climate changes in the 6th and 5th millennia BCs on the formation, continuity and decline of human societies in the CA cultural period.

The Mid-Holocene Climate

Although the 6th and 5th millennia BCs were in the Holocene Climate Optimum but severe warming events occurred during this period. These climate changes have been accompanied by extreme droughts in some regions and in the others with extreme weather events, torrential rainfalls and floods. The effects of warming events on human health have certainly been linked to an increase in infectious, epidemic and fatal diseases (especially in ancient time), but drought periods can drastically cause water tensions, reduction and decay agricultural crops, occurrence of famine, malnutrition and increased mortality rates. A 5-year drought in pre-industrial age could have destroyed many water-based human societies. Such events can only be illustrated by high-resolution paleoclimate research.

In studying the climatic conditions of this period, it is necessary to pay close attention to the region in question, as it is possible that the paleoclimate research in Zagros region, for example, provide quite contradictory information about the climate of NCI. For this reason, it is important, first, to pay attention to high-resolution studies (that have been carried out rarely in Iran), and it is also necessary to consider paleoclimate studies in a region with a relatively similar climatic conditions to NCI. For instance, although Ardabil province has a colder weather than the region, however, Neor lake studies may illustrate the drought periods in NCI.

The result of Greenland Ice Sheet Project 2 (GISP2), a critical paleoclimate research in an entirely pristine area, is the diagrams that show temperature and humidity changes during the quaternary period. Due to the high-resolution, it is the basis of many archaeological studies in the world. These diagrams illustrate cold and dry climatic conditions at ca. 6200 BC. Thereafter, the temperature increased sharply at ca. 5800 BC, and then, up to 5200 BC, a downward trend followed, with an incremental fluctuation of ca. 5500 BC, which lasted about a century. During the 6th mill. BC, moisture increased gradually, reaching its peak at ca. 5000 BC. After that, the temperature increased drastically and the moisture dropped, but again from ca. 4800 BC, the temperature and aridity decreased. Subsequently, with an oscillating trend, the temperature and dryness increased up to ca. 3700 BC. Diagrams show a relative warm-dry oscillation at ca. 4000 BC (Fig. 1a,b) (Alley 2004a, b).

Radiocarbon dating on 20 samples from a 775-cm peat core, retrieved from Neor Lake, located in Ardebil province (NW Iran), show a nearly constant rate of accumulation (1.7 mm yr-1, R2=0.99) since 13356 ± 116 cal yr B.P. Down-core X-ray fluorescence measurements of conservative lithogenic elements (e.g., Al, Zr, Ti) as well as redox-
sensitive elements (e.g., Fe, K, Rb, Zn, Cu, and Co) at 2 mm intervals reveal several periods of elevated dust input to this region since the early Holocene. The results of this study indicate dry periods with increasing dust flux in 6300-5900 BC, 5600-5400 BC, 5000-4900 BC and 4200-3000 BC (Sharifi et al. 2015).

In the southeastern region of Iran, two paleoclimate studies have been carried out in Hamoun Lake (Hamzeh et al. 2016) and Jazmurian playa (Vaezi et al. 2018) that can describe the Holocene climatic conditions. According to a multi-proxy record from a 5-m long sediment core from the Jazmurian playa, between 7000 and 3000 BC, there were 4 dry periods in intervals (ca. 6500-6100 BC), (ca. 5800-5300 BC), (ca. 4400-4000 BC) and (ca. 3500-3000 BC). Also, Hamoun research, by analyzing of two sediment cores, 6.2 and
6.8 m long, indicates several drought oscillations in periods (ca. 6800-6100 BC), (ca. 5900-5700 BC), (ca. 5400-5200 BC), (ca. 5000-4850 BC) and (ca. 4550-4100 BC).

Sedimentary analysis on a core retrieved from Zeribar Lake (with very low resolution) indicates the warm-humid climatic conditions, increasing spring rainfall and moisture, increasing lake water depth in intervals 6950-4870 BC and 3500-1170 BC, and the warm-dry climate, reduce rainfall and humidity, occurrence of drought and decreasing lake water depth in periods 4870-3500 BC and 1170-300 BC (Maghsudi et al. 2014, 43). Another paleoclimate research shows the increase in lake salinity during 4400-3900 BC (Wasylikowa et al. 2006). Also, according to van Zeist and Bottema (1977), particularly pronounced lowering of lake level occurred ca. 5800–5500 BC.

Mid-Holocene climatic conditions were reconstructed for the eastern Mediterranean region through a high-resolution (3–20 yr) oxygen and carbon isotopic record in a
speleothem from Soreq Cave, Israel. The research indicates two wet events at ca. 4550–4450 BC and 2800–2700 BC and 5 dry events at ca. 4650–4600 BC, 4250–4180 BC, 3700–3600 BC, 3250–3170 BC and 2200–2050 BC (Bar-Matthews and Ayalon 2011) (Fig. 2).

Environmental Sedimentary Studies on Archaeological sites in NCI

In the second year of “Sialk Reconsideration Project”, in order to reconstruct geomorphology of Kashan plain in Holocene and at the same time as the first settlements of the Sialk site, at a distance of 110 m north of the southern tepe and 330 m of the northern tepe, in a flat part of the agricultural land, a trench (A) was excavated to a depth of 6 m. The width of the trench was initially 10 × 10 m, which at the end reached 90 × 100 cm. When the trench depth reached about 5 m, the characteristics of sedimentary deposits became uniform, and the excavation finally stopped at a depth 6.1 m. The total sediments of trench A was divided into 3 main units and each one was subdivided into smaller subunits. In the study of Unit III deposits, it was found that a river with high discharge between two Sialk tepes was flowing. The existence of this river is a strong reason for the high rainfall in the early and middle Holocene in the Kashan plain, since no permanent river is currently passing through this area (Haidari 2002, 104). In spite of trench A, excavations at trench B (6 × 6 m and maximum depth 6 m, located in 100 m south-east of the northern tepe and 300 m north-northeast of the southern tepe) and at trench Milchah (1 × 1 m and maximum depth 6 m, located in the eastern edge of the southern tepe) showed that in depth about 4 m of all 3 trenches, coarse grain sediments appeared that continued up to the end of the trenches. The color of the sediments in this depth changed from gray to brown, which, according to the pottery and stone tools found from the trenches, is actually the boundary of the variation of the sialk II to III period (Kavousifar 2004, 132-136). Also, environmental sedimentology of Sialk shows that the beginning of intense sedimentation in the Kashan plain occurred at 4960-4720 BC, which simultaneously with the abandonment of Northern Sialk, however, humid climates have gradually dried up between Sialk II and III (Malek Shahmirzadi 2002, Simpson and Kourampas 2013, Fazeli 2011, 19).

During the excavations at Tepe Pardis in Qarchak Varamin, in the same layer of the late Neolithic pottery and brick structures, a section showed a direct north-south anthropogenic irrigation canal, dated by OSL at 6.7+0.4 ka (5100-4300 BC) and the sediments surrounding are dated at 5220-4990 cal. BC. This result confirms the antiquity of the feature and demonstrates that it was formed at about the same time as (or is even older than) the paleo-river channels. The age of this channel is close to those proposed for the first irrigation channels in Mesopotamia, such as the mid-6th mill. BC dates for the channel at Choga Mami (Oates 1982) and on the Deh Luran plain (Hole 1977), and suggests a rapid diffusion of this skill to the more arid, peripheral regions to the east. After ca. 4000 BC, the OSL dates show a hiatus in the fluvial record of the site. The absence of river channels suggests that the source of water available at ca. 4500 BC disappeared until at least 1000 BC (Gillmore et al. 2011, 64-65).

In another field study in the Sagz Abad cluster (Zagheh, Ghabristan and Sagz Abad) in the Qazvin plain, probabilistic links between environmental changes and cultural
evolution have been investigated. The study shows that at ca. 5200 BC, with increasing humidity and access to water, was provided a good opportunity to settle in the Hadji Arab fan. It is probable that the beginning of settling in Zagheh (ca. 5170 cal. BC) was due to favorable climatic conditions around this time (Schmidt et al. 2011, 593).

Cheshmeh Ali Settlements

The CA period, following the Sialk I culture, appeared ca. 5300 BC and was ended at ca. 4300 BC. The red and fine pottery of this period was found not only in NCI, but also in neighboring regions. This cultural period has taken its name from the CA site in Ray city (South of Tehran), first excavated by Schmidt in the 1930s and again by Sarraf and Fazeli in 1997. According to absolute dating (C14) of samples of this site, all of which belong to the Transitional Chalcolithic period - experimental specimens from other layers has not been obtained - the site belongs to 5170-4690 cal. BC (Wong et al. 2010, Fazeli et al. 2004). However, evidence from the Sialk III and IV cultures has also been found from CA.

The Sialk site, located in Kashan, have been excavated by Ghirshman in the 1930s and by Malek Shahmirzadi between 2001 and 2005. According to absolute dating (C14), Northern Sialk was inhabited at (? -5715 cal. BC), (5370-5250 cal. BC) and (5145-4900 cal. BC) (Pollard et al. 2013a, 45 Table 9). The earliest settlement in Northern Sialk is probably not older than 5900 BC.

Tepe Zagheh, about 60 km south of Qazvin, has been excavated several times by the Department of Archeology of the University of Tehran before and after the Revolution of Iran. All the archaeological evidence derived from Zagheh show the transition from a simpler social structure to a relatively more complex society with more specialized economic, livelihood, demographic and belief systems (Mollasalehi et al. 2006, 28). The absolute dating of Zagheh suggests that this site was inhabited between ca. 5380 and 4320 cal. BC (Pollard et al. 2013a, 45 Table 9, 2013b, 120).

Tepe Paris, located in Qarchak Varamin, was excavated by Fazeli in the 2000s and is one of the most important sites in which was discovered pottery kilns (Fazeli et al. 2007a, 268-269), the pottery wheel (Fazeli et al. 2007b, 421) and the water channel (Gillmore et al. 2011). This site was inhabited since the 2nd half of the 6th mill. BC up to the Sialk III6-7b period (Fazeli et al. 2007a, b, Valipour et al. 2009). Also, after a long gap, it is resettled in the Iron Age for the burial (Pollard et al. 2013a, 45 Table 9). Tepe Pardis has settled between 5290 and 4760 cal. BC. Similar pottery with Sialk I have also been discovered from this site (Fazeli et al. 2007a,b, 2010, Coningham et al. 2006).

Tepe Ibrahim Abad, located about 20 km south of Qazvin, was excavated by Fazeli in 2006 (Fazeli et al. 2009). In this site, evidence was found from the 2nd phase of the Neolithic period (5600-5200 BC) and the Transitional Chalcolithic 1 (5200-4600 BC). It was inhabited between ca. 5500 and 5000 cal. BC (Pollard et al. 2013b, 115).

Ghara Tepe of Qomroud, located 20 km northeast of Qom, is divided into two parts of prehistoric and Islamic ages (Kaboli 1999, 65). Excavations, surveys and archaeological studies on Ghara Tepe have been carried out between 1994 and 2005. In this site, 7 prehistoric layers belong to the 6th to the 4th mill. BC and a cemetery belong to the early Islamic centuries have been identified (Kaboli 2005, 13, 16). The environmental
sedimentology shows that this area was destroyed and abandoned by the flood in the mid-4th mill. BC (Kaboli 1999, 33, 72, 79, 83, 140-142). According to a review of the dates of Ghara Tepe, this site was inhabited for 2 phases: the first (7th and 6th layers), belongs to ECA / Sialk II (5200-7 BC), and the 2nd (the 5th to the first layers) belongs to Sialk III (4300-3500 BC). Between these two phases, there may have been a settlement gap (Kaboli 2005, 245, 296), and although Kaboli is implicitly referred to by the state between layers 6 and 5, but it remained silent about this possible gap. This is probably due to the fact that the absolute dates of this site are with very high errors (Shaikh Baikloo 2018).

The Ozbeki site, located in Savojbolagh, including 5 ancient tepes named Ozbeki Tepe, Yan Tepe, Maral Tepe, Jairan Tepe and Dushan Tepa, has been excavated by Majidzadeh (Majidzadeh 2010 a, b). This site, which has 10 cultural periods, was inhabited since the mid-6th mill. BC to the late 4th / the early 3rd mill. BC, and then, with a long gap, again in the 2nd half of the 2nd mill. BC (in the Iron Age) has been resettled. there is no absolute date for the Ozbeki site.

Moien Abad Tepe, located in Varamin, has evidence of the cultural periods of Sialk I and II and the remains of a large brick building, belonging to the early Sialk II/ ECA (Hessari 2014, 110-113). Despite the lack of absolute dates for this site, but according to dating (C14) of Tepe Pardis, the settlement of Tepe Moien Abad has probably started at ca. 5300 BC and ended at ca. 4700 BC.

Ghara Tepe of Shahriyar, located about 40 km south-west of Tehran, was excavated in 1957 by Burton-Brown for two weeks. This site was inhabited during the CA period (probably ECA) (Burton-Brown 1979).

Moushelan Tepe, located in 3 km from Ismael Abad village in Savojbolagh, 65 km west of Tehran, was first excavated by Hakemia in 1958-1959 and again by Navaie in 1978-1979 (Malek Shahmirzadi 1999, 366). Talaie (1997, 616), according to the time of settlement in each of the architectural phases, estimated the duration of settlement on this site about 500 years, which likely belongs to LCA and the early Sialk III periods.

Tepe Mafin Abad, located in Islamshahr, was excavated by Chaychi in 2005 and 2006. Surface surveys in 1998 and 2 seasons excavations showed that this site has settled from Sialk II to the early Sialk III. During the excavations, about 200 m north east of Mafin Abad, the remains of an ancient great river were discovered below the plain sediments, which had indicative evidence from Sialk III, indicating that some of the cultural remains of the site were buried under the sedimentary deposits. Therefore, it can be said that around the mid-4th mill. BC, this area has probably witnessed huge environmental changes due to severe climate changes (Chaychi 2007, Shaikh Baikloo et al. in press).

Tepe Shoghali, located in Pishva Varamin, was excavated by Hessari in 2006, 2007 and 2014 (Hessari et al. 2007, Hessari 2015). Stratigraphy of Shoghali is horizontally and most of its findings belong to the Sialk III and IV periods. None of the red ceramics found from the main trench that illustrates the evolution of the Sialk III pottery are not similar to the CA pottery (Hessari et al. 2007, 140). In order to determine the boundaries of this site, 4 small trenches (2, 3, 5, 6) were excavated around the tepe. All the ceramics found from trench 2 (700 m north of the main trench) belonged to the CA/ Sialk II period. It should be noted that in the 10th layer of the main trench, 2 pieces of sialk II pottery have also been found (Hessari et al. 2007, 136, 141, 142).
The Amin Soultan site, located in Tehran’s market area, was excavated by Sarlak, Mosadeqhi and Ismaeli Jelodar in 2014. During excavations, evidence of a prehistoric thermal feature (possibly a stove), the remains of a mid-aged woman and the Sialk I and II pottery, and also a small number of Sialk III pottery have been found. The results of TLD experiments on two ceramics showed the dates 4950 ± 280 and 4870 ± 300 cal. BC.
In general, this site could be one of the first seasonal settlements in NCI.

Pouienak Tepe, located between the villages of Pouienak, Khair Abad and Khorvin, was excavated by Malek in 1995 and showed little evidence from the CA period (Malek Shahmirzadi 1997, 49-49).

Tepe Gazor Sang, located about 2 km north of the village of Gazor Sang in Nazarabad, was excavated by Momeni in 2013. Two cultural periods have been identified in this tepe: (1) the CA period (possibly LCA), (2) the Sialk III\textsubscript{1-3} period. Based on comparative studies carried out on pottery, Tepe Gazor Sang can be dated from 5200 to 4000 BC (Momeni and Sadeghi 2014, 410-410).

Tepe Kholeh Kuh, located in Takistan city and 20 m north of Abhar River, was excavated by Maleki in 2000 and by Rezaie Khalaj in 2003 and 2011. Emergency excavations were carried out at Kholeh Kuh in 2014 and evidence of the CA, Islamic and possibly historical periods was identified (Davoudi et al. 2015).

Shirashian site, located about 15 km west of Damghan, was excavated by Schmidt in the 1930s. This site represents a well-known material culture from the mid-to-late 5\textsuperscript{th} mill. BC in northern Iran and southern Turkmenistan (Schmidt 1937, 17, Dyson and Thornton 2009, 1). Shirashian, most likely, belongs to between 4700-4600 and 4400-4300 BC (Dyson and Thornton 2009, 19).

Gholi Darvish Jamkaran site is situated on the southwest of Qom city (Sarlak 2007, 189). This site was excavated by Sarlak during 8 seasons from 2003 up to 2014 (Sarlak 2015, 127) and has cultural layers of Sialk II, IV, Late Bronze Age, Iron Age, Historic and Islamic periods. Life evidence belonging to the 4\textsuperscript{th} mill. BC has not been found in this site (Sarlak 2007, 2011). After the end of Sialk IV at ca. 3000 BC, it was resettled at ca. 2050 cal. BC (Pollard et al. 2013a, 45 Table 9).
Table 1: CA Settlements in NCI. Early Sialk I (ESI); Late Sialk I (LSI); Early Cheshmeh Ali (ECA); Late Cheshmeh Ali (LCA); Sialk III\(_{1,3}\) (SIII\(_{1,3}\)).

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<td>42</td>
<td>4900-5200</td>
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<td>Gholi Darvish</td>
<td>5200-5500</td>
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<td>Sialk (Northern)</td>
<td>5500-6000</td>
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<td>Ghaleh Sefid</td>
<td>4000-4300</td>
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<td>Tepe Abuazar</td>
<td>4300-4900</td>
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Tepe Deh Khair, located in 9.5 km north of Shahrud, was excavated in 2004 and 2006 (Rezvani and Roustaie 2016, 15-18). Two animal bone samples, found from Trench 1, show dates 6068-5913 and 5056-5894 cal. BC (Rezvani and Roustaie 2016, 20 Table 1).

In addition to the excavated sites, other ancient sites were also located in the archaeological surveys of Tehran plain (Fazeli 1998, 2001b), Qazvin (Fazeli 2006), Semnan (Rezvani 1999, Mehriyar and Kabiri 1986), Qomroud (Kaboli 1999), and Natanz (Vatandoust et al. 2011) have been found which belong to the CA period (Figures 3-5, Table 1).

**Discussion and conclusion**

The first settlements in NCI appeared after the 8.2 kyr cal. BP cooling event. According to Paleoclimate studies, duration of this climatic event has not been the same everywhere. Since the earliest settlement of this region, Eastern Sang-e Chakhmagh, has been established at 6200 cal. BC (Nakamura 2014, 9-12), therefore, it is suggested that this event probably occurred in Iran a little earlier. Also, it is probable that the duration of this climatic event in Iran has been 300-400 years. Then, between 6000 and 5900 BC, a very dry period prevailed, and then, up to 5600 BC warm and relatively dry conditions dominated. During this period, we witness the emergence of the first settlements in NCI, such as Chahar Boneh (in Gazvin Plain) and Sialk I (Pollard et al. 2013a, 45 Table 9), which were mostly semi-sedentary. Then, a dry climatic condition occurred between
ca. 5600 and 5400 BC. This situation had a profound impact on the subsistence systems of the early societies and led to the continuation of semi-sedentary. Since ca. 5400 BC, the climatic conditions have gradually become favorable and at ca. 5300 BC, it reached the best condition (the beginning of the Sialk II / CA period) and lasted up to ca. 5000 BC. Tepe Pardis (Fazeli et al. 2004, 2010, Coningham et al. 2006), Tepe Cheshmeh Ali (Wong et al. 2010, Fazeli et al. 2004), Tepe Zagheh (Pollard et al. 2013a, 45 Table 9, 2013b, 120), Tepe Ibrahim Abad (Fazeli et al. 2009, Pollard et al. 2013b, 115), Ozbeki (Majidzadeh 2010 a, b), Ghara Tepe of Shahriyar (Burton-Brown 1979), Tepe Moien Abad (Hessari 2014), Tepe Shoghali (Hessari et al. 2007) and Ghara Tepe of Qomroud (Kaboli 1999, 2015) have been established during this time. In these sites, architectural evidence made of brick has been found and it is obvious that since ca. 5400 BC, sedentary-farming life style has started in NCI.

However, from ca. 5000 to 4700 BC, a hyper warm period (the first cultural decline period in NCI) occurred. This is the time of a collapse / interregnum between ECA and LCA. Although some of the paleoclimate studies show a warm-wet period in some regions for this time, however, other studies indicate that some regions have suffered droughts. This is the probable drying date of the Sialk River, found between Northern and Southern Sialk. (Haidari 2002). Probably because of the difficulty of farm-based subsistence system during the period, many settlements such as Cheshmeh Ali, Sialk, Pardis, Ibrahim Abad and Moien Abad declined. In dry periods, due to lack of rainfall, constant droughts and extreme precipitation, the likelihood of flood events is high as well. The set of these factors causes soil erosion and, consequently, reduce agricultural crops. Therefore, it is not unlikely that in such periods the subsistence system of human societies has changed into semi-sedentary and, in other words, after experiencing a cultural flourishing period, they have again become nomads.

According to the absolute dates, Pardis and Cheshmeh Ali declined at ca. 4700 BC for several centuries. The environmental impacts of this climate change seem to have been so severe that the inhabitants of the region have long been affected and eventually failed to survive. It is also likely that the end of ECA, despite the occurrence of climatic events, may have been associated with changes in the social status of societies in NCI.

Undesirable climatic and environmental conditions recovered from ca. 4700 BC, which lasted up to ca. 4400/4350 BC. A number of sites (such as Ghara Tepe of Qomroud) were rebuilt or were formed for the first time (such as Ghara Tepe of Shahriyar) in the mid-5th mill. BC. All of these sites are located in the basins of permanent rivers, such as Karaj and Qomroud-Ghara chay. It is also probable that the location of some sites, in fact, has changed due to the displacement of the rivers. It is not unlikely that in the 5th mill. BC there was another tepe near Northern and Southern Sialk, with cultural material belonging to Sialk II, completely destroyed by human activities or any other factor. In the mid-5th mill. BC, significant decrease in the number of sites of the Varamin alluvial fan is well visible. Probably, Jajroud sedimentations or agricultural activities in this area have caused the destruction of settlements - in the central and upstream parts of the Varamin fan, no sites belonging to the mid-5th mill. BC or LCA have been discovered yet. In this area, the sedimentation of the permanent river of Jajroud is greater.
The next warm-dry period probably started from ca. 4400/4350 BC, which led to the collapse of Tepe Zagheh at 4300 cal. BC. Sialk III settlements, such as Southern Sialk, Tepe Ghabristan (Pollard et al. 2013a, 45 Table 9) and Tepe Hisar (Voigt and Dyson 1992, 135-136 Table 1), which have absolute dates, after the end of the climate change, were established between 4100 and 4000 BC. However, there seems to be a continuity of settlement in some of the sites, such as Ghara Tepe of Qomroud and Moushelan Tepe. Regarding Tepe Shoghali and Tepe Mafin Abad, which have a horizontal stratigraphy, although it is not possible to speak with a high probability about a settlement gap between the Sialk II and III periods, but this is not completely rejected.

Bibliography


