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CHALLENGES OF THE FARS NEOLITHIC CHRONOLOGY: AN APPRAISAL

Morteza Khanipour[1]* • Kamalaldin Niknami[1] • Masashi Abe[2]

[1]Department of Archaeology, University of Tehran, Iran
[2]Tokyo National Research Institute for Cultural Properties, Tokyo, Japan

ABSTRACT. Over the past few decades, several excavations that have been performed in the Fars Neolithic sites have resulted in the presentation of different chronologies for the region. Most of the research in Fars centered on the Kur River Basin (KRB). Fars has always had a different environment for the formation of different cultures over time, therefore, in order to reach a better understanding of the prehistoric cultures of the region it is necessary to make a brief review of the geographical zones of the plains and valleys of Fars province. Taking into account the existence of several questions and ambiguities regarding Neolithic Fars, the Hormangan site, located in the Bavant River Basin, was excavated. During the excavation, two settlement phases were identified that contained cultural materials relatively comparable to Tol-e Mushki, Tol-e Jari B, Kushk Hezar, and Rahmat Abad sequences. The goal of this paper is to explore the absolute chronology of the Hormangan site as well as other Neolithic sites located in the northern half of the Fars region with a special reference to the local cultural and technological sides of different Neolithic sites throughout the region. Bearing in mind the similarities of Bashi materials with Hormangan, Rahmat Abad, and Mushki regions and the absolute chronology of these regions, consideration of Bashi phase does not seem logical. Therefore, by comparing the cultural materials and absolute chronology done in other regions, a sequence chronology including Rahmat Abad (7500–7000 BC), formative Mushki (7000–6400 BC), Mushki (6400–6000 BC), Jari (6000–5600 BC), and Shams Abad (5600–5200 BC) for the Neolithic period of Fars can be presented. According to the excavation of Rahmatabad and Tal-e Sangi, it seems that Fars was inhabited in the middle of the 8th millennium BC and the Neolithic package entered this area, and there is no evidence of the Neolithization process. In the past, the Mushaki period was introduced as the oldest pottery Neolithic period, but with new excavations, it seems that the use of pottery had become common in Fars, as in many parts of Southwest Asia, around 7000 BC.

KEYWORDS: absolute chronology, Fars cultural basin, Hormangan site, Neolithic period.

INTRODUCTION

The number of Neolithic sites in the Fars region increased considerably during the pottery Neolithic period. How this pattern indicates the high capability of the pottery Neolithic period of Fars is not clear yet. Even though a definite path to the growth of indices of Neolithic settlement patterns in Fars during the 7th and 6th millennia BC has been recommended (Sumner 1990), which may indeed be true, for this period we cannot solely rely on the Kur River Basin (KRB) and its adjacent regions, but rather on the settlements that are also located in the valleys between mountains in Fars as well (Weeks et al. 2006), even though most of the known pottery Neolithic sites are located in KRB (Sumner 1977, 1990; Alden et al. 2004; Pollock et al. 2010). Until now, most archaeological studies and research conducted in the Fars region had focused on the KRB and Marvdasht plain in particular. Regarding the diversity of the Fars region environment, which is composed of various valleys and plains with different environmental characteristics, more comprehensive studies, as well as surveys and excavations in other regions, are required to present a more accurate analysis of the Neolithic period in Fars. The results of the studies conducted in the region demonstrate different Neolithic cultures in southern Fars. According to these studies, regions such as Fasa and Darab of the southern Qareagaj river basin had a different pottery culture from that of northern Fars. The present paper discusses the northern cultures of Fars, which are parallel to those of KRB.

Considering existing problems in the Fars cultural zone, an archaeological survey was conducted in the Bavnat river cultural area (Khanipour 2015), during which the

*Corresponding author. Email: khanipoor.m@ut.ac.ir.

Hormangan Neolithic site was discovered and selected for excavation (Khanipour 2016). Excavation of that site was important for several reasons: (1) it is a site outside the Marvdasht plain; (2) the site is located at an elevation of about 2360 m, making it the highest Neolithic site throughout the Fars region; and (3) the Hormangan and Mushki synchronization could contribute to clarify not only the chronology of Mushki itself but to the re-evaluation of the subsistence economy of the Neolithic in the region. In this paper, the existing challenges within the chronology of the Fars Neolithic period will be presented and then the results of the excavations in the Hormangan site, as well as the absolute chronology of the site, will be discussed.

Fars Neolithic Chronology Challenges

Taking into account the rather long history of Neolithic period studies in this site, there remain some unanswered questions, the most important of which is the problem of its chronology. The beginning of the Fars Neolithic period is not yet certain—and how, when and from where the inhabitants of the Fars Neolithic populations entered Fars is not fully clear yet, either (Alizadeh 2004a: 75). Before the Rahmat Abad excavations (Azizi Kharanaghi 2014), most scholars considered the Mushki period to be the oldest phase of the Fars Neolithic period, even though Vanden Berghe hints that it is probable for a number of the sites discovered in the survey to be related to the pre-pottery Neolithic period; even Sumner during his research did not discover any other pre-pottery Neolithic sites (Sumner 1972). Alizadeh also believes it is possible for an older period than Mushki to exist in Fars, however, based on his comparative study on the pottery specifications, he came to conclude that both the Mushki and Jari periods in the Fars Neolithic could be related to the contemporary or even the earlier cultures from central Zagros. Further, he emphasized the considerable similarities that have existed between the late Neolithic cultures of central Zagros such as Qale Rustam I and II and those from the Fras Neolithic sites such as Mushki, Jari, and especially the Kutahi site. By such an analogy between the material culture of two regions, he eventually pointed to a proposition explaining the possible origins for the Fars Neolithic developments. In the end, he viewed the most ancient pottery traditions of Mushki and Jari to have originated from the Shahr-e-Kord and Khanmirza regions somewhere in the Zagros mountainous areas (Alizadeh 2004a: 75–76). The chronological relations between the two cultural phases of Mushki and Jari have given rise to many arguments from the 1950s to the present (Vanden Berghe 1953–1954; Fukai et al. 1973; Egami et al. 1977; Sumner 1977; Maeda 1986; Alizadeh 2004a, 2004b). Vanden Berghe did not succeed in correctly separating the sequences of the two excavated phases of Tol-e-Mushki and Jari, however, he tentatively designated the Jari phase to have been older (Vanden Berghe 1951–1952: 212–213, 1953–1954). From the Japanese excavation in the lowest cultural levels of Tol-e Jari, many Mushki potteries were discovered (Egami 1967: 2939) but whether these potteries are associated with Jari's pottery is not yet clear. In any event, the excavators believe that the Mushki pottery style is older than that of Jari (Fukai et al. 1973: 77).

Sumner, in order to present conclusive evidence from both sites and also the distribution of the sites that he had explored during his surveys (Sumner 1977: 299), concluded that the Mushki phase is older than the Jari one. Moreover, in the TMB trench from Tol-e Mushki, pottery similar to Jari B and Tol-e Bashi was found, however, the chronological relationships between these types of pottery with that of the Mushki period are not fully clear. Based on inter-regional pottery evidence, Voigt and Dyson also believed that Mushki pottery is older (Voigt and Dyson 1992: 135–137). They suggest that Mushki is similar to Sialk (I3), while

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Jari, even no more pottery groups are available, is closer to Sialk (I4). Alizadeh commented that the pottery assemblages of Mushki and Jari show that although Mushki might be slightly older than Jari, and the two cultures evolved parallel to each other for some time before finally Jari replaced Mushki (Alizadeh 2004a: 76).

Following the excavations conducted by the Japanese team, the sequential precedence of Mushki against the Jari phase has been accepted by most archaeologists. Nevertheless, even though in his book *The Origins of State Organizations in Prehistoric Fars*, Alizadeh to a great extent argued about the Fars Neolithic chronology, in the chronological table represented, he maintained that Jari A and Bakun B1 seem to be much earlier so that they were coinciding with the Archaic Susiana 3 of Khuzistan and Archaic Plateau (lower Zagheh). He proposed a date of about 6000 BC for Jari A and Bakun B1 sequences, which have been followed by Jari B about 6000–5500 BC. In his statement, Mushki is assumed to have been contemporary with the early Susiana, the early middle Susiana of Khuzistan and the early plateau A-B (Sialk I and II), which lasted up to early 5000 BC (Alizadeh 2004a: 91, table 4). In the footnote of the table presented, he claimed that by his recent fieldwork (April and May 2005) in the Tol-e Mushki, Tol-e Jari A and B, and Tol-e Bakun A and B sites, he was able to bring about a complete change to the early sequences of prehistoric Fars. Thus, based on the foregoing statement, the oldest prehistoric layer was to be seen in Tol-e Bakun B (layer B1), and Tol-e Jari sites were subsequently followed by Jari B and Mushki phases, respectively. The chronological framework proposed by Alizadeh faced the Fars Neolithic chronology with a great challenge in such a way that it seems such propositions may ignore some obvious results of many years of excavations and research achieved from the Fars region. Nishiaki, to establish a Mushki-Jari-ShamsAbad chronology framework—before his recent ^{14}C analysis on the cultural materials of Tol-e Mushki—had suggested a date of about 6000–5400 BC for Mushki period, 5400–4900 BC for Jari, and 4900–4600 BC for Shams Abad (Nishiaki 2003: fig 3). Further, by considering the findings from the Kushk Hezar site, Alden and his colleagues suggested a date of ca. 6100–5600 BC for the Mushki period, ca. 5600–5000 BC for Jari, and ca. 5000 to nearly 4800 BC for Shams Abad (Alden et al. 2004: 27, fig 2). It seems that any effort for understanding the expansion of the Neolithic Fars cultures in the absence of absolute dating would remain hypothetical. One of the reasons for such problems concerns the lack or limited number of ^{14}C dates from the Mushki or Jari B sites. In addition, from the Jari B excavation project, only a preliminary report has been published (Egami 1967), which has led to the presentation of a variety of chronology tables separating the Mushki and Jari phases into different time units (Fukai et al. 1973; Hori 1989; Voigt and Dyson 1992; Alden et al. 2004; Nishiaki 2010a); luckily, during the past few years, cultural materials from these regions were reassessed by Nishiaki, and several examples of absolute chronology from the regions were presented by him (Nishiaki 2010a, 2010b). However, by the excavation of Tol-e Bashi, a new cultural phase by the name of Bashi, between the two phases of Mushki and Bashi, has been suggested (Bernbeck et al. 2004; Pollock et al. 2010), which leads to more complexity within the cultural/historical framework of this region.

In 2003, Tol-e Bashi was excavated by Abdi, Bernbeck, and Pollock where the excavators of this site believed that a phase could be added between the two phases of Mushki and Jari by the name of the Bashi phase (Pollock et al. 2010), which also added to the challenges of the Fars Neolithic chronology. Over the years, the Bashi phase has gone under review and evaluation by the researcher Nishiaki, in the analysis of cultural materials from Tol-e Mushki's TMB trench, while referring to the Bashi phase uses the term Bashi or TMB instead and declares that the

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Bashi phase, the phase named during the second sounding in Tol-e Mushki TMB (Maeda 1986), is considered the transitional stage between Mushki and Jari phases (Nishiaki 2010a: 5). By excavating the Rhmat Abad tepe, according to the pottery evidence and absolute dating, Azizi Kharanghi tried to compare evidence of Rahmat Abad with those of Bashi, Mushki, and Jari. He maintained that there is no strong evidence to prove the presence of the Bashi phase in Rahmat Abad layers and thus in his belief, the presentation of a special type or pattern of pottery in the cultural layers does not necessarily indicative of a new cultural phase.

On the basis of information available from Tol-e Mushki, Jari B, and Rahmat Abad sites, he eventually came to conclude that what we referred to as Beshi phase pottery is indeed a typical type of pottery with a special style and motif that has been commonly used by Mushki peoples. Moreover, this type was also represented by the same contexts of Mushki at the Rahmat Abad site (Azizi Kharanaghi et al. 2012b: 92). However, Weeks places the Bashi phase to have occurred between the two phases of Mushki and Jari (Weeks 2013). It is necessary to mention here that according to the excavations carried out in the various parts of the Fars region, the Jari phase was followed by Bakun B or shams Abad phase, about which there is not much information available and the only cultural characteristics known from which are the coarse and unpainted potteries found in the Tol-e Bakun B and Jari layers (Langsdorff and MacCown 1942: 23; Egami 1967; Alizadeh et al. 2004). Nevertheless, the absolute dates of the Shams Abad period and therefore the end of the Neolithic period in the Fars region remain to be determined.

Hormangan Site

Hormangan is located west of Jeshnian (UTM: 39 R 741396 3377711), the southern basin of Bavanat River, at 2364 m altitude (Figures 1 and 2). The site was discovered during archaeological surveys conducted in the Bavanat district by Khanipour (Khanipour 2015: 156). Hormangan extends north–south and its eastern parts were disturbed during agricultural activities. The first season of excavation took 45 days from March to April 2016. The most important goals were to understand settlement sequences, establish relative and absolute chronology, investigate regional interactions and interactions during settlement periods, investigate animal and vegetal remains in order to recognize regional subsistence patterns, fauna, and flora during every cultural period, find evidence of cultural and commercial exchanges relying on archaeological findings, and determine the function of the site during different settlement periods and political and social evolutions.

To determine the site extent, 1 × 1-m test trenches (14 total) were dug in the different parts of the mound, which was followed by digging 3 additional trenches, sized 8 × 8 m, 5 × 5 m, and 4 × 4 m. They were dug to 1-m depth, which resulted in recognizing cultural layers from the late 7th century. Test trenches, however, revealed that the Neolithic village of Hormangan might occupy an extent of about 0.5 hectare. This site was southwardly stretched and disturbed by the following agricultural activities (Khanipour 2016). Following excavation of Trench 1 and removing disturbing levels, traces of a wall consisting of several right-angled structures appeared (Figure 3). The walls were made of plastered chaff-tempered clay (piece). Continuing excavations revealed cultural sedimentation under the structure including several ovens, burnt soil, and ashes, less than 30 cm thick. Therefore, two settlement phases were identified. The earliest phase revealed no architectural remains, whereas ovens and ash indicated seasonal settlement, while the later phase included architectural remains and

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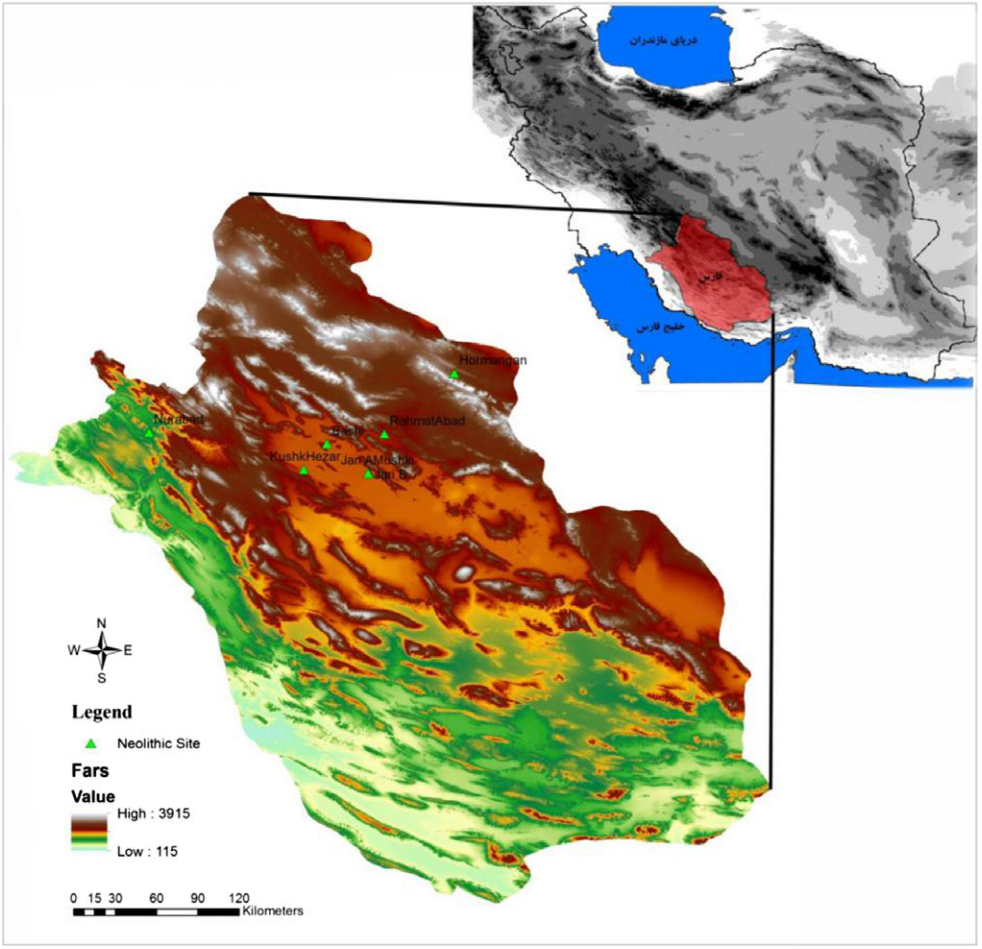

Figure 1 Map showing the location of Neolithic sites in Fars as discussed in the text (image by the author).

Figure 2 The Neolithic building structure of Hormangan in the excavated site (photo by the author).

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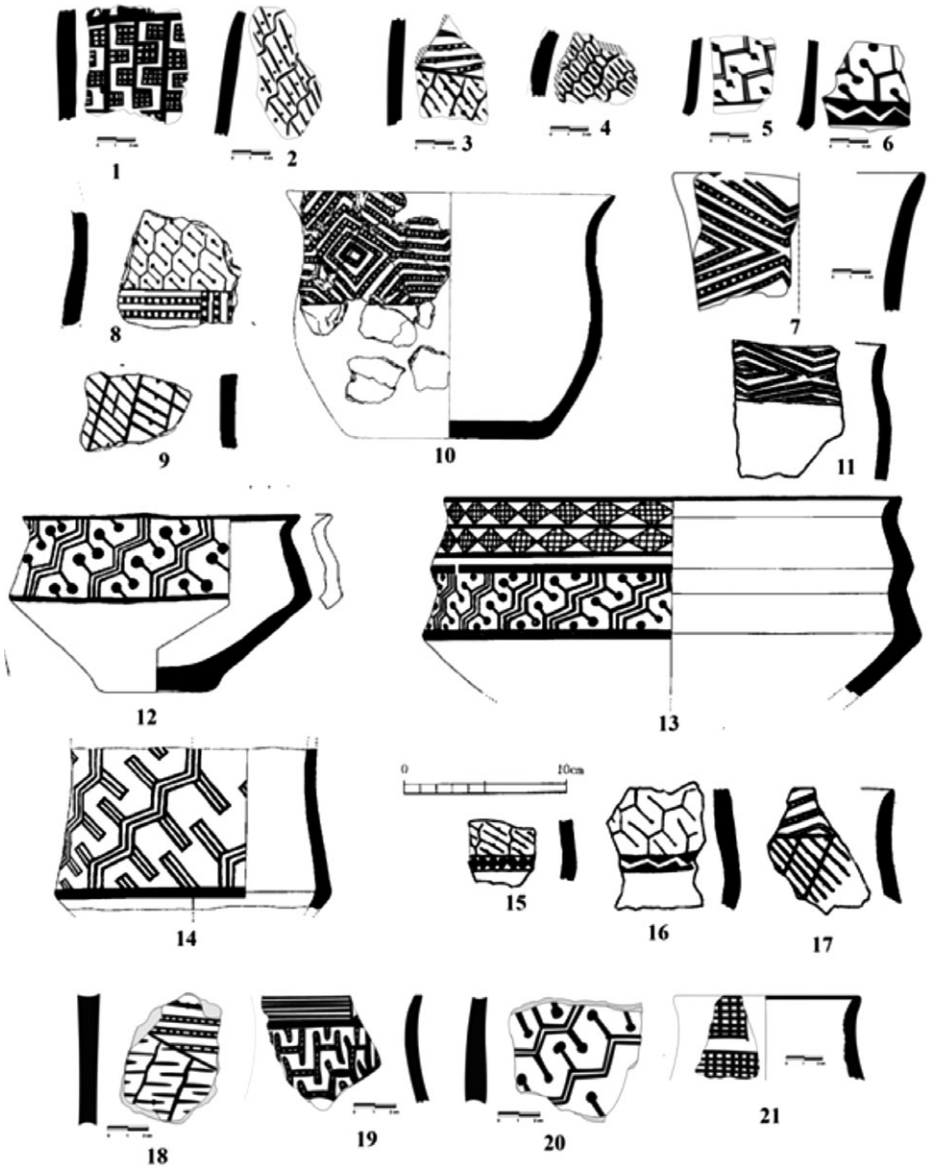

Figure 3 Painted Neolithic Potteries found at the following sites: 1–7 Hormangan, 8–10 Tol-e Bashi (after Bernbeck 2010: 150), 11–17 Tol-e Mushki (after Fukai et al. 1973, PL: XLVII; Maeda 1986, Fig. 8), 18–21 RahmatAbad Tape (after Azizi Kharanaghi et al. 2012b, fig. 12).

indicated a sedimentary lifestyle and permanent settlement. Excavations at Trench 2, after removing the surficial layer, revealed traces of walls including several spaces. Following excavations at Trench 3, there appeared a burnt structure, on which surfaces boiled, agglomerated, and became green under heating. There was a layer of red soil, because of heating, under the former level.

During excavation of the Hormangan site, efforts focused on gathering charcoal from different layers for ^{14}C absolute dating. The sampling method aimed to avoid hand contact with dating

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Table 1 A simplified version of ^{14}C dates for Hormangan site.

Site	Lab no.	Trench	Context	Cal date (yr BP ±1 σ)	^{14}C date (yr BP ±1 σ)	Cal BC (2 σ)	Material
Hormangan	PLD-32545	1	1038	7421 ± 25	7420 ± 25	6373–6236 cal BC (95.4%)	Charcoal
	PLD-32546	1	1015	7208 ± 24	7210 ± 25	6108–6011 cal BC (93.2%)	Charcoal
	PLD-32547	2	2034	7255 ± 27	7255 ± 25	6212–6060 cal BC (95.4%)	Charcoal
	PLD-32548	2	2028	7244 ± 25	7245 ± 25	6211–6051 cal BC (95.4%)	Charcoal
	PLD-32549	3	3008	7209 ± 25	7210 ± 25	6110–6011 cal BC (91.1%)	Charcoal
	PLD-32550	3	3006	7202 ± 25	7200 ± 25	6106–6007 cal BC (94.6%)	Charcoal
	PLD-32551	1	1020	6964 ± 24	6965 ± 25	5966–5956 cal BC (1.6%) 5905–5756 cal BC (93.8%)	Bone
	PLD-32552	2	2006	7166 ± 28	7165 ± 30	6071–5995 cal BC (95.4%)	Charcoal

materials. The samples were meticulously put inside aluminum foils using scourge to avoid contact with hands, smoke, or exposure to light.

A total of 24 samples were taken from different trenches and layers, among which 7 coal samples and 1 animal bone sample were sent to the Paleo Labo in Japan for ^{14}C dating (Table 1). According to the results, 1 coal sample from an early phase showed a date of about 6373–6236 BC and 6 coal samples that were taken from a late phase show a date between 6000 and 6200 BC, however, the only bone sample that was tested showed to be slightly later than the other samples. According to the survey and excavation results, it can be concluded that the Hormangan region had been occupied seasonally at about 6350 BC, and then after 6200 BC it had been occupied permanently by inhabitants with the same culture, and also considering the ^{14}C dating results, it showed that the furnace found from Trench 3 had been used simultaneously with the late Hormangan phase (Khanipour and Niknami 2017).

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Fars Neolithic Chronology Evaluation Based on Absolute Dating

As explained, up until recent years, the beginning of the Fars Neolithic period was subject to various discussions and opinions. Recent excavations by Azizi Kharanaghi at the two sites of Rahmat Abad (Azizi Kharanaghi et al. 2012b, 2013; Azizi Kharanaghi and Khanipour 2014) and Qasr e Ahmad Kavaar (Azizi Kharanaghi et al. 2012a) revealed some evidence from pre-pottery Neolithic and also the early pottery Neolithic in Fars. According to the excavations, it was revealed that at about the middle of the 8th millennium BC, Fars was inhabited by people with the rudimentary agronomical—and more probably with an early herding subsistence economy. For the Fars region, the pre-pottery has been introduced as the Rahmat Abad phase since on the basis of absolute dating data derived from Rahmat Abad, Azizi Kharanaghi proposed date of ca. 7450 to ca. 7000 BC for the earliest phase of Rahmat Abad Tape (Azizi Kharanaghi et al. 2013, 2014; Azizi Kharanaghi 2014; Azizi Kharanaghi and Khanipour 2014). After that, the early phase of Rahmat Abad data was manipulated to have been as the commencing period of Neolithization in the entire Fars region. Soon after, it became a criticism against the previous belief that regarded the Mushki pottery as the oldest in the Kur River Basin of the Fars region.

Through excavations at Rahmat Abad, it became clear that before the Mushki period, people from Rahmat Abad had achieved and used pottery-making techniques for several centuries, a period which came to be known as the Mushki formation phase, a term that has been proposed by some archaeologists based on stratigraphy evidence, pottery characteristics, as well as ^{14}C dating and most importantly the Mushki formation phase sequentially, was to be seen before the Mushki period consequently can be regarded as the first stages of pottery production in the pottery Neolithic of Fars region. Since there is no a considerable cultural gap between the Mushki formation phase and the Mushki phase itself, which has been located immediately above it thus it can be possible to conclude that the Mushki pottery has been continued from the early Neolithic culture known here as the formative Mushki. In summary, archaeological and ^{14}C data from Rahmat Abad as well as other well-known Neolithic sites from the Fars region (Alizadeh 2006: 121; Mashkour et al. 2006: 121; Nishiaki 2010a: 8) would suggest a period of about 7000–6400 BC for the duration of the Mushki formation phase located within the Rahmat Abad cultural sequences (Azizi Kharanaghi and Khanipour 2014: 74).

In the Fars region for the pottery Neolithic period, there has been a small number of sites with absolute dating. The second half of the 7th millennium BC has been introduced as the Mushki period in Fars. Alizadeh evaluated four samples from Tol-e Mushki in two laboratories and on the basis of an accurate stratification he proposed a chronological sequence for the Mushki site. In his statement Mushki has witnessed the successive occupations from the lowermost 22nd layer (ca. 6235–6063 BC), the 17th layer (ca. 6180–6000 BC), the 12th layer (ca. 6210–6020 BC), and Jari B (ca. 5970–6060 BC), respectively (Alizadeh 2006: 120–121, table: 9–10). A few years later, Nishiaki reexamined the Mushki data in order to acquire absolute dating. He assigned the first inhabitants of Mushki (from 1st to the 4th layer) to have occupied the site around 6400–5981 BC. He also proposed date of about 5730–6177 for the Jari B period. (Nishiaki 2010a: 5). He assessed the data provided by the Japanese team through their excavation in Mushki during 1950–1960. By examining 11 bone and charcoal samples he proposed an absolute date of ca. 6050–6350 BC for the Mushki settlements (Nishiaki 2010a: 8; see Table 2). For Neolithic dating purposes, was another pioneering fieldwork carried out at Tol-e Bashi by Bernbeck, who located the site to have been settled in the

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Table 2 ^{14}C dating for sites Tol-e Jari B and Mushki (Nishiaki 2010a: 5).

Site	Level	Date (2 σ) years BP	Lab no.	OxCal v4.1.3 cal BC	Bayesian analysis cal BC	Context	Material	Ref.
Jari B	Level 1	6867 ± 50	AA-56413	5931–5618	5977–5721	AIII, Layer 1-2	Animal bone	1
	Level 1	6939 ± 72	AA-56412	6075–5610	5979–5730	C, Layer 2	Animal bone	1
	Level 4	7127 ± 69	AA-56415	6254–5722	6076–5915	WT, Layer2, RI fill	Animal bone	1
	Level 4	7259 ± 74	AA-56411	6428–5873	6096–5917*	AIII, Layer 5, R7-fill	Animal bone	1
	Level 8	7173 ± 71	AA-56410	6270–5750	6177–6008	WT, Layer 6, R5a	Animal bone	1
	—	7140 ± 40	Beta-207565	6060–5970		–1.65 m below surface	Charred seeds	2
	—	7297 ± 45	AA-56411	6235–6063		ca. 50 cm above virgin soil	Charred seeds	2
Mushki	Level 1	7270 ± 50	TKa-13821	6438–5849	622–6082	MS-L12-lb (Room 8)	Charcoal	
	Level 2	7330 ± 35	TKa-13820	6251–6074	6261–6198	MS-L12-2bl	Charcoal	
	Level 2	7370 ± 35	TKa-13819	6371–6097	6263–6211	MS-LI2-2al/2/3	Charcoal	
	Level 2	7425 ± 35	TK.a-13817	6389–6231	6271–6217	MS-LI1 2al	Charcoal	
	Level 3	7347 ± 71	AA-56409	6464–5981	6331–6241	V1S-K 11 -3a	Animal bone	1
	Level 3	7410 ± 35	TKa-13814	6382–6225	6331–6241	MS-K.11-3	Charcoal	
	Level 3	7420 ± 40	TKa-13816	6394–6226	6331–6241	V154-K 12-3a	Charcoal	
	Level 3	7455 ± 35	TKa-13815	6411–6242	6332–6242	MS-K.11-3	Charcoal	
	Level 4	7370 ± 30	TKa-13818	6367–6099	6377–6278*	MS-L1I-4	Charcoal	
	Level 3	7270 ± 80	TK-571	—	—	MS-L12-3a	Charcoal	
	—	7220 ± 40	Beta-207563	6180–6000	—	Burnt surface	Charred seeds	2
	—	7250 ± 40	Beta-210984	6210–6020	—	Occupational debris	Charred seeds	2
	—	7707 ± 76	AA-63493	—	—	Above virgin soil	Charcoal	2

transitional stage between Mushik and Jari (Bernbeck et al. 2004: 76–78). Two samples collected from the 6th layer of this site dated it to 4800–4500 BC, while tree samples from the 5th layer indicated a date of about 6230–5720 BC for the layer 5 depositions. The same procedure was also applied the 4th layer by taking four samples, which showed a date of 6160–5730 BC, and another extra sample from that layer proposed a date of 5720–5530 BC. Moreover, two samples taken from the 1st layer are about a thousand years apart (Table 3; Pollock et al. 2010: 263).

It should be mentioned here that through this research the Jari phase at Tol-e Bashi, known as the final phase Neolithic Fars, was dated to ca. 6050–5800 BC (Nishiaki 2010a: 8). Tol-e Nur Abad (phases A27 to A20) is a Neolithic site in the Fars region that witnessed ^{14}C dating by taking six charcoal samples. Although the excavator gave a date between 5990–5320 to samples of this site and assigned the lowermost samples to be comparable with Muski, further analysis proved that samples from Tol-e Nur Abad were synonymous with Jari (Potts and Rustaei 2006: 68 table 4). Although there have been some Neolithic sites in the Fars region such as were subjected to excavations and data collection for ^{14}C datings such as Tol-e_Mian Ruod

Table 3 ^{14}C dating for sites Tol-e Bashi (Pollock 2010a: 262) and Tol-e Nur Abad (Potts and Rustaei 2006: 68).

Site	Lab code	Provenience	Level/ phase	Lab determination (BP)	Calibrated date (BCE) (2σ)
Bashi	AA56341	Unit A Loc. 74	I	6028 ± 44	5040–4780
	AA5633B	Unit A Loc. 49	I	7037 ± 46	6010–5790
	AA56342	Unit B Loc. 24	III	6702 ± 39	5720–5530
	AAS6343	Unit D Loc. 17	IV	6977 ± 43	5980–5730
	AA56353	Unit D Loc. 13	IV	7082 ± 39	6020–5840
	AA56340	Unit C Loc. 40	IV	7123 ± 49	6160–5840
	AAS6355	Unit D Loc. 11	IV	7157 ± 42	6160–5910
	AA56339	Unit C Loc. 71	V	6949 ± 47	5980–5720
	AA56354	Unit C Loc. 54	V	7132 ± 40	6160–5890
	AA56351	Unite: Loc. 61	V	7283 ± 43	6230–6020
	AA56352	Unit C Loc. 68	VI	5830 ± 42	4800–4550
	AA58025	Unit C Loc. 70	VI	5837 ± 40	4800–4550
Nur Abad	WK13989	Loc. 174	A27	6488 ± 54	5610–5590 (.012) 5560–5320 (.942)
	WK13990	Loc. 170	A26	6977 ± 56	5990–5940 (.125) 5930–5720 (.829)
	OZI128	Loc. 167	A25	6950 ± 50	5980–5940 (.062) 5920–5730 (.892)
	WK13991	Loc. 163	A24b	6952 ± 61	5990–5940 (.079) 5930–5720 (.875)
	WK13992	Loc. 147	A23	6938 ± 54	5980–5950 (.038) 5920–5710 (.916)
	WK13993	Loc. 123	A20	6810 ± 56	5800–5620 (.954)
	WK13994	Loc. 117	A19	5850 ± 49	4840–4820 (.017) 4810–4580 (.915) 4570–4550 (.022)
	OZI129	Loc. 113	A19	5910 ± 50	4940–4680 (.954)

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(Ebrahimi et al. 2014) and Tol-e Qasre Ahmad Kavaar (Azizi Kharanaghi et al. 2012a) but nothing reported yet to be considered here (Figure 4).

As discussed previously, there are some major problems regarding the Fars Neolithic absolute chronology that require more rigorous studies. At the first stage of the study, comparative studies should be made to assess in situ relative chronological order cultural materials explored from the different Neolithic sites of Kur River Basin areas through which comparing the physical morphology and diagnostic characteristics of finds may well help to place them in their exact order. At the same time, an attempt is necessary to conduct a study on the absolute datings of the same Neolithic sites especially from the Hormangan to enable researchers to solve the chronological complexities and eventually the problems of the Fars Neolithic. For this, it is reasonable to say that the close similarities of cultural materials observed between Hormangan site and those from Tol-e Mushki and also absolute chronologies between them may lead to the conclusion that the Mushki period should be considered older than the Jari period. The result appears to be confronted with what Alizadeh previously commented (Alizadeh 2004a: 91).

Furthermore, potteries found from Hormangan are fully comparable to the same finds in terms of shape, pattern, production, and baking quality from Tol-e-Mushki, Tol-e-Bashi, and the 8th layer of Tol-e-Jari B and the latest Neolithic layers of Rahmat Abad sites (Figure 3). In summary, Azizi Kharanaghi and his colleagues have correctly pointed out (Azizi Kharanaghi et al. 2012b: 92) while most of the patterns and other characteristics of potteries were similar, the presence or absence of a specific pattern cannot imply new or different phases.

Also, according to ^{14}C dating, pottery motifs known as Bashi phase were in use by the inhabitants of the two phases of the Hormangan site, and as the ^{14}C dating showed, these types of pottery were used in the Hormangan (simultaneous with Mushki phase) from about 6350 BC as well as by the Bashi peoples in 6100–6000 BC.

To establish accurate relative chronological sequences for the Neolithic Fars there has been evidence playing an important role in the ordering structures rater than the pottery themselves. This evidence includes many stone tools discovered from different Neolithic sites. The stone tools obtained from the Horamngan, Mushki, and Bashi sites would be indicative of close similarities to each other, whereas stone tools from those sites were quite different in some character in terms of raw material used and technology applied from their early and even from their subsequent sequences. At these three sites, geometric microblade tools made from fine cherts and shaped mainly in the trapeze (broad geometrics) and lunate (narrow geometrics) forms were dominantly visible (Fukai et al. 1973; Hori 1989; Ghasidian et al. 2010; Nishiaki 2013). While the Jari B site produced only trapeze-shaped blades. Hori has emphasized that the broad geometric microblades tool type from Jari B is smaller than from that of Mushki tools and suggests that this might be part of the process by which the sizes of tools are being minimized intentionally (Hori 1989). The stone tool industries of Hormangan and Mushki to some extent may be viewed to be in accordance with the the late Moallafat in Mesopotamia. However, the modified types of this particular lithic industry are seen from the post-Moallafat period at the beginning of the early 6th millennium BC through which utilization of the bullet-shaped cors by impressed percussion techniques for blade production and producing backed bladelets were considerably reduced.

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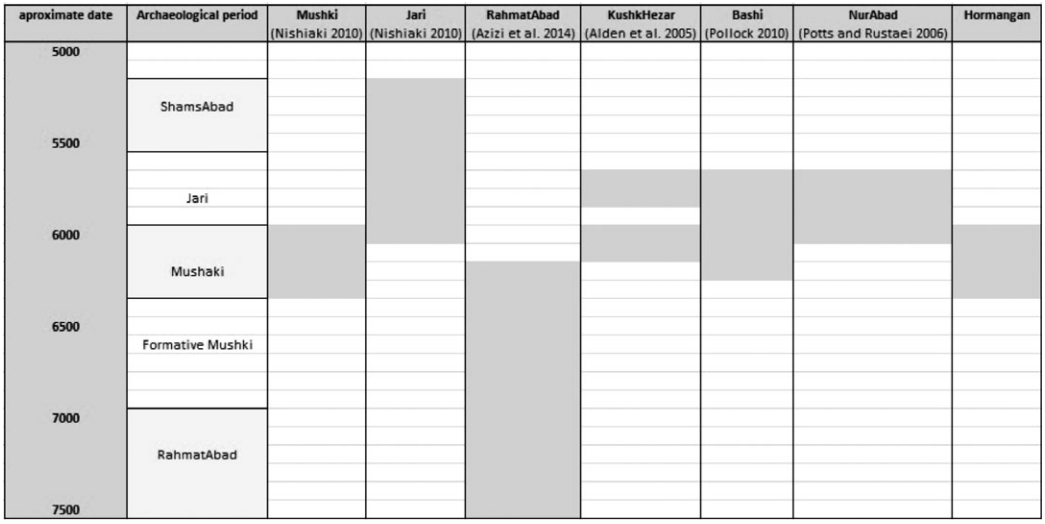

Figure 4 Chronological framework of the Neolithic period proposed for the Fars region (by author).

To this end, the geometric tools also became uncommon so that all types showed a rather simple form; probably reflecting a change in the methods of arrowhead production (Abe 2011).

What most characterizes Hormangan, Bashi (Pollock 2010b), and Mushki (Fukai et al. 1973) from the other Neolithic sites is the presence of many small stone-clay objects (Figure 5). Many debates have centered around their usage until recently. However, the abundance of these objects is extremely limited among the Neolithic sites during the second half of the 7th millennium BC. To conclude, objects of this kind discovered from Hormaigan, Bashi, and Mushki sites represent a typologically similar pattern, which allows us to draw inferences that these three sites may account for having simultaneous cultural identity, as ^{14}C datings from the Hormangan site also indicate time overlaps between the absolute chronological sequences of the Hormangan with the Mushki and Bashi sites.

Pre-Pottery Neolithic Period at Fars

Over the past few decades, there have been many studies on the transition from the Paleolithic to the Neolithic in the Near East (Braidwood 1960, 1961; Flannery 1965; Binford 1968; Hole 1984; McCorriston and Hole 1991; Zeder 2009, 2010). Over the last two decades, excavation at sites such as Sheikh-e Abad (Matthews et al. 2013), Chogha Golan (Riehl et al. 2013), and east Chia sabz (Darabi et al. 2011, 2013; Darabi 2015) has provided valuable information about the transition of societies to food production and the emergence of sedentary groups. Based on this, it has been determined that the initial stage of this transition in Iran should be found in central Zagros and other regions such as Dehloran, Khuzestan, and Fars lowland plains have been inhabited in the next stage, i.e. the second half of the 8th millennium BC, so that the first settlements such as Chogha bonut (Alizadeh 2003) in Shushan, Ali Kosh in Dehloran (Hole et al. 1969: 29; Hole and Flannery 1962; Hole 2000; Darabi et al. 2017), Mahtaj site in Behbahan (Darabi 2016), RahmatAbad (Azizi Kharanaghi et al. 2013), and Tol-e Sangi

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Figure 5 Clay and stone objects from the Neolithic site of Fars: 1–10 from Hormangan, 11–19 from Tol-e Bashi (after Javari et al. 2010, Figure 10.1; Pollock 2010b, figs. 9.1–3), 20–27 from Tol-e Mushki (after Fukai et al. 1973, PL: XXXVIII–XXXIX), 28–30 from RahmatAbad Tape (after Azizi Kharanaghi et al. 2012b, fig. 13).

(Khanipour 2019) have been formed in the Polvar River Basin and Tol-e Qasr Ahmad (Azizi Kharanaghi et al. 2012a) in the Qara Aghaj River Basin in Fars Province.

Recent excavations of Azizi Kharanaghi in the two tell sites of Rahmat Abad (Azizi Kharanaghi et al. 2012b, 2013; Azizi Kharanaghi and Khanipour 2014) and Qasr-e Ahmad of Kavar (Azizi Kharanaghi et al. 2012a) and Tol-e Sangi (excavation by one of the authors) revealed evidence of the pre-pottery Neolithic period in Fars. As a result of the excavations, it was discovered that around the middle of the 8th millennium, the population of Fars depended upon agriculture for their subsistence; the pre-pottery Neolithic period was labeled the Rahmat Abad phase. According to absolute dating, this phase was determined to be in 7450–7000 BC. Primary results of the archaeobotanical study of Rahmat Abad led to some expectations: cereals (glume wheat, and to a lesser degree, barley) are recorded throughout the occupational sequence. Since the earliest pre-pottery Neolithic levels, spikelet remains are of the domestic-type (tear-off scar) and there is no sign of a local domestication process of either wheat or barley. It is therefore likely that crops arrived at the site in an already domesticated form as a result of diffusion from other sites or regions. This is consistent with the largely accepted opinion that agriculture first occurred in the central Zagros range before spreading to other parts of western Iran (Weeks 2013). Glume wheat species (einkorn and emmer) constitute the main agricultural production during all periods. Even though agriculture was part of the subsistence economy at Rahmat Abad since the pre-pottery Neolithic.

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According to recent excavations and available information, it seems that the process of Neolithization occurred in other areas and in the middle of the 8th millennium BC it entered Fars, although this view may change with the new excavations. Concerning the excavations carried out in Fars, there is a stratigraphic interruption and no connection between the Epipaleolithic and Neolithic sites. Also, in terms of chronology, there is a gap of more than a thousand years between the lower strata of RahmatAbad mound and Tol-e Sangi with the oldest pre-pottery Neolithic sites of central Zagros. Also the lack of any evidence of pre-domestication of goats or pre-domestication of grains in this area compared to such evidence in pre-pottery Neolithic sites in Southwest Asia such as goats in Sheikh-e Abad (Matthews et al. 2013), and Nevali Çori in the heights of Torus (Peters et al. 1999) and Ganj Darreh (Zeder and Hesse 2000) all indicate that the process of Neolithization in Fars was not internal. It seems that grains and animals were domesticated outside the Fars region and then entered the Fars region as a package. It is not clear at this time whether the spread of these domesticated Neolithic products was due to Demic Diffusion or the Cultural Diffusion in the area.

Emergence of Pottery in Fars and Iran

The invention of pottery signifies the beginning of genuine pyrotechnology, the most important technological innovation in human history. It is clear that these technological innovations went hand in hand with social advancement. Therefore, to provide a complete sketch of human history, we need to consider pottery's emergence as an initial technological advance (Tsuneki 2017a: 1). So far, a lot of research has been done on pottery's emergence, the results of which show the emergence of pottery in West Asia lagged a few millennia behind that of East Asia. Recent dates of ca. 16,000–15,800 cal BC are associated with sherds in the Yuchanyan Cave in southern China (Boaretto et al. 2009), southern Sahara, and the Nile Valley (e.g. Jesse 2003; Huysecom et al. 2009) provides another context in which pottery appeared earlier than in West Asia. In comparison to Europe at least, pottery appeared at a relatively early date in West Asia (Campbell 2017: 133). There are many debates about the earliest pottery in West Asia. Some consensus has been reached that practical and stable pottery production started at the beginning of the Neolithic pottery, around 7000 cal, BC in West Asia (Le Mière and Picon 1998; Aurenche et al. 2001; Campbell 2017). However, it is also true that "pottery" has been reported from many pre-pottery Neolithic sites (Cauvin 1974: Fig. 1; Smith and Crepeau 1983; Le Mière and Picon 1998: Fig. 3; Tsuneki 2017b). All of these artifacts, except those at Jericho, were discovered in the context of burnt layers, and we cannot confirm if they were originally unbaked or intentionally burnt clay vessels (Tsuneki 2017a: 3).

One of the most comprehensive studies about early pottery of Southwest Asia was conducted by Campbell. He analyzed the onset of the pottery Neolithic period based on 281 samples of absolute chronology analyzes from 13 sites (Campbell 2017: 133). Bernbeck also published a comprehensive article on the emergence of pottery in Iran (Bernbeck 2017). Prior to RahmatAbad excavations, the Mushki period pottery was known as the oldest pottery in the region. Alizadeh also maintains that it may be possible for an older period than Mushki to exist in Fars, however, based on his comparative study on the pottery specifications, he eventually came to conclude that both the Mushki and Jari periods in the Neolithic Fars could be related to the contemporary or earlier cultures originating from the central Zagros areas. At the end, he viewed the most ancient pottery traditions of Mushki and Jari to have originated from the Shahr-e-Kord and Khanmirza regions somewhere in

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the Zagros mountainous areas (Alizadeh 2004a: 75–76). Bernbeck also considered the widespread use of pottery in southern Zagros to be 500–1000 years after the initial use of pottery compared to other areas (Bernbeck 2017).

Pottery samples from the Rahmat Abad excavation (Azizi Kharanaghi and Khanipour 2014; Azizi Kharanaghi et al. 2013, 2014), Tol-e Sangi (Khanipour 2019) and the Polvar river basin seem to have been produced before Mushki, and they can be regarded as the earliest pottery production samples in Fars. On the top of the pre-pottery deposits in the both sites of Rahmat Abad and Tol-e Sangi, there have been so called red plain potteries were categorized as pre-Mushki style and dated back to 7000–6400 BCE (Azizi Kharanaghi et al. 2013, 2014). These sherds are almost red with clay slip on exterior side with vegetal tempers, whereas in Tol-e Sangi some sherds were painted (Figures 6 and 7). Tol-e Sangi, located in the Morghab plain, was excavated in 2019, the data from which revealed pre-pottery Neolithic and early pottery Neolithic period in the region (Khanipour 2019). Tol-e Sangi, with an area of about half a hectare and 5 m of Neolithic deposits, can be used as a key site for the transition from pre-pottery Neolithic to pottery Neolithic to determine many of the ambiguities of this period. Considering the fact that this site has been recently excavated, its absolute dating has not been determined yet, but by comparing its ceramics with Rahmat Abad and considering there is no gap between pre-pottery Neolithic and pottery Neolithic deposits in the stratigraphy sequence, probably the beginning of the pottery Neolithic in this site was about 7000 BC. Also in the Kerman region, the Gav Koshi site was excavated, although the ceramics of the new phase are comparable to the sites of Fars such as Qasr Ahmad, Kushk-e Hezar, and Hormangan, but its oldest deposits, which include the beginning of pottery Neolithic, except for one example, show a date between 7083 and 6653 BCE (Alidadi Soleimani and Fazeli 2018, Tab: 1). In central Zagros, the beginning of pottery Neolithic in Tappe Guran is about 7000 BC (Zeder 2006; Bernbeck 2017: 101–102). The datings of Ganj Dareh have been conducted by Zeder and Hesse (2000) and Housley (1994) as well as Hole (1987).

Figure 6 Emergence of pottery, Tol-e Sangi (photo by author).

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Figure 7 Stone tools, Tol-e Sangi (photo by author).

There is no date from Level S, the earliest with pottery, but there are dates from both Level T (the final aceramic level) and Level R. The boundary between the two, which might approximate to the start of ceramics, is 7124–7011 cal BC at 1 standard deviation. Nonetheless, it can be used to suggest Ali Kosh Pottery is present for the first time in the Mohammed Jaffar phase at Ali Kosh (Hole et al. 1969). There are 14 recent dates from Ali Kosh, all produced by Beta Analytic, with four of them from the Mohammed Jaffar phase (Zeder 2008).

Darabi's recent excavations in Ali Kosh and applying ^{14}C dating to two samples showed the beginning of Mohammad Jafar phase dated 7064–6902 BC and 7061–6823 BC (Darabi 2018). It seems that according to the excavations carried out in Rahmat abad, Tol-e Sangi, Gav koshi, and Ali Kosh, some areas of Iran such as Fars (Alizadeh 2004a: 75–76; Bernbeck 2017) and central Zagros (Mortensen, 1991; Darabi 2015) where the beginning of the pottery Neolithic is considered to be more recent, should be reviewed. dates for the beginning of the pottery Neolithic in each region fluctuate by several hundred years around 7000 cal BC. Although we estimate that these fluctuations are quite large, we cannot help but consider that pottery Neolithic societies in each region exchanged their ideas on making pottery (Tsuneki 2017a: 4).

CONCLUSIONS

By the beginning of the Neolithic studies in Fars, the formerly proposed chronologies have always faced some challenges. In this paper, we first attempted to express the challenges concerning the Neolithic period of Fars, and second we tried to give a concise explanation on the Neolithic site of Hormangan, which has been recently excavated by one of us (M. Khanipour), and how the absolute dating of which could help somewhat in evaluating

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the different proposals of the Fars Neolithic chronologies. Before the recent excavations conducted in Hormangan, the origins of pottery Neolithic of Fars faced several uncertainties, and some were thinking that the central Zagros region might have been the origin, but with the recent excavations carried out at the Rahmat Abad site and its absolute dating, a gap of more than one thousand years of Fars settlement history of the Fars Neolithic that had remained blank was corrected. The excavator of the Rahmat Abad site proposed a date of about 7450–7000 BC for the site, which is related to the pre-pottery Neolithic in this region. Most importantly, through stratigraphic sequences of the Rahmat Abad site, it is also made clear that in this site the pottery Neolithic has been laid down immediately above the pre-pottery Neolithic depositions since those potteries were as primitive as Mushki's pottery, thus it has been named afterward as Formative Mushki and given a date of about 7000–6400 BC. While the Mushki itself is known as the Mushki phase based on ^{14}C dating derived from Mushki, Bashi, and Hormangan, it was located in the time zone of nearly 6400–6000 BC. The subsequent prehistoric cultural period in Fars known as the Jari period came on the scene after the excavations at Jari A and Tol-e Nur Abad were completed. For the Jari period in the context of the Fars Neolithic, a date of about 6000–5600 BC was proposed. This point, of course, should be taken into account that the Mushki and Jari periods more likely coexisted for a short time and after that a cultural period representing the coarse and plain pottery has been replaced. That is known as Bakun B1 or Shams Abad, by which the Neolithic period in the Fars region came to its end. According to the excavation of Rahmatabad and Tal-e Sangi, it seems that Fars was inhabited in the middle of the 8th millennium BC and the Neolithic package entered this area, and there is no evidence of the Neolithization process. However, in the past, the Mushaki period was introduced as the oldest pottery Neolithic period, but with new excavations, it seems that the use of pottery had become common in Fars, as in many parts of Southwest Asia around 7000 BC.

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