

Evidence of an early accounting system found at Tal-e Mash Karim, a Chalcolithic site in Iran

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ABSTRACT – Investigating accounting systems and their progressive development during the prehistoric period is a critical issue in the recognition of human societies, their communication, and the formation of inter- and intra-regional trade systems, which led to the invention of writing systems. The present study deals with the typology and classification of the Chalcolithic (Bakun) period. Numerical/counting tokens have been discovered in Tal-e Mash Karim in Semirom district in Esfahan province in Iran. The cultural materials include thirty-two numerical tokens and a clay slab with tally marks. The numerical tokens may be divided into three main categories and seven subcategories: round and oval tokens for measuring agricultural products, and flat and disc-shaped tokens representing animals and food products. The discovery of a tallying slab beside the artefacts proves the existence of an early accounting system.

KEY WORDS – accounting system; Chalcolithic period; numerical tokens; clay slab with tally marks; Tal-e Mash Karim

Dokazi o zgodnjih sistemih štetja in beleženja na halkolitskem najdišču Tal-e Mash Karim v Iranu

IZVLEČEK – Raziskovanje sistemov štetja in beleženja ter njihovega postopnega razvoja v prazgodovini je pomembna tema pri prepoznavanju človeških skupnosti, njihove medsebojne komunikacije in oblikovanja znotraj regionalnih in med-regionalnih sistemov menjav, kar je privedlo do odkritja sistemov pisave. V članku se ukvarjamo s tipologijo in klasifikacijo halkolitika oz. obdobja Bakun. Žetoni so bili odkriti na najdišču Tal-e Mash Karim v okraju Semirom v provinci Esfahan v Iranu. Kulturne ostaline vključujejo 32 žetonov in označeno glineno ploščo. Žetone lahko razdelimo na tri kategorije in sedem podkategorij: okrogle in ovalne žetone za merjenje kmetijskih pridelkov ter ploščate žetone v obliki diska, ki predstavljajo živali in hrano. Odkritje glinene plošče z vrezi oz. označitvami dokazuje obstoj zgodnjega sistema štetja in beleženja.

KLJUČNE BESEDE – sistem štetja in beleženja; halkolitik; numerični žetoni; označene glinene plošče; Tal-e Mash Karim

Introduction

Small objects in various shapes and sizes at prehistoric Near Eastern sites have always been the most significant finds of archeological projects. Archeologists and art historians have attributed many appli-

cations to these items, from games to religious symbols and, ultimately, numerical/counting objects. However, their actual function was not clear until the American-French researcher Denise Schmandt-Bes-

serat suggested they were used in accounting and numerical systems, or as numerical tokens (*Schmandt-Besserat 1974*), and interpreted them as prototypes of the emergence of writing.

Before Schmandt-Besserat's studies, some hollow clay balls (numerical globular envelopes), including tokens, were found in excavations of late prehistoric sites in Mesopotamia (Uruk, Nuzi) and Iran (Susa and Chogha Mish), and Adolf L. Oppenheim (1959.122) was the first to interpret them. He investigated the economic texts on the clay tablets and envelopes from the Nuzi site, and suggested that categorising these materials based on their shape would reveal quite interesting and reliable information about the administrative mechanism of bureaucracy in ancient societies (*Oppenheim 1959.122*). Therefore, despite lacking knowledge about the real function of these balls without tokens, after reading eight lines on one of the balls, he found that the 48 tokens inside the ball indicated a number of objects or animals.

Schmandt-Besserat's studies of the tokens show that ancient societies' familiarity with accounting activities and numerical systems dates back to the late Paleolithic and Epi-Paleolithic periods (*Schmandt-Besserat 1992.180*). The samples of bone objects with carved lines, like slabs with tally marks which refer to goods, found in the caves of these periods, are considered as the first steps in documenting and transferring information. Unlike these slabs, the tokens which become prevalent from the Neolithic period were artefacts with specific shapes, and made of clay for communication and documentation purposes. In fact, tokens were the modern media for processing information, and the technology had been devised long before. These objects continued to be used until the Chalcolithic period and the Bronze ages and, alongside the bulla and clay ball objects, had a major role in the administration of early complex societies and the emergence of early states and the beginning of writing (*Schmandt-Besserat 1996*). Due to the development of administrative techniques in the form of tablets and reliefs during the historical period, their usage declined, continuing merely as simple numerical tokens.

The present study is intended to describe and analyse tokens and a clay tallying slab from Tal-e Mash Karim, a fifth millennium Chalcolithic site, and attempts to clarify their role in developing ancient accounting systems by making comparisons with other contemporary or similar settlements.

Evidence of accounting from prehistory

Based on their shapes, Schmandt-Besserat categorised numerical tokens into sixteen types (*e.g.*, conical, globular, flat, cylindrical, triangular, and other; *Schmandt-Besserat 1978.44–45*). Their markings include carved lines, cuts, holes or impressions made with a finger. Since they are handmade we can recognise many variants of these types at different sites. The usual token size is between 1 to 3cm. However, some larger conical or flat examples are 3 to 5cm.

Unlike the slab with tally marks, each token shape has a specific meaning. Therefore, unlike the slab lines, which can have an infinite number of possible interpretations, each clay token was a specific sign with a certain importance. If the slabs had been found outside their context, they would make no sense, while for those familiar with this system, tokens are comprehensible based on their shape and importance. For example, the conical shape was used for a specific amount of grain. Thus the tokens indicate a type of pictography, with each token representing a specific meaning, just like the motifs of the late Sumerian period, where tokens were 'conceptual symbols' (*Schmandt-Besserat 1992.161*).

However, the major innovation of this medium was the emergence of a 'system'. There was not only one type of token with an absolute meaning, but a complete set of related types of tokens on which information regarding different categories of goods could be modified. Therefore, this system was the result of more complex processing of information and storing a huge amount of information that avoided the risks inherent in human memory. This system was open, so it was possible to add new information any time. The smoothness of clay was also a key feature for developing codes, so the token system can be considered the first code, or the most ancient system of signs for transferring information. The systematic feature of tokens had a great influence on their geographical distribution. These bullae were transferring as a certain code from one society to another, and eventually extended throughout the Near East.

Unlike slabs with tally marks, which store only quantitative information, tokens can also register qualitative information about merchandise. According to the assemblages from Neolithic sites such as Ganj Dareh and Asiab in Iran and also Tal-e Osud, Muri Beit, and Sheikh Hassan in Syria (*Nilhemn 2002*), the emergence of tokens dates back to periods after

sedentarisation. Neolithic tokens are the second stage between the stages of information processing, coming after the Paleolithic and Mesolithic eras' slabs with tally marks as the complementary phase. With the emergence of pictographic writing in early states and urbanised societies, tokens lost their initial simplicity and became more complicated, and can be categorised into two groups:

- ① Simple tokens: their utilisation began from the emergence of tokens in 8000 BC and continued until 4400 BC; this category consists of geometric shapes only.
- ② Complex tokens: these emerged around 4400 BC, and included geometric shapes and naturalistic forms. The developmental peak of these tokens was in the middle of the fourth millennium BC, which was the foundation of pictographic writing and, eventually, around 2900 BC, writing emerged to record historical events and religious matters (*Schmandt-Besserat 1992.164*).

The history of the use of tokens and numerical tokens in Iran dates back to Neolithic societies such as Asiab and Ganj Dareh, and sites such as Sheikhi Abad, Chiya Sabz, and Chogha Golan, which have recently been studied more. Tepe Zaqheh in Qazvin is one of the prominent sites of this period, containing the transitional period from the Neolithic to Chalcolithic, and its numerical tokens and accounting system have been precisely investigated (*Salehi 1997; Fazeli, Moghimi 2013*). During the primary excavation season at Tepe Zaqheh, 19 tokens were discovered (*Moghimi, Fazeli 2015*), 238 fragments were also discovered during the recent season (*Moghimi 2015*). These finds indicate the existence of a society with a quite developed accounting system at the beginning of the Chalcolithic era on the central Iranian plateau. Furthermore, some evidence of numerical tokens has been discovered in Tepe Qabrestan, another Chalcolithic-related society on the Qazvin Plain (*Madjidzadeh 2008.45*).

In this regard, 253 numerical tokens were discovered in Tepe Khalese in Zanjan, another Neolithic site, which fall into eight categories of different shapes (*Valipour et al. 2013*). Moreover, Tepe Qeshlaq Chehel Amiran in the eastern region of central Zagros and the southern area of Lake Urmia is also one of the main sites related to the Chalcolithic Dalmia culture, with many numerical tokens (*Motarjem, Sharifi 2014*).

Chogha Mish in the southwest of Iran on the Susiana Plain, was a developed society in terms of account-

ing and administrative affairs (*Delougaz, Kantor 1996*). The long settlement sequences from 8000 BC to 4000 BC, the extensions of sites over some 17ha and the extensive archaeological excavations on the one hand, and the emergence of urbanism and writing on the other provided for the discovery of 813 numerical fragments in a variety of shapes. Of this number, 241 tokens were found in rooms and floors, 81 in pits, 5 in the remnants of carpet tiles, 63 in structures such as channels, kilns and walls, while 375 were found in sedimentary deposits, and 48 examples were found in areas with no specific context (*Delougaz, Kantor 1996.121-122, Tab. 11*). The main tokens, conical and disc shapes, date back to the middle Susiana (early Chalcolithic) period.

Other prehistoric sites on the Susiana Plain, such as Susa, Jafarabad and Jowi, also contained some representative samples of these tokens (*Amiet 1972.69*). Five other tokens from the late Susiana era 2, dating back to the late fifth millennium BC, have been found in Tale Geser, on the Ramhormoz Plain (*Alizadeh et al. 2014*).

Regarding the attribution of Tale Mash Karim excavations in Semirom County to Fars cultural traditions, referring to the main prehistoric sites of this area can reveal more real evidence about cultural and commercial interactions and the accounting system of the region. In this regard, the archeological excavations at Tale Bashi (*Pollock et al. 2010*), Tale Bakun (*Alizadeh 2006*), Tepe Mehr Ali (*Sardari Zarchi et al. 2011*) and Rahmatabad Tepe (*Bernbeck et al. 2005*) in Jari, and Bakun (fifth and sixth millennium BC) have revealed some accounting and numerical evidence.

Several numerical tokens were discovered in Tale Bashi on the Beyza Plain in Fars that are related to the Jari period in the early sixth millennium BC; these tokens include five small ball-shaped fragments made of clay that have been identified by researchers (*Pollock et al. 2010.192*). Moreover, the researcher of Tale Bashi discovered eight numerical tokens during another excavation in Rahmatabad Tepe, a site adjacent to Dareh Bolaqi, northwest of Fars, and identified them as tokens. However, these items may be confused with sling shots that the local people made of clay for hunting birds (*Bernbeck et al. 2005.95*).

Tepe Mehr Ali in the Sarhad region in the north of Fars province is the closest site to Tale Mash Karim containing evidence of numerical tokens from the

Bakun and Lapui periods. A total of 9 tokens including 2 conical, 5 globular and 2 hemispherical have been discovered at this site (Sardari Zarchi et al. 2011:322). The hemispherical tokens are perforated with traces of strings, indicating their function as complex tokens related to fusiform stamped pieces (Schmandt-Besserat 1992:146).

Tal-e Bakun on the Marvdasht Plain, in the centre of Fars, is the most significant site contemporary with Tal-e Mash Karim. Extensive excavations at this site have led to the discovery of numerous tokens, including 46 different examples, which can be divided into 46 different shapes, such as tetrahedral, prismatic, conical, globular, planar, cylindrical, triangular, nail shape, wedged, heart shape, and also painted examples (Alizadeh 2006:55–154). The time-span of these objects continues from the establishment of Tal-e Bakun A until its end, and are distributed in every layer; however, they are mainly concentrated in layer III, along with clay seal fragments, indicating the importance of these objects in early administrative procedures.

Several numerical tokens have been found at Tepe Haji Firuz in the Solduz valley, a late Neolithic site in the northwest of Iran; the excavators described these clay fragments as conical (Voigt, Dyson 1992: 279).

Tal-e Mash Karim and archeological excavation

Tal-e Mash Karim is a small, low-lying mound in the south of the Semirom district, identified during surveys in 2007 (Javeri 2008). This site covers an area of approx. 35 x 40m and is two metres higher than the surrounding land. The presence of the oldest materials and layers ever found in Semirom, in the south of Esfahan province, is the main reason this site is significant (Figs. 1 and 2). These layers have been dated to the Bakun period, *i.e.* 4468–4339 BC, based on the recent excavation, which reveals the closeness of this area to the local cultures of southern Iran and Fars province.

The Bakun period is the fifth millennium BC cultural phase in Fars province, with the emergence of painted buff ware ceramic assemblages, one of the most important stages of the Chalcolithic period in Iran (Herzfeld

Number of types and subtypes	Description of types and subtypes
8	conical
2	with total static
1	without static
2	with rounded tip
3	with triangular base
23	globular and oval type
2	series A
21	series B
1	disc shape type
32	total

Tab. 1. Numerical tokens from Iranian sites.

1929). Most archeologists believe that the Bakun period is a crucial stage in the socio-economic transformation in Iran (Sumner 1994; Alizadeh 2006). As the cultural expansion of this period in Iran and during prehistory includes all of Fars and several neighbouring provinces, such as Esfahan (Sardari Zarchi et al. 2011), a precise study of materials and artefacts from Tal-e Mash Karim can yield new insights into cultural, economic and social aspects in the north and the cultural expansion of Bakun in the Sarhad (upper borderlands) region.

The excavations at this site consisted of two trenches of 5 x 5m, and a sounding of 1 x 2m, which revealed significant evidence of several occupational phases and the remnants of simple architectural remains. The layers containing remains of ash and stone foundations may suggest that there was seasonal and short-term settlement in the area. However, the remains of a square room with walls painted in three colours and a brick platform would indicate the importance of this site. Some scattered



Fig. 1. Location of Tal-e Mash Karim in Esfahan Province in Iran (Nishiaki et al. 2018).



Fig. 2. A view of *Tal-e Mash Karim mound*.

evidence of numerical tokens and, in some cases, a number of them were found among the deposits and ash.

Description of numerical objects found at Tal-e Mash Karim

A total of 32 numerical tokens were recovered from the three trenches at Tal-e Mash Karim. They are made of stone or clay and can be divided into three general categories: conical, globular and elliptical, and disc shapes.

Conical type

This category comprises 8 numerical token fragments, used mainly to calculate and maintain grain amounts. Small cones represented units of small grains or a small basket (*Schmandt-Besserat 1981*.

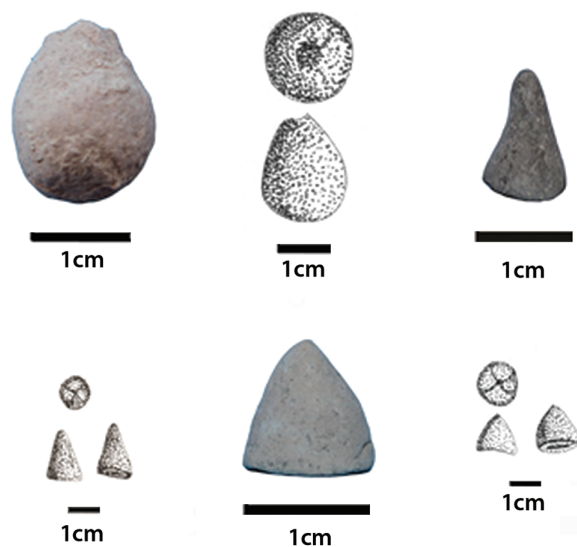


Fig. 3. *Conical clay tokens*.

283; 1996.80–82) and are divided into four subtypes:

- ❶ Subtype with complete static (2 items)
- ❷ Subtype without static (1 item)
- ❸ Subtype with rounded tip (2 items)
- ❹ Subtype with triangular and pyramidal base (3 items made of black stone)

The conical types are generally 15 to 20mm high and weigh 2 to 4g. The clay types are made of baked red paste, with a black polished surface, and have complete static; however some of them do not have static, despite their delicacy, and might have had different functions (Fig. 3).

The two subtypes with rounded tips are made of brown and black baked clay, and are 10 to 15mm high and weigh 2 to 4g (Fig. 3).

All of the subtypes made of black stone have triangular bases and sharp tips; the heights range between 15 to 20mm and weights from 2 to 4g (Fig. 4).

Globular and elliptical types

This type, totalling 23, is the most frequent among the objects discovered. These objects represented large units (large baskets) of grains and cereals (*Schmandt-Besserat 1981*.283; 1996.80–82).

This category includes two different sets based on the location of the discovery:

- ❶ Series A: 2 tokens made of baked clay found in trench A, location 54. Their form is almost oval; they are 13mm high, 17mm wide, and 16mm in diameter, and weigh 4g (Fig. 5).
- ❷ Series B: 21 tokens discovered in a corner of trench B, location 37, all made of baked clay and brownish. They are divided into three categories based on dimensions:
 - ❶ 20mm high, 17mm wide, 16mm in diameter, and weighing 14g (5 items).
 - ❷ 6mm high, 9mm wide, 8mm in diameter, weighing 5g (8 items).
 - ❸ 6mm high, 9mm wide, 8mm in diameter and weighing 5g (7 items) (Fig. 4).

Disc type

There was only one item of this type among the objects found. This object represents a group or herd of animals. For example, a disc-shaped numerical token

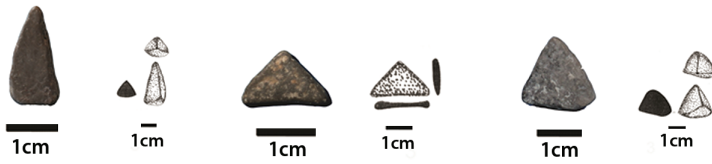


Fig. 4. *Triangular and pyramidal tokens.*

represents ten sheep (Fig. 7) (Moghimi 2015). Tokens of this type were made of baked clay with a completely polished surface, as well as two grooves on their reverse side, although some parts were damaged. Its diameter is 24mm and it weighs 8g.

Clay slab with tally marks: this object was discovered in trench B; it is brownish baked clay, with traces of grooves and engraved curved lines on its surface, which were made by a sharp pointed object. This object is almost oval in form: 23mm high, 44mm wide, 25mm thick, and weighing 35g. The traces of circular and winding marks engraved on one side of the object are not clear and cannot be reconstructed to know their precise function (Fig. 8).



Fig. 5. *Examples of globular and elliptical numerical tokens (close-up view).*

This slab is similar to the objects discovered in Tepe Sofalin (Hessari 2013:55, Fig. 22). The object found in Tepe Sofalin is elliptical, with carved half-crescent grooves on it. Moreover, a few pieces of artefacts discovered in Chogha Mish (Delougaz, Kantor 1996: 119) are in the shape of broken pieces. These objects

seem to be long clay boards with dots and grooves, and one of them is probably the end of a rough plaster board of irregular thickness, while another is an elliptical object with corrugated edges and four holes.

Discussion and conclusion

Due to the lack of evidence allowing the identification and reconstruction of their precise nature, examining the numerical tokens from prehistoric sites is usually difficult, and requires the use of any possible clues to understand them. Besides the functional nature of the cultural materials found in archaeological layers, comparing them with other sites in different regions can pave the way to analysing them, especially since these objects were used in economic exchanges and trading; thus a specific and coordinated pattern can be perceived based on the results of comparative studies. Therefore, the statistical analysis of the examples discovered based on the distribution of sites is very important.

Tal-e Mash Karim has an area of some 1500m²; only 3.5% of its cultural layers have been excavated within an excavation area of 50m². The average thickness of the excavated cultural layers is about 1.5m, and a total volume of 75m³ have been excavated. Identifying 32 numerical tokens in such a small area is quite significant, and strengthens the possibility that a great deal of economic activity occurred here, along with accounting with these tokens and clay slabs with tally marks. However, it

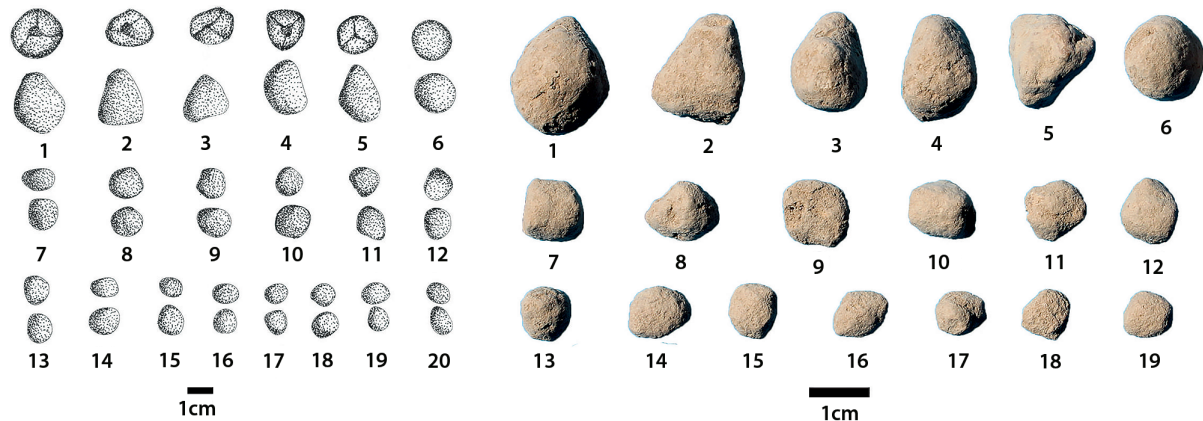


Fig. 6. *Examples of globular and elliptical numerical tokens.*

is necessary to explain these accounting objects in the general framework of economic and subsistence activities.

The quantity of tokens discovered at Tale Bakun and the excavated area is very limited (Alizadeh 2006.154). Although the number of conical tokens in Tale Bakun is almost the same as the number of examples at Tale Mash Karim, the globular and elliptical tokens in Tale Mash Karim are much more numerous compared with the number found at Tale Bakun.

Tepe Mehr Ali is also another site contemporary with Tale Mash Karim; despite the wide area of excavations of this area (200m²), no particular accounting activities were discovered (Sardari Zarchi et al. 2011); however, the 5 globular tokens among the total of 9 numerical tokens found were similar to the Tale Mash Karim materials.

The globular tokens, as found at Tale Mash Karim in large numbers are also in the majority, along with conical tokens at other sites such as Tale Bashi (Pollock et al. 2010.192), Rahmatabad (Bernbeck et al. 2005), Tale Chehel-Amiran (Motarjem, Sharifi 2014.33), and Zagheh (Moghimi 2016), which may represent grain quantities. Furthermore, the elliptical types also refer to the number of livestock and sheep (Schmandt-Besserat 1996.210). Therefore, the discovery of conical, globular and disc-shaped tokens in large quantities at many sites may be due to their frequent use in counting and recording agricultural and husbandry activities. Globular tokens were also in the great majority in Chogha Mish in three categories based on their sizes (Delougaz, Kantor 1996.121). The conical and globular subtypes in Tale Mash Karim, which were in standardised shapes, represent more detailed values and quantities of agricultural and husbandry goods.

The spatial distribution of numerical tokens is also an important component in identifying them precisely, so their exact context of discovery, such as waste holes and pits, rooms and their floors, the remnants of debris, ceramics' and structures' waste, needs to be considered. Most of the examples at Tale Mash Karim occur in ash and dust heaps between trenches of A and B. Their location at the centre of



Fig. 7. Disc-shaped numerical token.



Fig. 8. Sample of slab with tally marks discovered at the site.

the Tepe site indicates the layer was a place for waste objects such as discarded numerical tokens.

From a general point of view, we consider the ancient site of Tale Mash Karim in Semirum as a main centre of cultural interactions and economic exchanges and trade, and as a society with simple agricultural methods, but developed husbandry. Through studying the materials' distribution from these interactions, we can analyse this site in the more extended context of the Iranian plateau. Tokens and numerical tokens are symbolic materials for such interactions and activities in accounting and recording merchandise and services in Tale Mash Karim; they represent the fundamental similarities of such technologies in the economic system of this site and other primary rural and pastoral nomad societies in Iran during the prehistoric period.

Finally, these tokens are representative of a society with an administrative and chiefdom system. Regarding the location of the residential society of Mash Karim on the trade route between Esfahan and northern Fars, an accounting system was required to manage their trading and economic affairs, and the archeological evidence and discoveries confirm this hypothesis.

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