

The first direct evidence of the Djeitun pottery type in Eastern Mazandaran

Article

Published Version

Creative Commons: Attribution-Noncommercial 4.0

Open Access

Asadi Ojaei, S. K., Seresti, R. A., Thornton, C. P. and Matthews, R. ORCID: <https://orcid.org/0000-0002-8316-4312> (2025) The first direct evidence of the Djeitun pottery type in Eastern Mazandaran. *Iranian Journal of Archaeological Studies*, 15 (2). pp. 43-58. ISSN 2251-743X doi: 10.22111/IJAS.2025.53586.1375 Available at <https://centaur.reading.ac.uk/127754/>

It is advisable to refer to the publisher's version if you intend to cite from the work. See [Guidance on citing](#).

Identification Number/DOI: 10.22111/IJAS.2025.53586.1375
<<https://doi.org/10.22111/IJAS.2025.53586.1375>>

Publisher: University of Sistan and Baluchistan

All outputs in CentAUR are protected by Intellectual Property Rights law, including copyright law. Copyright and IPR is retained by the creators or other copyright holders. Terms and conditions for use of this material are defined in the [End User Agreement](#).





www.reading.ac.uk/centaur

CentAUR

Central Archive at the University of Reading

Reading's research outputs online

The First Direct Evidence of the Djeitun Pottery Type in Eastern Mazandaran

Seyyed Kamal Asadi Ojaei¹  Rahmat Abbasnejad Seresti^{*1}  Christopher P. Thornton²  and Roger Matthews³ 

**Corresponding Author; ¹ Department of Archaeology, University of Mazandaran, Babolsar, Iran.*

E- mail: r.abbasnejad@umz.ac.ir

² Consulting Scholar, Asian Section, University of Pennsylvania Museum, USA.

³ Department of Archaeology, University of Reading, Oxford, UK.

Received: 08/ 07/ 2025; Received in Revised form: 25/ 09/ 2025; Accepted: 27/ 09/ 2025; Published: 20/ 12/ 2025

Abstract

The timing and process of Neolithisation in Eastern Mazandaran have been a topic of debate among archaeologists, as the Southern Caspian littoral is regarded as a likely route for the spread of Neolithic culture to Central Asia. Until recently, there was no reliable evidence connecting this region to the Pottery Neolithic (PN) sites of Central Asia (Djeitun Culture). However, an archaeological field survey conducted in 2021 at the site of Tappeh Fakhi has provided direct evidence of Djeitun pottery in this region. Since the processes of endogenous or exogenous Neolithisation and domestication in Eastern Mazandaran remain controversial, sites such as Tappeh Fakhi can shed light on the issues we are facing. When compared to adjacent regions such as the Central Plateau, Shahrud Plain, Gorgan Plain, Khorasan Region, and Western Central Asia, the Neolithic sherds found at Tappeh Fakhi suggest a chronology beginning in the final 7th millennium BCE. In contrast, the Chalcolithic sherds indicate that the site continued to be occupied until the end of the 5th millennium BCE. During the field survey, two potential paths for the introduction of the Djeitun culture to Eastern Mazandaran were considered: one from the southern slopes (Shahrud region) to the northern part of the Alborz mountains, and another through the Gorgan plain. Given the location of Tappeh Fakhi, it appears to be a significant site that connects the two cultures, i.e. the Djeitun and Caspian Neolithic Software, likely through the Gorgan Plain. This paper will summarise the known aspects of the PN in Eastern Mazandaran and its inter-regional interactions.

Keywords: Neolithic, Caspian Sea, Software, Djeitun, Chakhmaq, Pottery.

Article Type: Research Article

Introduction

In Southern Turkmenistan, pottery first emerged with the onset of the Djeitun Neolithic culture during the late 7th and early 6th millennium BCE, marking the region's initial agricultural community (Masson 1961; Coolidge 2005: 11; Harris 2010: 119-121). Geographically, the Djeitun culture is divided into three zones: 1) the Kopet Dag Central zone, 2) the Kopet Dag eastern zone (Meana-Chaacha district), and 3) the Kopet Dag western zone. Key sites within these zones include Djeitun, Chopan, Togolok, Pessedjik, New Nisa, and Gievdzhik in the Central zone; Chagylly, Chakmakly, Mond-

jukli, and Gademi in the Eastern zone; and Bami in the Western Zone (Coolidge 2005: 23-39). Djeitun pottery is typically handmade, chaff-tempered, and features a highly burnished and smooth surface, with a thick slip ranging from cream to reddish-pink. The painted designs predominantly consist of geometric motifs, coloured from brown to red. Based on these motifs, Djeitun pottery is classified into three phases: Phase I, which spans from the final 7th and early 6th millennium BCE (subdivided into A and B); Phase II, corresponding to the middle 6th millennium BCE; and Phase III, occurring during the late 6th millennium BCE (Masson and Sarianidi 1972; Coolidge 2005).



© The Author(s):

DOI: 10.22111/IJAS.2025.53586.1375

Publisher: University of Sistan and Baluchestan

Iranian Journal of Archaeological Studies

2025, Vol. 15, No.2

The origins of the Djeitun culture have sparked debate for decades. David Harris (2010) argued that there are no signs of local domestication processes for pigs, cattle, sheep, or goats. Genetically speaking, these domesticated animals were brought to the region from the Fertile Crescent; however, it remains unclear which specific regions contributed to their arrival in Southern Turkmenistan. Lamberg-Karlovsky (1973) proposed that the early phase of the Djeitun culture is closely related to the sites in the Fertile Crescent, such as Jarmo, Sarab, and Guran. Sarianidi (1970) suggested that the Djeitun culture was formed by the migration of people from the Alborz Mountains through the Gorgan Valley and the Southeastern Caspian littoral to Kyzyl Arvat, eventually reaching the Kopet Dag piedmont. Masson and Sarianidi (1972) compared the incipient Djeitun culture to early Sialk I material in North-Central Iran, concluding that “the Djeitun culture had the Mesolithic horizon of both southern Central Asia and Northern Iran as its basis”. There are indeed cultural similarities between sites in the Iranian Central Plateau, such as Sialk and Sang-e Chakhmaq, and Djeitun culture sites during the late Neolithic period (Coolidge 2005; Masuda *et al.* 2013; Roustaei 2016a). Christopher P. Thornton, in his paper based on the petrography analysis of pottery sherds from Sang-e Chakhmaq, concludes that this site “perhaps served as an important nexus of trade and cultural exchange” between the Caspian littoral shores, the North-Central Iranian plateau, and the southern Turkmenistan pediments (Thornton 2013). Furthermore, a recent paper identified *straight sickle* tools at Djeitun that closely resemble those found at Sang-e Chakhmaq, suggesting a spread of the Neolithic agricultural lifestyle into Western Central Asia through the Southern Alborz mountains, with Sang-e Chakhmaq posited as an intermediate site (Pichon *et al.* 2023).

In the current paper, the authors will examine the PN period along the southern (Shahrud and Bastam Plains, Khorasan region) and northern (Eastern Mazandaran and Gorgan Plain) slopes of the Alborz Mountains to explore potential connections with the Djeitun type in western Central Asia.

The PN of Northeastern Iran

Field surveys in the Gorgan Plain have identified at least 57 PN sites related to the Djeitun culture (Rezaei 2015; Roustaei and Nokandeh 2017). The nearest Neolithic site featuring Djeitun pottery to the well-known Neolithic sites in Mazandaran, such as Hotu and Kamarband (Belt) Caves, is less

than 50 kilometres away, which heightens the likelihood of discovering Djeitun ceramics at these cave sites. Neolithic ceramics were indeed found in both Hotu and Kamarband caves by Coon (1951), although the sherds received only limited attention (Matson 1951). Dyson (1991) attempted a cursory assessment of the pottery assemblage and categorised them into three horizons: 1) the oldest horizon, Caspian Neolithic Software (CNS type); 2) the Djeitun pottery horizon; and 3) the Sialk II horizon. However, subsequent studies of the pottery assemblage found no definitive Djeitun pottery among the cave assemblages, with most sherds belonging to the CNS type (Gregg and Thornton 2012). Dyson describes the CNS type as having been fired at low temperatures, handmade, chaff-tempered, and coated in a thick, creamy, brown, red-brown, or chocolate slip.

Sang-e Chakhmaq, located in the Bastam Plain, reveals the best evidence of Djeitun pottery in Northeastern Iran. The site was excavated over four seasons by Seichi Masuda in the 1970s (Masuda 1976; 1974; see Thornton 2013). Koroush Roustaei (2009) was persuaded to re-excavate the site to better understand the Neolithisation process in Northeastern Iran. The site includes two mounds: the Western mound, which belongs to the PPN (7200-6600 BCE), and the Eastern mound, which contains PN and early Chalcolithic material (i.e., Transitional Chalcolithic or Sialk II period). Although both Masuda and Roustaei found a few non-diagnostic sherds in the Western mound, all Neolithic ceramics from this site originate from the Eastern mound and are known to belong entirely to the Djeitun culture (Thornton 2013; Masuda *et al.* 2013). The earliest layers of the Eastern mound have been dated to around 6200-5700 BCE, with the site probably lasting until around 5200 BCE (Nakamura 2014). Based on the 2009 excavation, the PN levels date to 6200/6100~5300 BCE (Roustaei *et al.* 2015). Other nearby sites with Djeitun potteries, such as Kalateh Khan (5600-5300 BCE), Deh Kheir (6000-5800 BCE), and Rouyan (Roustaei and Rezvani 2021) (6000-5500 BCE), suggest a broader regional adoption of this material culture.

The Shahrud and Bastam plains, located in the Southern Alborz slopes, demonstrate strong cultural similarities with the Djeitun culture. Thus, Sang-e Chakhmaq is thought to be not only the route but also a potential origin of the Neolithic lifestyle in Southern Central Asia (Roustaei 2016a). However, a recent archaeological field survey in Eastern Mazandaran has questioned this assumption.

Survey Evidence and Tappeh Fakhi

Previously, only 14 lowland sites had been identified as Neolithic sites in the Eastern Mazandaran region, but published material for the Neolithic period of this region is limited. As a result, the connections between Eastern Mazandaran and adjacent regions, such as the Gorgan Plain, Shahroud and Bastam Plains, Khorasan region, and Southern Turkmenistan, remain unclear. Consequently, an archaeological field survey was conducted in the spring and summer of 2021 to detect Neolithic sites from the Caspian lowlands to the Alborz highlands (Asadi Ojaei 2023). During this field survey, 54 sites were visited, and 38 sites were recorded as PN sites; of these, 10 are located in the highlands, while the remaining 28 sites are in the lowlands. In the Neolithic highland sites, there were no signs of connection with the Southern Alborz slopes (e.g., Sialk I pottery), and only the CNS type was found on the surface (Figure.1). However, one site in the lowlands indicated evidence of connection with the Djeitun culture.

Tappeh Fakhi is a small mound located in the Eastern part of the Behshahr plain, at an eleva-

tion of -18 m above sea level ($36^{\circ}44'53.45''\text{N}$, $53^{\circ}40'4.64''\text{E}$). It is situated 4 kilometres south of the Caspian coast and 4.5 kilometres north of the Alborz foothills (Figures.2 and 3). This site has been damaged by farming and industrial activities, which have divided it into two mounds and reduced its size to 37000 m². Although this site has never been excavated, and no Neolithic evidence was reported in previous field surveys, Neolithic artefacts were found during the 2021 survey. The ceramics on the surface of Tappeh Fakhi can be classified into two groups: the Djeitun Neolithic group and the black-on-red sherds associated with the Transitional Chalcolithic group.

The Djeitun ceramics from Tappeh Fakhi are mostly simple (Figure. 4, B, D, E), though some have a thick painted band (Figure. 4, A, C). For example, Sherd A in Figure. 4 is very similar to the one found at Yell Vaz Tappeh (Figure.8, H) in the Gorgan Plain, which belongs to the Djeitun Culture. The slips on the ceramics are very thick and range in colour from light cream (Figure. 4, B) to pinkish red (Figure. 4, A) and brown (Figure. 4, C, D, E). All pieces exhibit coarse chaff temper (Figure. 4, C, D).

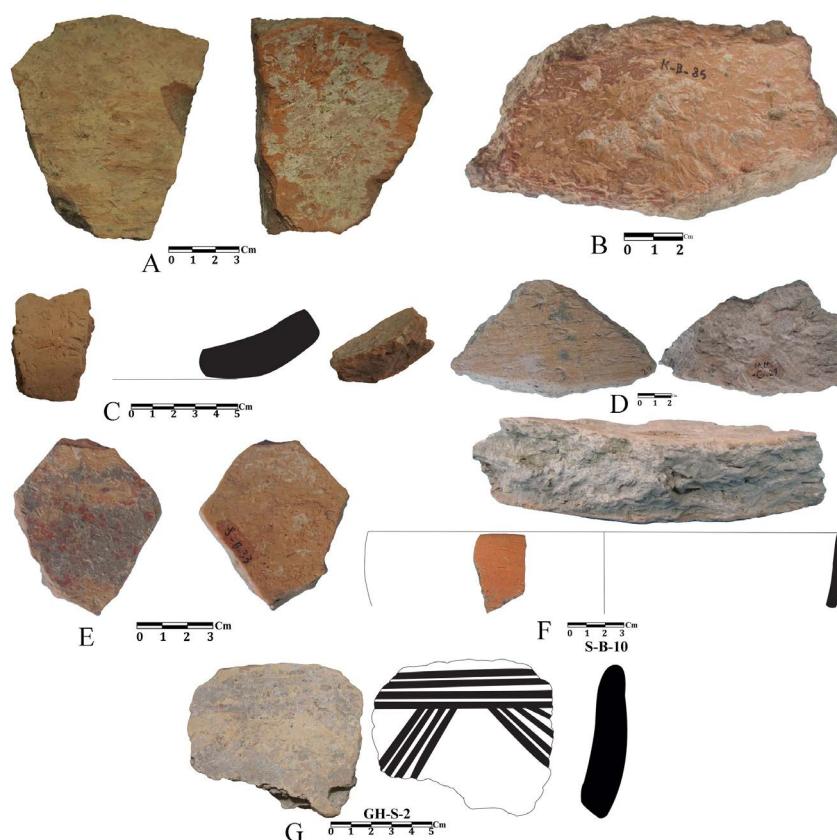


Figure. 1: Neolithic pottery of Eastern Mazandaran highlands: Starem (A); Kiasar (B, C); Mosayeb Mahalle (D); Samchool (E, F); Ghol Tappeh (G) (After: Asadi Ojaei et al. 2024a)



Figure 2: General view (up) and aerial photo (down) of Tappeh Fakhi

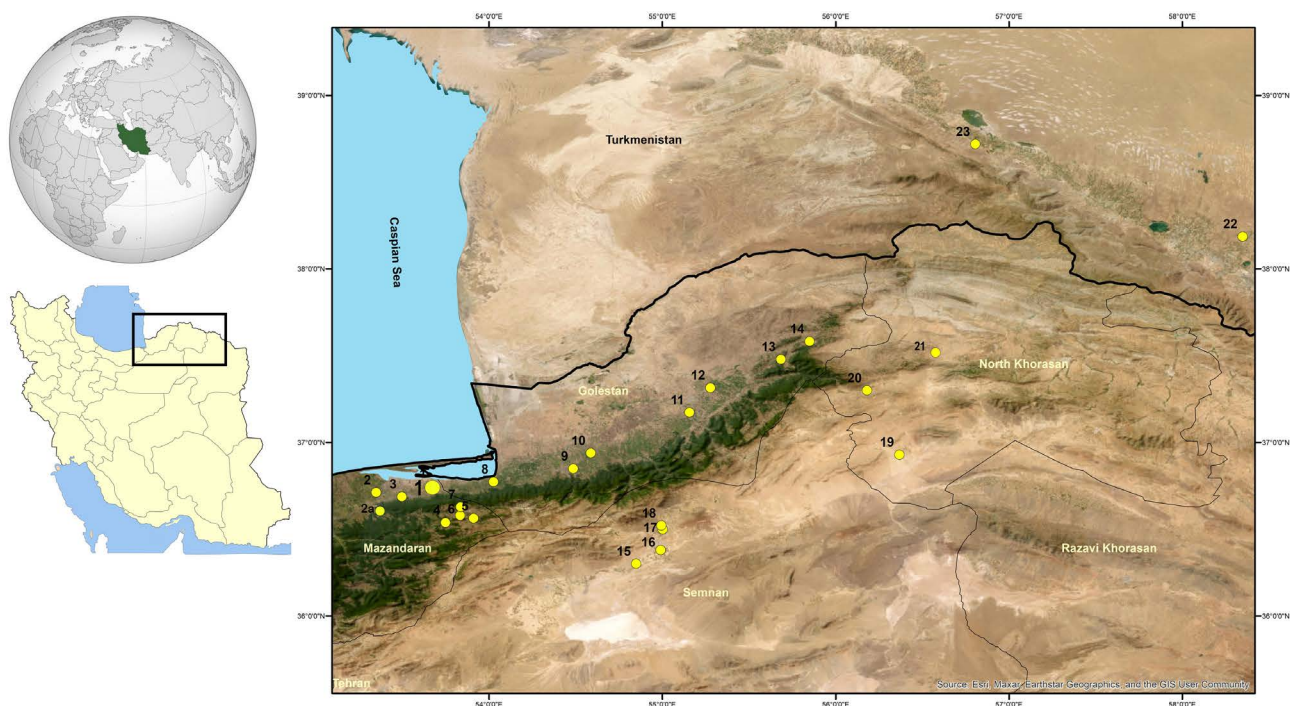


Figure 3: Map of Neolithic site of Northern Iran and adjacent regions: 1) Tappeh Fakhi; 2) Touq and Valiki; 2a) Komishan cave and Komishani open site; 3) Hotu, Kamarband and Al Tappeh caves; 4) Samchool; 5) Estarem; 6) Kiasar; 7) Mosayeb; 8) Bandar Gaz; 9) Pookerdvall; 10) Tureng; 11) Yarim; 12) Aq Tappeh; 13) Tigllek; 14) Yell Voze; 15) Kalateh Khan; 16) Royan; 17) Snng-e Chakhmaq; 18) Deh Kheir; 19) Pahlevan; 20) Amardlu; 21) Qaleh Khan 22) Djeitun; 23) Bami. (After: Map adapted from ESRI (www.esri.com, accessed 19 October 2024))



Figure 4: Djeitun Simple and Painted Band Sherds, Tappeh Fakhi.
(After: Asadi Ojaei 2023)

The more complex painted sherds are commonly found on the surface of Tappeh Fakhi (Figure.5). One of the most recognised motifs of the Djeitun type is the so-called *shady motif* (Zeyghami 2009), a few examples of which have been gathered from Tappeh Fakhi (Figure.5, A-B). This motif features parallel colour bands with shady lines, either the same colour or a paler fill, between them. Another motif consists of *parallel oblique lines* that intersect, forming a vertical line in the centre (Figure.5, C). Compared to similar motifs from other sites, this one from Tappeh Fakhi appears somewhat irregular. Additionally, the *vertical ladder motif* (Figure.5, D) is frequently seen in many Late Neolithic sites belonging to the Djeitun culture. Another motif features *parallel horizontal lines* that extend upward to the rim, where they are finished with short vertical lines (Figure.5, E); this is also related to the Djeitun culture. A rim with a complex line motif (Figure.5, F) is irregular but still appears to belong to the Djeitun type.

Other motifs associated with the Djeitun culture include *parallel wavy lines* (either horizontal or vertical) and *parallel horizontal lines intersected by a vertical line*. Both of these are characteristic motifs of Djeitun pottery. Similar Djeitun sherds have been found at various sites in Northeastern Iran, including Aq Tappeh (Malek Shahmirzadi and Nokandeh 2000), Yarim (Stronach 1972), Dik Seyyed and Bandar Gaz (Rezaei 2015), Tureng (Deshayes 1987), and Pookerdvall (Zeyghami 2009) in the Gorgan Plain as well as Sang-e Chkhmaq (Masuda *et al.* 2013; Roustaei *et al.* 2015), Deh Kheir (Rezvani and Roustaei 2016), and Kalateh Khan (Roustaei 2016b) in the Shahroud and Bastam Plain, Qaleh Khan (Garazhian *et al.* 2014) and Pahlevan (Azizi Kharanaghi *et al.* 2016) in northern Khorasan, and other Djeitun-related sites (Coolidge 2005) in Southern Turkmenistan (Figures. 6, 7 and 8).

As mentioned above, the Djeitun culture is divided into three phases spanning from the late 7th to the late 6th millennium BCE (Figure.9). Consequently, we can attempt to compare the Djeitun sherds from Tappeh Fakhi to establish a relative chronology. For instance, Sherd C (Figure.5) displays similarities to pottery from sites such as Chagylly, Bami, and Mondjukli, belonging to Phase III. Sherd D (Figure.5) also appears in Phase III at Bami. The horizontal wavy lines motif, represented by Sherd G (Figure.5), emerged in Phase II; before that, the wavy lines were vertical in Phase I. Sherd H (Figure.5) also seems to belong to Phase II; both motifs are observed in Togolok and Pessedjik. While the horizontal lines (Sherds A, B, E, Figure.5) seem to be present throughout all phases of the Djeitun culture, horizontal lines (wavy or straight) generally begin to appear from Phase II. Thus, Djeitun sherds from Tappeh Fakhi probably originate from the mid-6th millennium BCE, almost 1000 years later than the emergence of the CNS type.

In the Gorgan Plain, there is no absolute dating for PN sites. In the Khorasan regions, the earliest dating belongs to Tappeh Qaleh Khan, dating around 5800 BCE (Garazhian *et al.* 2014). Consequently, Djeitun pottery is thought to date to the early 6th millennium BCE. In contrast, the emergence of the PN (the CNS) in Eastern Mazandaran is estimated to be around 6600-6400 BCE (Thornton 2013; de Groene *et al.* 2023). Since CNS types are absent and Tappeh Fakhi presents only Djeitun group pottery, the relative chronology for the PN at this site is likely during the 6th millennium BCE.

Besides the Neolithic ceramics, Tappeh Fakhi holds Transitional Chalcolithic pottery as well (Figure.10). Some of these sherds still exhibit visible chaff temper in their fabric (Figures.10, F-G-1, 10, 11), while others have a fine mineral temper, resembling the contemporary findings at Sang-e Chakhmaq (Thornton 2013). Therefore, Tappeh Fakhi may indicate an unbroken sequence from the Late Neolithic to the Transitional Chalcolithic. These potteries can be compared to those from other adjacent sites (Figure.10). Sherd F-G-10 (Figure.10) is similar to sherds from Tappeh Rouyan (Figure.11, C), dated to 5700-5500 BCE, which also includes Sang-e Chakhmaq Neolithic potteries (Roustaei 2023). A sherd similar to Sherd C (Figure.10) was collected during a visit to Sang-e Chakhmaq, and comparable sherds were recovered at Tappeh Pahlevan in the Khorasan region, dated to 5800-5200 BCE (Figure.11, D-F). Sherd B-1 (Figure.10) also shares similarities with Transitional Chalcolithic ceram-

ics from Hotu Cave and Tappeh Pahlavan. Sherd D (Figure.10) parallels Sialk I pottery, which dates to the Late Neolithic II period (5600-5200 BCE), also found at Hotu Cave (Figure.11, sherd A-B). Sherds A-3,4, 6, and 7 (Figure.10) can also be compared to inter-regional sites such as Anau IA (Pumpelly, 1908), Aq Tappeh, Shir Ashian (or Shir-I Shian) and Siah Tappeh (Roustaei 2018), Qaleh Khan, as well as regional sites such as Tappeh Kiasar (Asadi Ojaei 2023) and Tappeh Abbasi (Abbasnejad Seresti 2009). Dyson and Thornton (2009) placed Shir Ashian and Anau IA in the same chronology context for the prehistory of northeastern Iran, assigning them to the Late Cheshmeh Ali (4700-4300 BCE).

For Tappeh Fakhi, a relative chronology can be estimated based on the surface ceramics. The Djeitun potteries from Tappeh Fakhi likely belong to Phase II of the Djeitun culture, dating to the mid-

6th millennium BCE, though there is a possibility of the presence of Phase I as well, which dates to the late 7th – early 6th millennium BCE. The Transitional Chalcolithic period has been dated to 5300-4600 BCE based on the chronology of the Central Plateau of Iran (Fazeli Nashli *et al.* 2013). However, as noted above, numerous Transitional Chalcolithic sites in Northeastern Iran have been carbon-dated to the mid-6th millennium BCE, thereby overlapping with the Djeitun culture in Southern Turkmenistan. Nowhere in Northeast Iran, however, have Djeitun-type ceramics and Transitional Chalcolithic ceramics been found in mixed contexts; the black on red type consistently appears stratigraphically later than the Djeitun type. Therefore, it seems probable that Tappeh Fakhi dates from the first half of the 6th millennium to the end of the 5th millennium BCE (Figure.12).

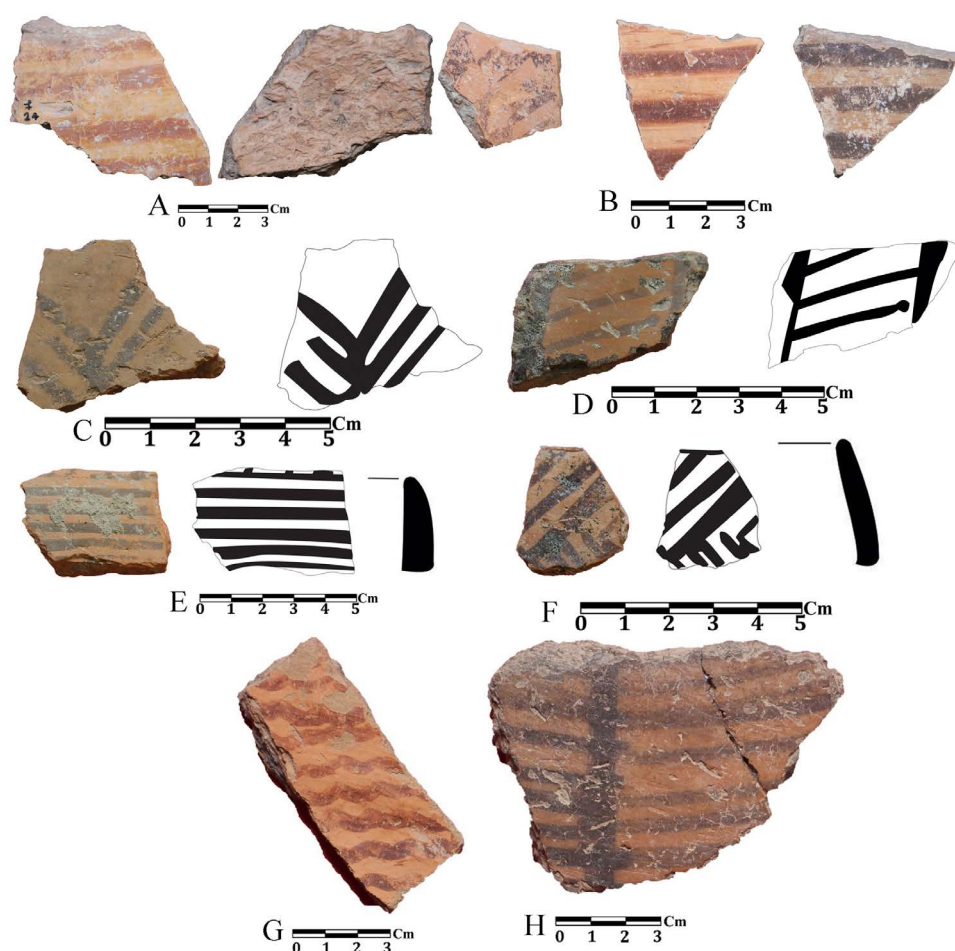


Figure. 5: The Djeitun Painted Sherds, Tappeh Fakhi, (After: Asadi Ojaei 2023)

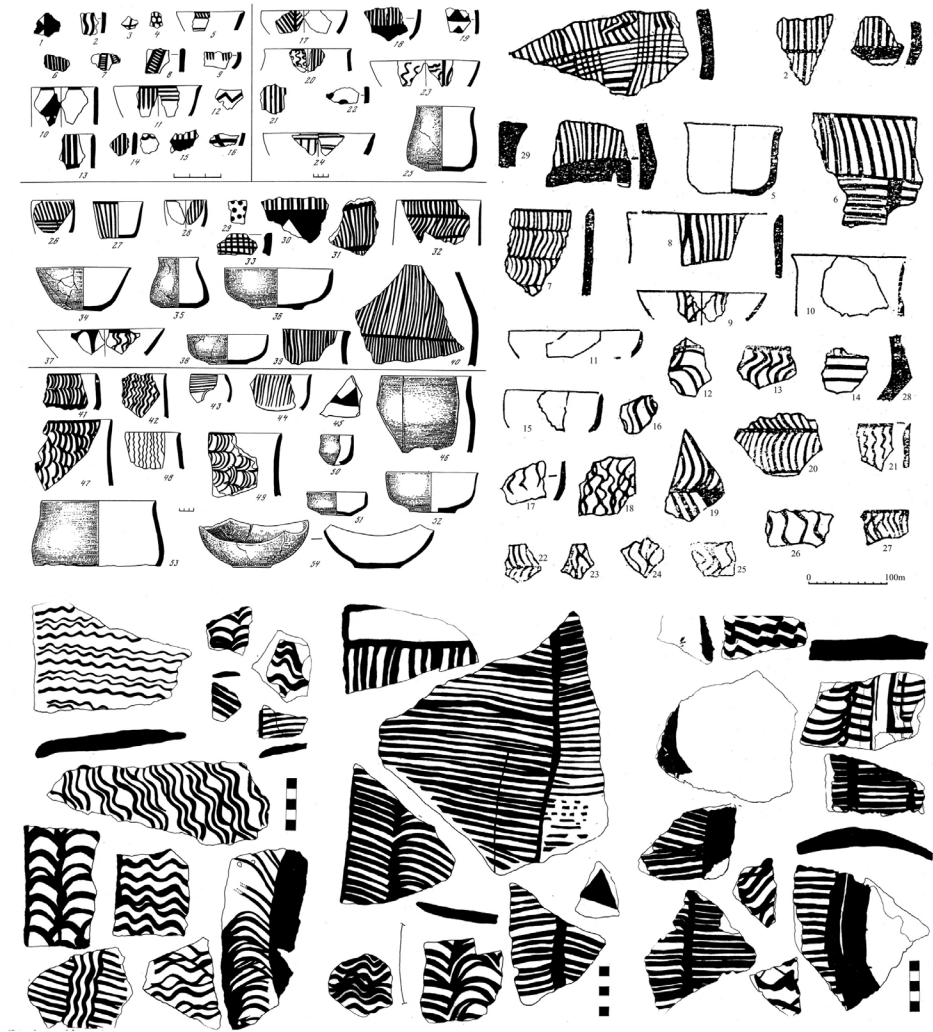


Figure 6: Djeitun Potteries from Southern Turkmenistan (After: Coolidge 2005)



Figure 7: Coloured photos of Djeitun type Sherds (Photography by S.K. Asadi Ojaei and Ian Cartwright): A and D) the shady motif-Djeitun; B) the parallel lines on the body-Pessedjik; C) the parallel lines on the rim-Djeitun; E) mixed horizontal parallel lines and vertical wavy liens-Djeitun; F) freehand drawing-Djeitun.



Figure. 8: Djeitun Type Sherds from Northeastern Iran Sites: **A** and **D**) Tappeh Pookerdvall (After: Zeyghami 2009); **B**) Aq Tappeh (After: Rezvani and Roustaei 2016); **C**) Yarim Tappeh (After: Stronach 1972); **E** and **G**) Sang-e Chakhmaq (After: Masuda 1974; Roustaei et al. 2015); **F**) Deh Kheir (After: Rezvani and Roustaei 2016); **H**) Tappeh Yell Vaz, **I**) Tappeh Dik Seyyed (After: Rezaei 2015)

phase	western zone	central zone	eastern zone

Figure. 9: Djeitun Culture Motifs by Phases (After: Coolidge 2005)

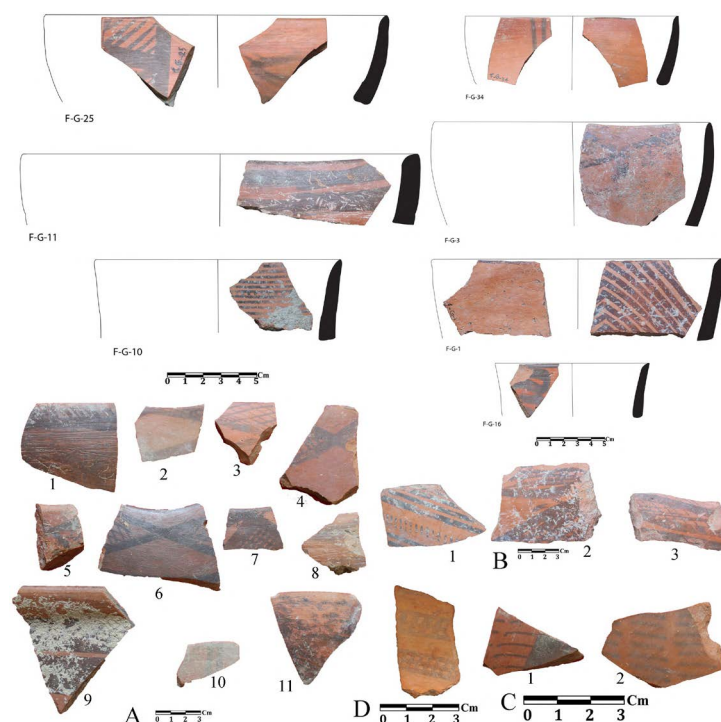


Figure 10: Transitional Chalcolithic (black-on-red) Potteries from Tappeh Fakhi.
(After: Asadi Ojaei 2023)



Figure 11: Late Neolithic and Transitional Chalcolithic Potteries from Other Sites:
A) Tappeh Sialk (After: Fazeli Nashli et al. 2013) B) Hotu Cave (After: Fazeli Nashli, 2021) C) Tappeh Rouyan (After: Roustaei 2023) D and E) Tappeh Pahlevan (After: Azazi Kharanaghi et al. 2016; Vahdati, 2010) F) Tappeh Sang Chakhmaq (field visiting by Asadi Ojaei)

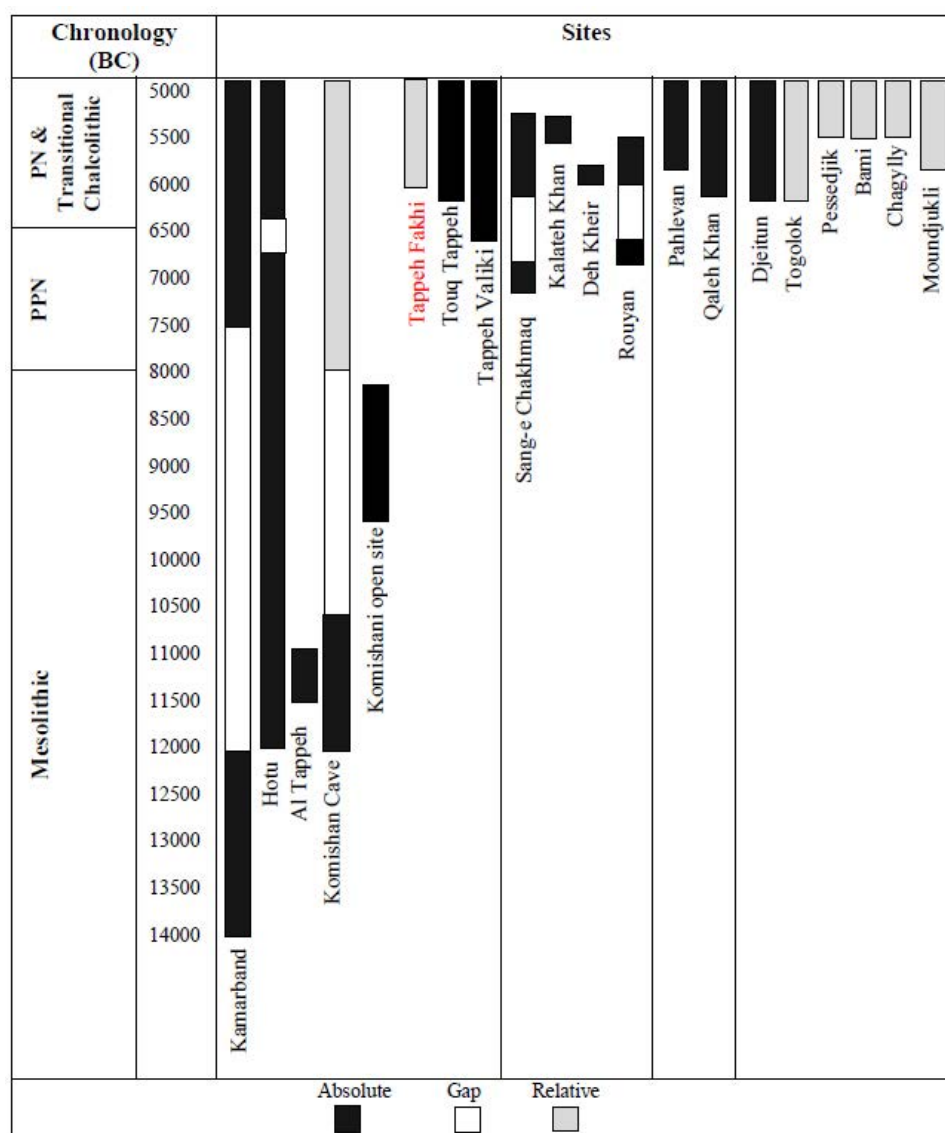


Figure 12: Chronology of Sites Mentioned in the Paper; Kamarband (After: Coon 1951); Hotu (After: Fazeli Nashli *et al.* 2024); Al Tappeh (After: Asadi Ojaei *et al.* 2024b); Komishan (After: Vahdati Nasab *et al.* 2011); Komishani open site (After: Leroy *et al.* 2019); Touq Tappeh and Tappeh Valiki (After: Abbasnejad Seresti *et al.* 2025); Sang-e Chakhmaq (After: Roustaei *et al.* 2015); Kalateh Khan (After: Roustaei 2016b); Deh Kheir (After: Rezvani and Roustaei 2016); Rouyan (After: Roustaei and Rezvani 2021); Pahlevan (After: Azizi Kharanaghi *et al.* 2016); Qaleh Khan (After: Garazhian *et al.* 2014); Djeitun (After: Harris 2010); Togolok, Pessedjik, Bami, Chagylly, Moundjukli (After: Coolidge 2005)

Discussion

Thus far, Eastern Mazandaran shows the earliest emergence of the PN (the CNS type) compared to other adjacent regions, dating back to the mid-7th millennium BCE (Abbasnejad Seresti *et al.* 2024). Pottery appears at Sang-e Chakhmaq around 6200 BCE and, slightly later, at Djeitun (Harris 2010). To date, there has been no clear connection between Eastern Mazandaran and the Djeitun culture, except

for a few limited sherds from the excavations at Touq Tappeh and Tappeh Valiki (Abbasnejad Seresti *et al.* 2025). However, the pottery assemblage from Tappeh Fakhi reveals connections to the middle and late Djeitun culture. The question arises regarding the pathway through which Djeitun pottery entered Eastern Mazandaran. According to the map (Figure.3), two potential routes can be identified. The first route follows the Southern slopes of the

Alborz Mountains, encompassing Central Southern Turkmenistan (Djeitun), the Khorasan region (Qaleh Khan and Pahlevan), the Shahroud and Bastam Plain (Sang-e Chakhmaq), and subsequently moving through mountain corridors to the Eastern Mazandaran. The 2021 field survey in the Eastern Mazandaran highlands, at sites such as Mosayeb Mahalle, Kiasar, Estarem, and Samchool, indicates that only the CNS potteries have been found (Asadi Ojaei *et al.* 2024a). The second route includes the northern slopes of Alborz, passing through Central Western Turkmenistan (Bami), the Gorgan Plain (Yellvose, Tiglek, Aq Tappeh, Yarim, Dik Seyyed, Tureng, Pookerdvall, Bandar Gaz, etc.), and ultimately reaching the Eastern Mazandaran.

Considering these two paths, the second appears to be the more probable route. However, the absence of absolute dating from Djeitun layers in Gorgan Plain prevents us from determining the exact date of the cultural connection between this region and Eastern Mazandaran. It is very difficult to determine the reasons for the connections between Southern Turkmenistan and the Gorgan-Eastern Mazandaran Plain, but one might speculate that population growth could be a contributing factor. The climate of the middle Holocene, ca. 8000-5000 BP, suggests warm and wet conditions, coinciding with the beginning of the 8.2k climate event and the establishment of Djeitun settlements. During the middle and late phases, Djeitun settlements increased in size, indicating population growth (Coolidge 2005; Harris 2010). In the Gorgan Plain, as well as the Shahrud and Bastam plains, the PN sites, more than 50 sites in each, appeared suddenly (Roustaei and Nokandeh 2017; Roustaei 2018). In Eastern Mazandaran, the number of sites also increased abruptly following a brief gap from the PPN period (Asadi Ojaei *et al.* 2024a). The growth and pressure of the population in Southern Turkmenistan may have contributed to the migration of Neolithic communities into the Gorgan-Eastern Mazandaran Plain in search of more land and resources. However, aside from Tappeh Fakhi, only Touq Tappeh and Tappeh Valiki have produced a limited amount of Djeitun-type pottery in excavations.

This issue may affect the emergence of domestication in these regions. A recent zooarchaeology study of Hotu Cave found no evidence of domesticated animals; however, the slaughtering pattern (including age and gender) suggests intense man-

agement of goats and sheep from the end of the 9th millennium BCE until the PPN. In the PN period, a decrease in the size of these animals was observed, which might indicate the arrival of human groups with smaller domesticated animals (de Groene *et al.* 2023). Additionally, there is a possibility of a local domestication process on the scale of low-level food production (Asadi Ojaei *et al.* 2024b). Research at the Komishani open site indicates management of plants and animals during the late Mesolithic and PPN periods (Leroy *et al.* 2019). Furthermore, de Groene and colleagues suggest that the small size of animal remains in the PN layer of Hotu may be the result of reduced sexual dimorphism due to domestication (de Groene *et al.* 2023). Regarding plants, domesticated wheat and barley from Touq Tappeh and Tappeh Valiki only appeared in context after 6200 BCE. There are also no signs of wild wheat species that would allow us to trace the domestication process from the PPN to PN periods. However, barley may have been domesticated locally as its ancestor (*Hordeum spontaneum*) has been found in botanical assemblages dating back to the Late Epipalaeolithic, PPN and PN (Asadi Ojaei 2025).

As previously mentioned, no Djeitun pottery has been found in Hotu and Kamarband caves, from both old and new excavations. Nevertheless, besides a few pottery sherds, comparisons of special finds from Touq Tappeh and Tappeh Valiki, such as small containers (Abbasnejad Seresti *et al.* 2022), spindle whorls, and clay objects, indicate connections between the Neolithic sites of Eastern Mazandaran and Djeitun culture (Abbasnejad Seresti *et al.* 2025), all belonging to contexts after 6200 BCE. Thus, it is possible that two different communities existed in Eastern Mazandaran during the PN period: one group living in caves without the need to domesticate species, and another group of Neolithic people who migrated from the Gorgan Plain and brought their domesticated species. The excavations at Touq Tappeh (Abbasnejad Seresti 2020) and Tappeh Valiki (Abbasnejad Seresti and Nemati Lujendi 2022), so far, have pointed to a PN presence in the plain, with no evidence of PPN, potentially indicating a demographic duality in the region. Based on the absolute dating and preliminary reports on the pottery assemblage, some sherds likely belong to the Djeitun type (Figure.13). All these sherds were recovered from layers dating to around 6000 BCE, including the so-called shady motif sherds

(Figure.13, A, D, E). Therefore, evidence suggests connections between the two regions, based on the pottery sherds, dating back to the late 7th millennium BCE. Future studies of faunal and botanical assemblages from these sites, along with excavations at Tappeh Fakhi (a Djeitun type site, Eastern Mazandaran), could significantly advance our understanding of issues such as inter-regional connections, Neolithisation processes, domestication, and food production in Eastern Mazandaran, located in the western part of the southeastern Caspian Sea.

Conclusion

The recent archaeological field survey of Neolithic sites in Eastern Mazandaran has provided a deeper understanding of the PN period in this region, such as increasing the number of Neolithic sites and elucidating connections between the lowlands and highlands. Another significant finding from the survey is Tappeh Fakhi, where all the sherds in the pottery assemblage belong to the Djeitun type, marking the farthest known reach of this culture. The survey results suggest that the Djeitun culture likely reached this area via the Gorgan Plain along the northern slopes of the Alborz Mountains, possibly linked to a population increase in the late 7th millennium BCE. Based on the surface pottery,

Tappeh Fakhi likely dates from the late 7th millennium BCE to the end of the 5th millennium BCE. It seems that two groups may have inhabited the Eastern Mazandaran region during the Late Neolithic period: local communities and migrants from southern Turkmenistan, who introduced the Neolithic lifestyle. However, there is also the possibility of a local Neolithisation process occurring. Several important questions remain: How does Tappeh Fakhi enhance our understanding of Neolithisation and the Neolithic lifestyle in the Eastern Mazandaran plain? Can dating Neolithic sites in the Gorgan plain help us strengthen the theory of a northern route from the Eastern Mazandaran (the CNS) to Southern Turkmenistan (the Djeitun)? Is the Djeitun culture the earliest archaeological period present at Tappeh Fakhi, or will excavation reveal even older periods? Future stratigraphic and horizontal excavations at Tappeh Fakhi could address critical questions regarding the timing and mechanisms of connections between West Central Asia and Northern Iran. Given that Tappeh Fakhi is the closest site associated with the Djeitun culture to the Neolithic sites in Eastern Mazandaran, we will need to obtain C14 dating samples. The animal and plant remains found are most likely already domesticated; thus, the strategies should be considered and compared

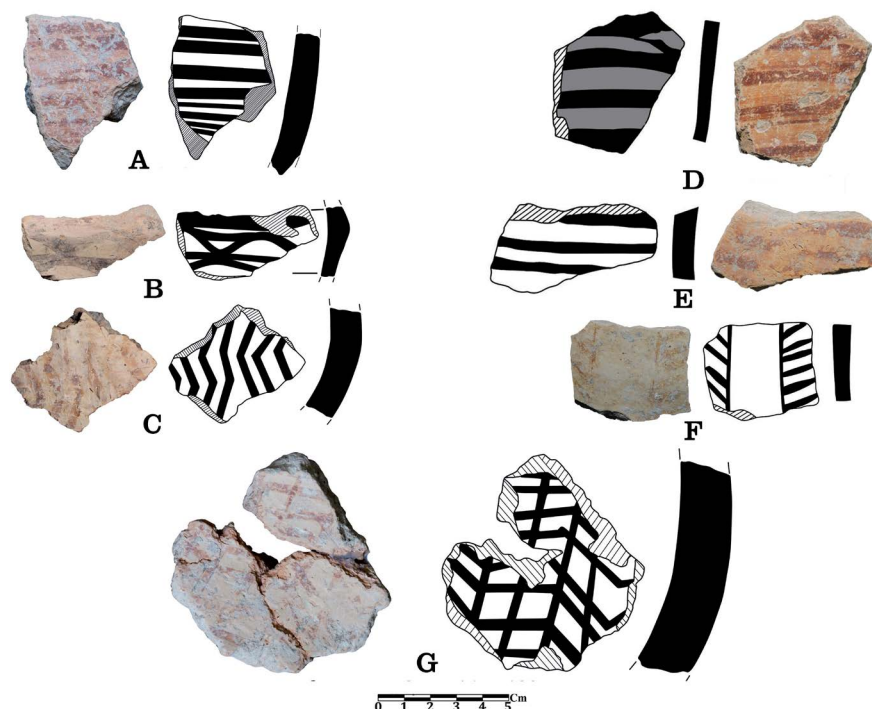


Figure. 13: Touq Tappeh (A, B, C, G); Tappeh Valiki (D, E, F) (After: Abbasnejad Seresti et al. 2024)

with both the Djeitun and the CNS cultures. Additionally, studying potteries from stratigraphic excavations will help us understand the sequence of the site's layers and the technology used in pottery manufacturing over time. Petrographic examinations of the potteries and comparing them to the potteries of both cultures will also be valuable. Therefore, for testing what we mentioned in the current paper, conducting stratigraphical excavation will be necessary to test the hypotheses presented in this paper.

Acknowledgment

Financial support for the field survey of Neolithic settlements in the eastern part of Mazandaran was provided by the University of Mazandaran and a research grant from the supervisor, Dr. Rahmat Abbasnejad Seresti. We appreciate the contribution of the relevant employees. We are also grateful to the Research Institute of Cultural Heritage and Tourism and the Research Institute of Archaeology for issuing the permission letter for this project. The unhesitating and sincere cooperation of the employees of the Cultural Heritage, Tourism, and Crafts Organisation of Mazandaran is sincerely appreciated. We like to express our deepest gratitude to Mike Charles and Ian Cartwright from the School of Archaeology at the University of Oxford for their assistance in accessing the Djeitun sherds assemblage. Also, thanks to Mr. Hossein Nemati Lojandi, Sirolah Ghasemi Gorji, Mohammad Abbasi, Omid Tousi, and Hadi Amirkhanlou, who helped us visit the sites. Lastly, special thanks go to Mrs. Soghra Ramzi for helping provide the map. Finally, the authors would like to express their sincere appreciation to the anonymous double-blind reviewers for their insightful comments and constructive suggestions, which significantly contributed to improving the clarity, methodological rigor, and overall quality of the manuscript.

References

- Abbasnejad Seresti, R. 2009. *Excavation Report of Tappeh Abbasi Khanehsar, Neka*. [In Persian]. Tehran: Iranian Center for Archaeological Research, Unpublished Report.
- Abbasnejad Seresti, R. 2020. *Excavation at the Neolithic site of Touq Tappeh-Neka*. [In Persian]. Tehran: Iranian Center for Archaeological Research, Unpublished Report.
- Abbasnejad Seresti, R; H. Nemati Lojendi. 2022. *Excavation at the Neolithic site of Tappeh Valiki, Neka*, [In Persian]. Tehran: Iranian Center for Archaeological Research, Unpublished Report.
- Abbasnejad Seresti, R; S. K. Asadi Ojaie; H. Nemati Loujandi. 2022. Tappeh Valiki: A Pottery Neolithic Site in the Neka Plain, Mazandaran, Iran. *Iranian Journal of Archaeological Studies* 12(1): 29-40. <https://doi.org/10.22111/ijas.2022.7492>
- Abbasnejad Seresti, R; S. K. Asadi Ojaie; X. Zhou & H. Kheiri Malakshah. 2024. Caspian Neolithic Software vs. Djeitun Pottery: New Absolute Dating from the Pottery Neolithic of Eastern Mazandaran. *Journal of Archaeological Studies* 16(2): 69-93. <https://doi.org/10.22059/jarcs.2024.382716.143299>
- Abbasnejad Seresti, R; X. Zhou & S. K. Asadi Ojaie. 2025. The Oldest Pottery Neolithic (PN) Culture of Northeastern Iran: First Absolute Dating from Eastern Mazandaran Plains. *PLoS One* 20(6): e0322478. <https://doi.org/10.1371/journal.pone.0322478>
- Asadi Ojaie, S. K. 2023. *Archaeological Field Survey of Neolithic Settlements in Highlands and Lowlands of Eastern Mazandaran*. [In Persian]. Tehran: Iranian Center for Archaeological Research, Unpublished Report.
- Asadi Ojaie, S. K; R. Abbasnejad Seresti; R. Matthews & C. P. Thornton. 2024a. New Evidence of the Pottery Neolithic in the Eastern Mazandaran Based on Recent Archaeological Field Survey. *Pazhoheshha-ye Bastanshenasi Iran* 14(41): 41-67. <https://doi.org/10.22084/nb.2023.28212.2619>
- Asadi Ojaie, S. K; R. Abbasnejad Seresti; C. P. Thornton & R. Matthews. 2024b. A Reflection on Neolithization in the Plains of Behshahr and Neka in Eastern Mazandaran, Iran. *Journal of Archaeological Research in Asia* 39(20): 1-17. <https://doi.org/10.1016/j.ara.2024.100522>
- Asadi Ojaie, S. K. 2025. *The Study of Food Production and Neolithization in Behshahr and Neka Plains in the South-eastern Littoral of the Caspian Sea, Iran*. Dissertation for PhD. University of Mazandaran.

- Azizi Kharanaghi, M. H; J. Thomalsky; M. Khani poor; M.J.Jafari. 2016. Archaeological Research at Tappeh Pahlavan, North Khorasan Province (Northeastern Iran). *Ancient Near Eastern Studies* 53(1): 59-73. <https://doi.org/10.2143/ANES.53.0.3154561>
- Coolidge, J. 2005. *Southern Turkmenistan in the Neolithic, a Petrographic Case Study*. BAR International Series 1423. Oxford: BAR Publishing. <https://doi.org/10.30861/9781841718620>
- Coon, S. C. 1951. *Cave Explorations in Iran 1949*. Philadelphia: the University Museum of Pennsylvania.
- de Groene, D; H. Fazeli Nashli & R. Matthews. 2023. The Epipalaeolithic–Neolithic Transition in Northeastern Iran: Zooarchaeological Evidence from the Southern Shores of the Caspian Sea. *Antiquity* 97(393): 541-556. <https://doi.org/10.15184/aqy.2023.37>.
- Deshayes, J. 1987. *Fouilles de Tureng Tepe* [Tureng Tepe Excavations]. Paris: Editions Recherche sur les Civilisations.
- Dyson Jr., R. H. 1991. Ceramics: Neolithic period Through Bronze Age in Northeastern and North-central Persia. *Encyclopedia Iranica* 5(3): 266–275.
- Dyson Jr, R. H & C. R. Thornton. 2009. Shir-i Shian and the Fifth-Millennium Sequence of Northern Iran, *Iran* 47(1): 1-22. <https://doi.org/10.1080/05786967.2009.11864756>
- ESRI. 2024. *ESRI Online GIS Resources*. Available at: <https://www.esri.com> (Accessed: 19 October 2024).
- Fazeli Nashli, H; R. Coningham; A. Marghussian; M. Manuel; H. Azizi Kharanagi & Mark Pollard. 2013. Mapping the Neolithic Occupation of the Kashan, Tehran, and Qazvin Plain. In R. Matthews, H. Fazeli Nashli (eds.), *The Neolithisation of Iran, The Formation of New Societies*. Oxford: Oxbow Books, 124–146. <https://doi.org/10.2307/j.ctvh1dp0q.14>
- Fazeli Nashli, H. 2021. *Stratigraphic Excavation of Hotu Cave* ,[In Persian]. Tehran: Iranian Center for Archaeological Research, Unpublished Report.
- Fazeli Nashli, H; M.Safari; R. Matthews;J. Thomalsky; J. Lentschke & M.Madihi.2024. Revisiting the Archaeological Stratigraphy of Hotu Cave, Iran: Preliminary Report of the 2021 Excavation. *Journal of Archaeological Studies* 16(2): 5-49. <https://doi.org/10.22059/jarcs.2025.388982.143332>
- Gregg, M & C.P.Thornton. 2012. A Preliminary Analysis of Prehistoric Pottery from Carleton Coon's Excavations of Hotu and Kamarband Caves in Northern Iran, Implications for Future Research into the Emergence of Village Life in Western Central Asia. *Intl. J. Humanities* 19 (3): 56-94.
- Garazhian, O; L.Papoli Yazdi; H.Fakhr Ghaemi. 2014. Qaleh Khan, a Site in Northern Khorassan and the Neolithic of North Eastern Iranian Plateau. *Archäologische Mitteilungen aus Iran und Turan*, Band 46(1): 21-50.
- Harris, D.R. 2010. *Origins of Agriculture in Western Central Asia, an Environmental-Archaeological Study*. Philadelphia :University of Pennsylvania Press. <https://doi.org/10.2307/j.ctt3fj6gz>
- Lamberg-Karlovsky C. C. 1973. Prehistoric Central Asia. *Antiquity* 47(185): 43-46. <https://doi.org/10.1017/S0003598X00034669>
- Leroy, S.A.G; A. Amini; M.W. Gregg;E. Marina va; R. Bendrey; Y. Zha; A. Naderi Beni; H. Fazeli Nashli. 2019. Human Responses to Environmental Change on the Southern Coastal Plain of the Caspian Sea during the Mesolithic and Neolithic periods. *Quaternary Science Reviews* 218(1): 343–364. <https://doi.org/10.1016/j.quascirev.2019.06.038>
- Malek Shahmirzadi, S & J. Nokandeh. 2000. *Aq Tappeh*,[In Persian]. Tehran: Iranian Center for Archaeological Research, Unpublished Report.

- Masuda, S. 1974. Excavations at Tappeh Sang-e Çagmaq, In F. Bagherzadeh, (ed.), *Proceedings of the 2nd Annual Symposium of Archaeological research in Iran, 1973*. Tehran: Iranian Center for Archaeological Research, 23–33.
- Masuda, S. 1976. Report of the Archaeological Investigations at Sahrud, 1975. In F. Bagherzadeh (ed.) *Proceedings of the 4th Annual Symposium on Archaeological Research in Iran*. Tehran: Iranian Center for Archaeological Research, 63–70.
- Masuda, S; T. Gote; T. Iwasaki; H. Kamuro; S. Furusato; J. Ikeda; A. Tagaya; M. Minami; A. Tsuneki. 2013. Tappeh Sang-e Chakhmaq, Investigation of a Neolithic Site in Northeastern Iran. In R. Matthews and H. Fazeli Nashali (eds.). *The Neolithization of Iran, the Formation of New Societies*. Oxford: Oxbow Books, 201-241. <https://doi.org/10.2307/j.ctvh1dp0q.18>
- Matson, F.R. 1951. Notes on the Composition and Manufacture of Sherds from Belt Cave, Appendix III. In C. S. Coon, (ed.), *Cave Explorations in Iran 1949*. Philadelphia: University of Pennsylvania Museum, 93-95.
- Masson VM. 1961. The First Farmers in Turkmenia. *Antiquity* 35 (139): 203-213. <https://doi.org/10.1017/S0003598X0003619X>
- Masson, V. M & V. Sarianidi. 1972. *Central Asia: Turkmenia Before the Achaemenids*. London: Thames and Hudson Ltd.
- Pumpelly, R. (ed.). 1908. *Explorations in Turkestan: Expedition of 1904. Prehistoric Civilizations of Anau: Origins, Growth, and Influence of Environment*. Washington DC: Carnegie Institution, Publication.
- Pichon F; I. Estevez JJ; P.C. Anderson; A. Tsuneki. 2023. Harvesting cereals at Tappeh Sang-e Chakhmaq and the introduction of farming in Northeastern Iran during the Neolithic. *PLoS ONE* 18(8): e0290537. <https://doi.org/10.1371/journal.pone.0290537>
- Rezvani, H & K. Roustaei. 2016. Preliminary Report on Two Seasons of Excavations at Tappeh Deh Kheir, Bastam Plain, Northeast Iran. In K. Rostaei & M. Mashkour (eds.). *In the Neolithic of Iranian Plateau, Recent Research*. Berlin, Ex Oriente, 15-52.
- Rezaei, H. 2015. *Diffusion of PN Settlements in Gorgan Plain, Case Study: Systematic Survey of Dik Seyyed Tepe in Gonbad-Kavous*. [In Persian], Unpublished MA Dissertation. Tehran: Islamic Azad University.
- Roustaei, K. 2009. *Preliminary Report on the Stratigraphic Soundings at Sang-e Chakhmaq Tappeh*, [In Persian]. Tehran: Iranian Center for Archaeological Research, Unpublished Report.
- Roustaei, K; M. Mashkour & M. Tengberg. 2015. Tappeh Sang-e Chakhmaq and the Beginning of the Neolithic in North-East Iran. *Antiquity* 89(345): 573-595. <https://doi.org/10.15184/aqy.2015.26>
- Roustaei, K. 2016a. An Emerging Picture of the Neolithic of Northeast Iran. *Iranica Antiqua* 51: 21-56. <http://dx.doi.org/10.2143/IA.51.0.3117827>
- Roustaei, K. 2016b. Kalateh Khan: A Sixth Millennium BCE Site in the Shahroud Plain, Northeast Iran. In K. Roustaei & M. Mashkour (eds.) *The Neolithic of the Iranian Plateau: Recent Research*. Berlin: ex Oriente, 53-84.
- Roustaei, K & J. Nokandeh. 2017. Neolithic Developments in the Gorgan Plain, South-East of the Caspian Sea. *Antiquity* 91(358): E3. <https://doi.org/10.15184/aqy.2017.124>
- Roustaei, K. 2018. Beyond the Mounds: Insights into a Late Sixth Millennium BCE Sherd Scatter Site in the Shahroud Plain, Northeast Iran. *Ancient Near Eastern Studies* 55: 143–82. <https://doi.org/10.2143/ANES.55.0.3284689>
- Roustaei, K & H. Rezvani. 2021. New Evidence of Two Transitions in the Neolithic Sequence of Northeastern Iran. *Near Eastern Archaeology* 84 (4): 252-261. <https://doi.org/10.1086/724784>

- Roustaei, K. 2023. A Unique Painted Sherd from the Mid-Sixth Millennium BCE Neolithic Context of Northeastern Iran. *Near Eastern Archaeology* 86(2): 92-101. <https://doi.org/10.1086/724784>
- Sarianidi, V. I. 1970. Drevnie Sviazi Iuzhnogo Turkmenistana i Severnogo Irana,[Ancient Connections Between Southern Turkmenistan and Northern Iran]. *Sovietskaia Arkheologia* 4(1): 19-32.
- Stronach, D. 1972. *Yarim Tepe, Excavation in Iran*. Oxford: The British Contribution.
- Thornton, C.P. 2013. Tappeh Sang-e Chakhmaq, a New Look. In R. Matthews & H. Fazeli Nashli (eds.), *The Neolithization of Iran, the Formation of New Societies*. Oxford: Oxbow Books, 241-256.
- Vahdati, A. A. 2010. Tepe Pahlavan: A Neolithic-Chalcolithic Site in the Jajarm Plain, North-Eastern Iran. *Iranica Antiqua* XLV: 7-30. <https://doi.org/10.2143/IA.45.0.2047117>
- Vahdati Nasab, H;M. Jayez; A.H. Nobari; F.K.Nadooshan; H. Ilkhani & A. Mahfroofi. 2011. Komishan Cave, Mazandaran, Iran: An Epipalaeolithic and later site on the southern Caspian Sea. *Antiquity* 85(328):112-118.
- Zeyghami, M. 2009. *Classification and Typology of Pookerdvall Neolithic Site Potsherds in Gorgan*. [In Persian], Unpublished MA Dissertation. Tehran: Islamic Azad University.