Querns from Vadnagar: The Multifunctional Household Utilitarian Tools

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Abstract: *This article discusses the querns excavated at Vadnagar. Querns are grinding stones used for processing grains and other foodstuffs. The article describes three types of querns found at Vadnagar: saddle querns, legged querns, and rotary querns. Saddle querns are the earliest type of quern found at the site, and they were likely used for grinding grains and pulses. Legged querns appeared later in the archaeological record, and they may have been developed from saddle querns. Rotary querns are the latest type of quern found at Vadnagar, and they were likely introduced from elsewhere. The introduction of rotary querns may have been due to a shift in the types of grains being cultivated at Vadnagar. The article also discusses the possible uses of querns based on their decoration and the ethnographic information collected from local residents. Overall, the article provides a valuable insight into the changing patterns of food processing at Vadnagar over time.*

Keywords: Saddle Querns, Legged Querns, Rotary Querns, Food Processing, Vadnagar, Excavation, Climate

Introduction

Saddle and rotary querns of stones are called *Pato* and *Ghanti*, respectively, in Gujarati, and *Pata* and *Jate* in Marathi, and *Sil and batta* in Hindi. These are among the significant artefacts of the material culture found at Vadnagar. They are also a feature of any Indian household. Banerjee (1957) suggests the use of stone for querns due to its popular usage in domestic work. Querns, particularly saddle querns, have been discovered from the Neolithic times. However, their form kept changing from time to time. Querns have broadly been divided into three groups based on their form (Ghosh, 1989): 1. Saddle querns, 2. Legged querns, and 3. Rotary querns.

In context of archaeological sites, generally two types of saddle querns have been found: - a. saddle quern with flat upper grinding surface, and b. saddle quern with concave or sunken depressed surface (Banerjee, 1957). Saddle querns are prepared with stone blocks and have a saddle-like depression at the centre. This depression is formed by rolling a smaller stone (mullers) over the surface for crushing grain to make flour or paste — type

'a'. However, occasionally, a small regular sunken depression is found on the surface — type 'b'. Such querns were probably used for pounding herbs and spices. These types (both type 'a' and 'b') of quern have been reported from the beginning of the Neolithic period and continue through the chalcolithic to the early Historical times. (Sankalia 1977; Dhavlikar, 1999). Banerjee (1957), while describing both the saddle querns, stated that the type 'a' specimens were followed by type 'b' in the subsequent stage.

Generally, the concavity formed on the querns is determined by two factors. The first factor is its usage, and the second is the nature of grinding or pounding stones (mullers and pounders) used. A small discoid pebble used for the to and fro movement tends to make a depression at both ends, while a long and elongated muller restricts the depression to one end. While comparing this observation with modern-day practice, it is noticed that such specimens of querns are used with mullers to prepare spices with the help of water, which tends to create depression at one end. Hence, to mitigate this, a common practice is to rotate the sides of the quern periodically. It would be challenging to extract dry flour by grinding grains through saddle querns instead of rotary quern. Hence, Sankalia (1977) opined that, cereals were kept in water overnight, made into a thick paste using saddle querns, and baked in bread-like forms.

The legged querns, regarded as the second stage of development in the history of querns, are simple querns with legs and a flat rectangular surface, sometimes with a projection on one end of the flat surface (suitable to put a dish below the projecting end). Such querns with four legs and a flat rectangular surface began appearing from the 4th century BCE. The excavation at Adam has shown a consistent progression in its forms (Nath 2016).

- Type A: Simple, oblong querns with four legs and a projected shorter axis on the opposite side.
- Type B: A plain oblong variant with a protrusion toward the shorter axis on one side.
- Type C: Plain oblong variant with distinct legs and no protrusion on the shorter axis.
- Type D: Oblong, plain quern with unidentifiable legs.

Legged querns from the excavation at Prakash show the legs are rather indistinct in the beginning, looking more like block legs, but very soon, they are well cut, very well distinct, and defined. (Dhavalikar 1999; Nath, 2016). Margbandhu (1985) defines two stages in the evolution of the legged querns. The earlier form, with undifferentiated legs, dates to the 6th to 1st centuries BCE, while the later stage, with separate legs, dates to the 1st to 2nd centuries CE. The more primitive flat querns eventually took their place. Remarkably, such economic household querns were prevalent and used throughout India before and after the Common Era. They have been reported from Taxila, Rarh, Karvan (South Gujarat), Kolhapur, and South India (Sankalia 1977).

Generally, coarse-grained, gritty stones like basalt, sandstone, quartzite, granite, dolerite, and schist were used for querns. Their abrasive surfaces quickened the operations of grinding, pounding, and crushing. (Ghosh, 1989).

Figure 1: Simple Quern

Figure 2: Saddle Quern

Querns from the Excavation at Vadnagar

The excavations at Vadnagar have yielded a variety of querns. They are saddle, legged, and rotational varieties. However, not much variation has been noticed among the saddle quern variety, in contrast to findings from other excavation sites. The legged

quern variety has been found with a saddle-like depression on the surface. This depression occurred due to the constant use of a smaller stone rolled to and fro over it. The third variety of querns from the excavation is the rotary quern, which involves the rotation of one stone on top of another. Tracing the development of querns, it has been found that the rotary querns are more effective for grinding grains than the other two forms. The appearance of this variety of rotary quern is controversial and was dated to the late Saka-Parthian period (2nd/1st century BCE – 50 CE) (Dhavalikar 1999; Margbandhu, 1985).

Figure 3: Saddle Quern

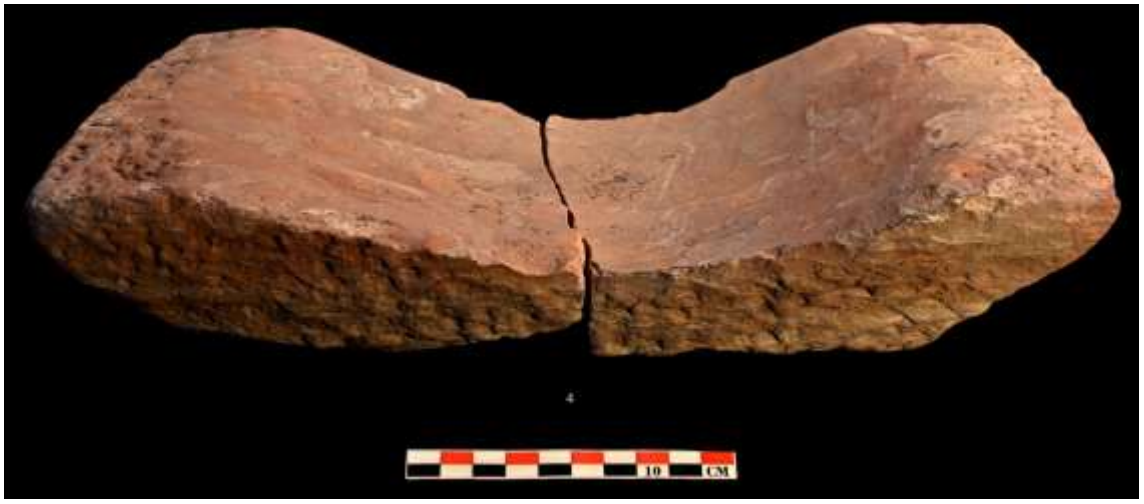

Figure 4: Saddle Quern

Figure 5: Saddle Quern

Figure 6: Saddle Quern

Figure 7: Legged Quern

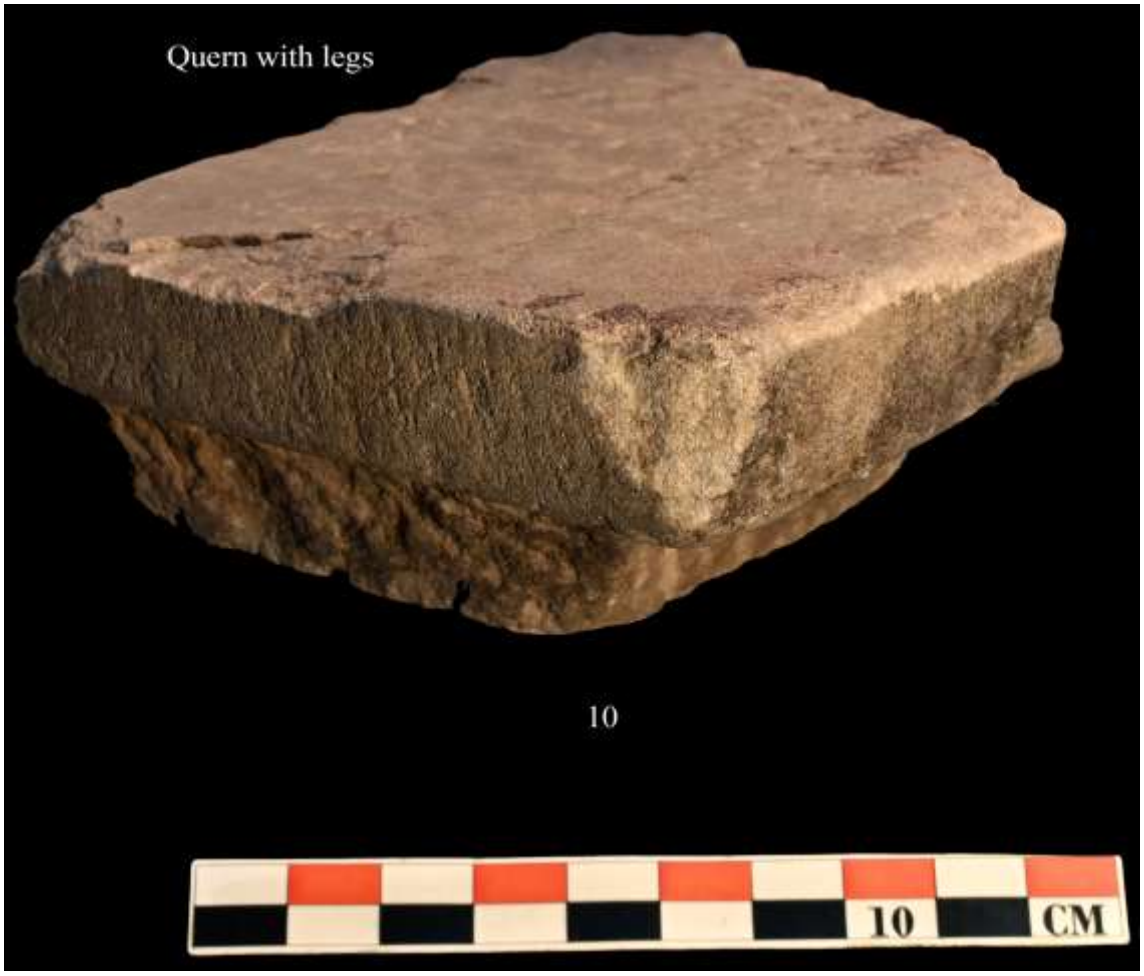

Figure 8: Legged Quern

Sankalia (1977) previously opined that the stratigraphical context at Kolhapur shows that the rotary quern was perhaps unknown in the Deccan until the Bahmani or the preceding Silahara Yadva period. Later on, its antiquity stretched back to the 1st century CE. However, the findings at Vadnagar are interesting in this context as they shed light on the antiquity of rotary querns. The stratigraphical context is analogous to the Kolhapur excavation result.

The mechanism used in the rotary querns consists of two parts: the lower one is stationary, and the upper one is slightly heavier which rotates. The upper stone has transverse sockets to insert the handle horizontally or transversally to rotate it. In certain examples, the feeding hole for pouring grain is broad on the top and thin at the bottom (much like a wine cup). Contrary to this, later on, the rotary querns where the vertical handle was used for rotation were comparatively lighter, larger, and broader. Such modified versions have a socket on the rim to place the handle vertically, whereas the previous versions have a transverse socket.

From Vadnagar excavations, 29 stone querns have been yielded, out of which 19 specimens have been described and included in the study.

Table 1: Description of simple quern found from Vadnagar excavation

Simple Quern				
Sl. No.	**Period**	**Dimensions in cm.** (diameter x thickness) or (length x breadth x height)	**Description**	**Colour**
1	IIIA	17.8 x 17.8x 6.9	Fragment of a rectangular solid block of sandstone, with straight sides and flat surface - so that a smaller stone / muller can be pushed or rolled to and fro over it. Such flat surface could be more useful for grinding herbs and spices (Figure 1).	5 YR 7/2 grayish orange pink.

Table 2: Description of trapezoidal saddle querns found from Vadnagar excavation

Trapezoidal Saddle Querns				
Sl. No.	**Period**	**Dimensions in cm.** (diameter x thickness) or (length x breadth x height)	**Description**	**Colour**
2	V	41.8 x 23.2 x 9.1	Saddle quern, basalt dressed block, upper surface bears shallow ovalish depression formed due to constant use, possibly used as shell polisher. Lower portion is flat, concavo-convex profile, slightly damaged edges. (Figures 2 and 14 - Sl. no.2).	5Y 6/1 Light olive grey
3	V	41.8 x 23.2 x 9.1	Saddle quern, sandstone, rectangular block, upper surface bears slightly concave depression, lower portion is flat and sides having chiselled marks. Trapezoidal section. (Figures 3 and 14 - Sl. no.3)	5R 6/2 pale red
4	V	36.4 x 24.2 x 8.9	Saddle quern, broken in two pieces, sandstone, upper surface bears deep depression formed due to constant use and is	5R 6/6 Light red

			trapezoidal in section. (Figures 4 and 14 - Sl. no. 4)	
5	V	21.5 x 13x 5.63	Fragment of a saddle quern of basalt, showing decorated side on both the axis, the decorative band consist of a floral motif and smooth glossy upper surface. (Figures 5 and 14 - Sl. no.5)	N4 medium dark gray

Figure 9: Legged Quern

Table 3: Description of Oval saddle quern found from Vadnagar excavation

Oval Saddle Quern				
Sl. No.	**Period**	**Dimensions in cm.** (diameter x thickness) or (length x breadth x height)	**Description**	**Colour**
6	VI	28 x 18.6 x 6.32	Oval shaped sandstone pebble, upper surface bears shallow depression formed due to regular use (Figures 6 and 14 - Sl. no. 6).	5 YR 5/2 Pale brown

Table 4: Description of legged quern found from Vadnagar excavation

Legged Querns				
Sl. No.	**Period**	**Dimensions in cm.** (diameter x thickness) or (length x breadth x height)	**Description**	**Colour**
7	IVB	15.4 x 23.6 x 18.8	Legged quern, damaged, light brown sandstone, stumpy legs, evenly smooth, upper surface bears deep depression (formed due to constant use), upper surface does not protrude beyond the axis of legs, similar to specimen with protruding portion of shorter axis beyond legs noticed during the exploration at Hathab (Figures 7 and 14 - Sl. no. 7). This particular quern has been found in association with a group of oval hearths. It is worth mentioning that oval hearths, which are used for household activities, continue to be widely prevalent in modern times. One side of the hearth is elevated to serve as a base for the cooking vessel, while the opposite side is flat save for the lining that surrounds the edge of the hearth. It has a dual function: it collects ash and regulates the cooking process	5YR 6/4 Light brown

			by controlling excessive heat through the removal of firewood and confining it to this designated area. It is suggested that certain oval hearths uncovered during excavation may have been domestic hearths, exhibiting similar characteristics to those found in contemporary such hearths (Figure 7a).		
8	IVB	19.1 x 24.1 x 16	Fragment of legged quern, sandstone, stumpy legs, evenly smooth, upper surface bears depression (upper surface does not protrude beyond the axis of legs).	5YR Light brown	6/4

Figure 10: Rotary Quern

Figure 11: Rotary Quern

Figure 12: Rotary Quern

Table 5: Description of square legged querns found from Vadnagar excavation

Square Shaped Legged Querns				
Sl. No.	**Period**	**Dimensions in cm** (diameter x thickness) or (length x breadth x height)	**Description**	**Colour**
9	IVA	33.5 x 17.2	A square-shaped legged quern having decoration on all sides of the longer axis has been found. The decorative bands are two-fold in nature. The first line consists of a frieze with four petals, a diamond-shaped floral design within squares, followed by a line of downward arrow-shaped pattern. A four-petal floral engraved design can be seen at regular intervals between the second decoration line. Eight flowers (seven of which are visible while one is completely weathered) are visible. Each leg of the quern consists of two flowers on either side. Each of these flowers is eight-petal and encompassed within squares. All four legs of the quern are also square. Such a specimen, called *Bajot* in Gujarati, is used during religious ceremonies (Figure 15 – Sl. no. 9).	10 YR 6/2 Pale yellowish brown
10	V	12.69 x 5.39	Fragment of legged quern, unfinished, sandstone, flat surface and stumpy legs, rectangular section. The base having chisel marks (Figures 8 and 15 - Sl. no. 10).	10R 6/2 Pale red

Table 6: Description of circular legged querns found from Vadnagar excavation

Circular Legged Querns				
Sl. No.	**Period**	**Dimensions in cm** (diameter x thickness) or (length x breadth x height)	**Description**	**Colour**
11	V	41.4 x 12.90	Circular legged quern of three legs, however one leg is damaged, sandstone, flat surface with a	10 YR 8/2 very

			groove line at periphery, devoid of any decoration (Figures 9 - Sl. no. 11 and 15 - Sl. no. 11).	pale orange
12	VI	11.66 x 4.54	Fragment of a circular quern with undefined legs having flat & smooth upper surface and convex profile with an extension as a base, basalt (Figures 9 - Sl. no. 12 and 15 - Sl. no.12).	N3 Dark grey

Figure 13: Rotary Quern

Rotary Quern

Rotary quern/ mill is made in two parts: the lower one is squat, cylindrical shaped with a flat surface and the upper one is slightly concave at the base. This upper part has a transverse hole for handle. Generally, upper part which is heavy circular wheel with a narrow concave neck and wide feeding mouth on top has been found. The square transverse opening in neck meant for fixing a horizontal wooden bar to facilitate rotation.

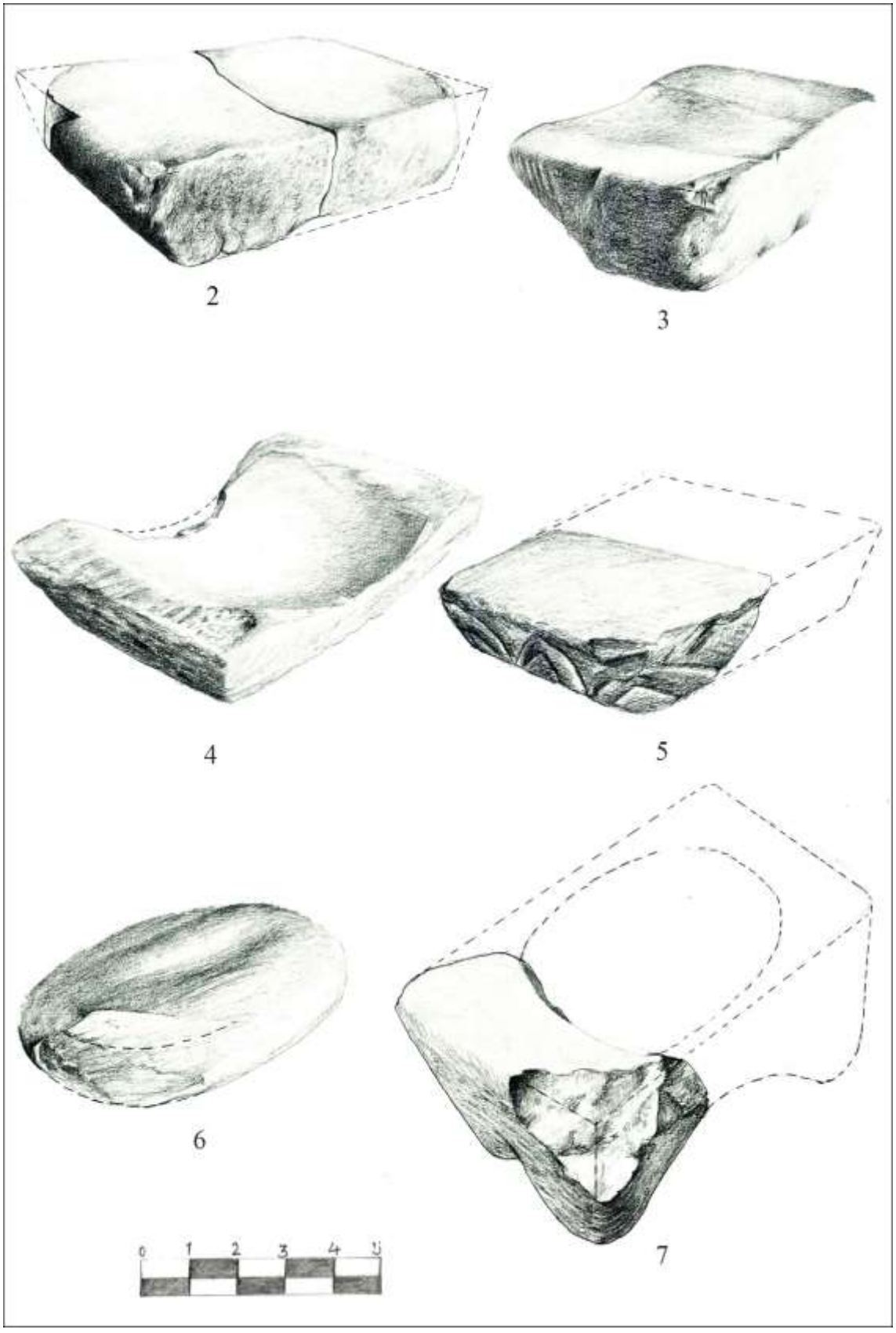

Figure 14: Drawing of Saddle and Legged Querns

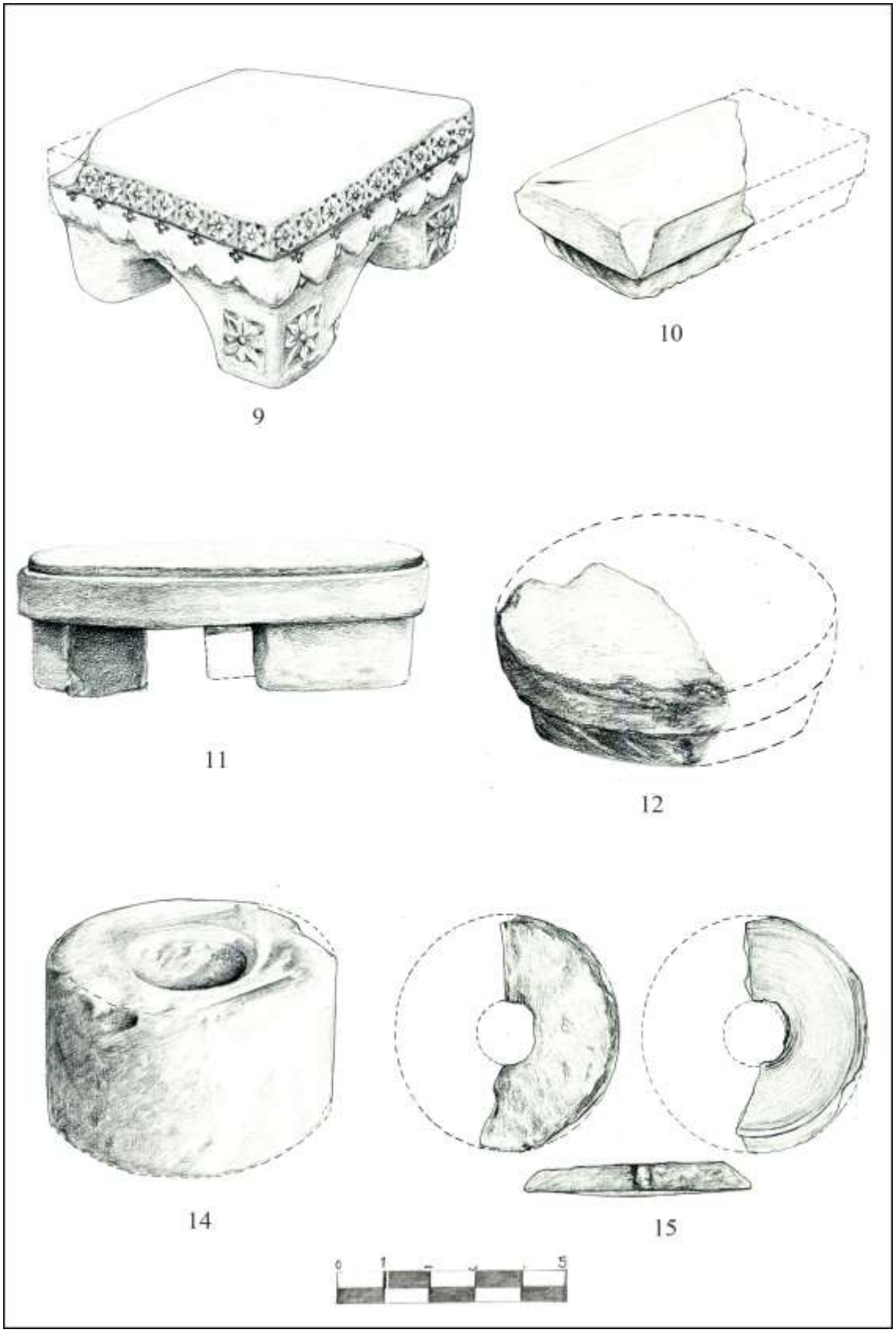

Figure 15: Drawing of Legged and Rotary Querns

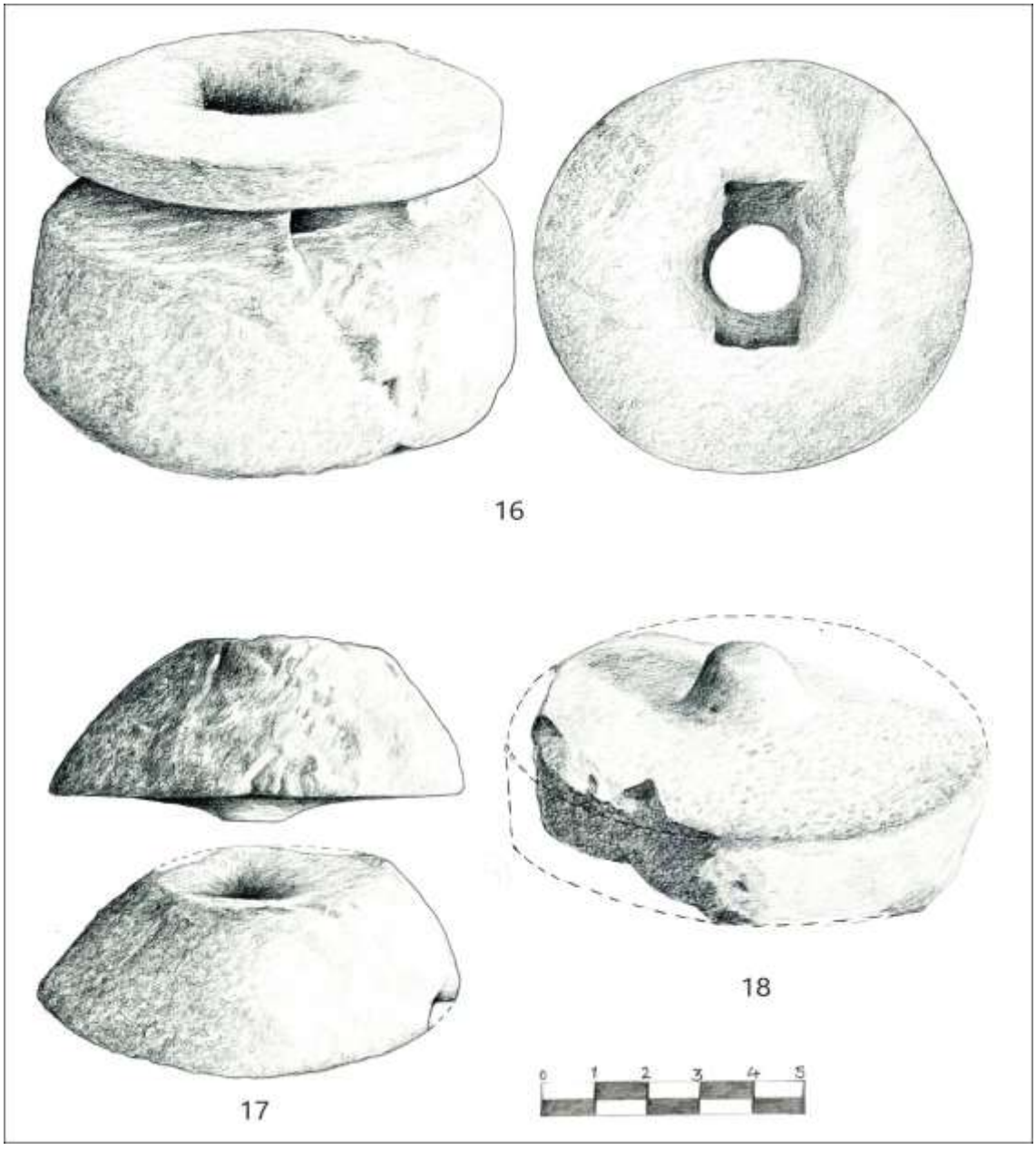

Figure 16: Drawing of Rotary Querns

Table 7: Description of the rotary querns found from Vadnagar excavation

Sl. No.	Period	Dimensions in cm. (diameter x thickness)	Description	Colour
13	IVA	Diameter: 29.8 cm. Dimension of feeding	Upper part of grinding stone, made of sandstone, flat slab of a rotary mill, circular in shape, having feeding mouth for receiving grain at the centre, slightly raised side at periphery and a	5YR7/2 Grayish orange pink

		mouth: 12.4 x 6.7	projection for holding the quern for rotation (Figure 10).	
14	V	29.8 x 15.5	Cylindrical shaped mortar, sandstone, a shallow open mouth at the centre (filled with the soil and possibly the lower part of the rotary quern or pivot) (Figure 15 - Sl. no. 14).	10 YR 6/2 Pale yellowish brown
15	V	23.8 x 2.65 Inner diameter: 6.95	Upper part of rotary quern, broken, basalt, light weight in comparison to the other rotary quern, possibly used by travellers. The flat slab of circular shape having opening at the centre for feeding grain, concave upper surface and smooth lower surface having three concentric circles projected at the periphery (Figures 11 - Sl. no. 15 and 15 - Sl. no.15).	N4 medium dark gray
16	V	34.2 x 19.3	Upper part of rotary quern, sandstone, heavy, slightly concave at the base, a narrow concave neck and open mouth on top for receiving grain. It also has a square bracket perforation at the neck for fixing a horizontal wooden bar to facilitate movement (Figures 11 - Sl. no. 16 and 16 - Sl. no. 16).	5R 5/4 Moderate red
17	VII	35.4 x 11.5	The lower part of rotary quern made of sandstone, cylindrical tapering at the base with slightly convex upper surface and has a small perforation at the centre for the pivot (Figures 12 - Sl. no. 17 and 16 - Sl. no.17).	5R 5/4 Moderate red
18	VII	35.8 x 14.3	Lower part of rotary quern, made of basalt, circular in shape and damaged from the periphery, an oval projection at the centre acted as an axis for the upper stone of rotary quern (Figures 12 - Sl. no. 18 and 16 - Sl. no.18).	5R 5/4 Moderate red
19	VII	Upper stone- Diameter: 42 cm and height: 6.5 cm and lower stone-	Two flat stone slabs circular in shape fitted one upon another with upper stone has a convex surface and a perforation of 8cm at the centre and another perforation towards periphery for a vertical handle of 2.84	10R 5/4 Pale reddish brown

	Diameter: 41 cm and height: 6 cm	cm. The stationary lower stone has similar perforation at the centre of 3 cm for the pivot, in which wooden piece is fitted to rotate the upper disc on a fixed axis. Such millstone specimen still presently in used (Figure 13).

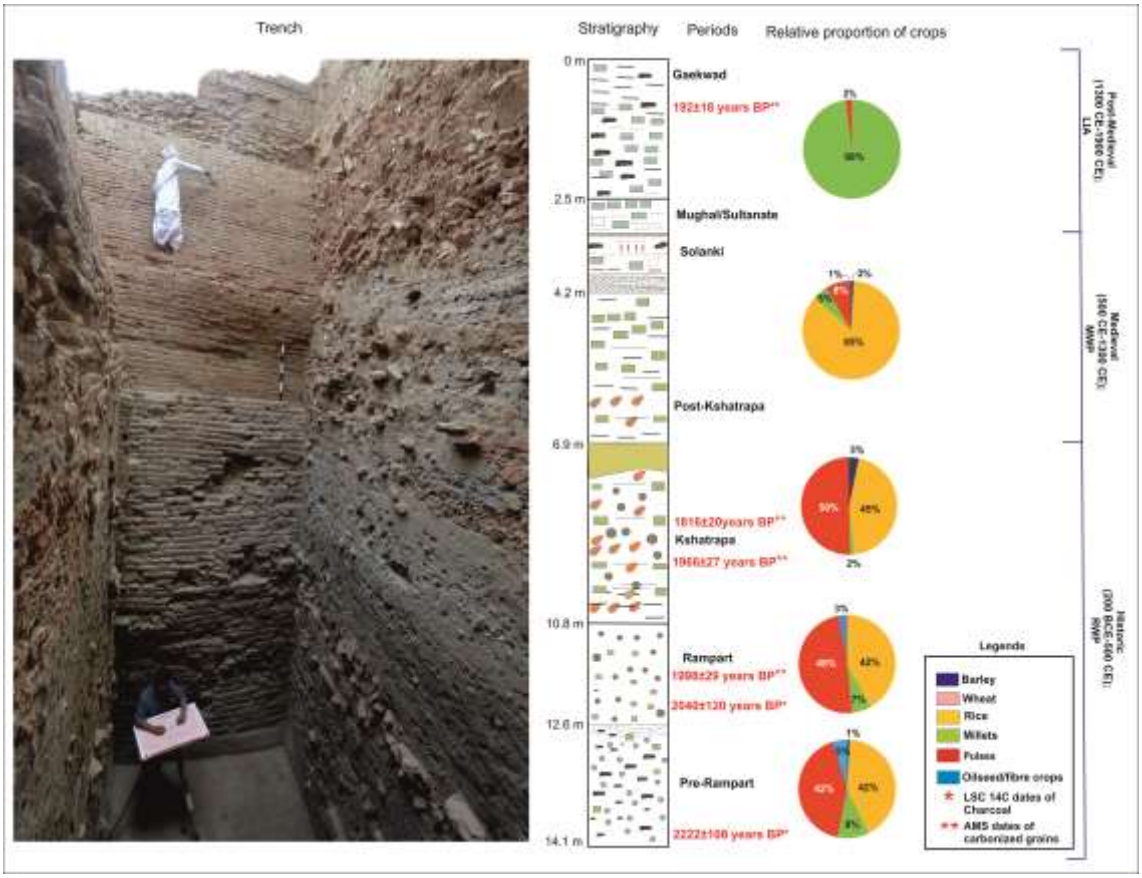

Figure 17: Relative proportion of archaeo-botanical data and corresponding cultural phases (Courtesy: Anil Pokharia)

Discussion

Querns have always been an essential part of settlements as they indicate the culinary behaviour, and subsistence pattern of the respective population. Changes in food habits or cultural habits travels parallelly with changes in agriculture, owing to changing monsoon and environmental factors. Simultaneously, the tools required for food processing also evolved.

The earliest specimen of a prepared block of stone probably used as a quern, is from the early Kshatrapa period (Pd. III A), which dates back to the 1st - 2nd century CE. The saddle querns (with saddle-shaped depression) possibly used to process the cereals or grains to remove the chaff have been recorded from the period IV deposit onwards. Table 8

illustrates various types of querns and their distribution throughout the cultural periods. Other varieties of querns, i.e., legged querns with stumpy legs and rotary querns have been recorded from the beginning of period V onwards.

Table 8: Distribution of querns with respect to cultural periods

Types of Querns	**Periods**								**Total**
	II	**III A**	**III B**	**IV A**	**IV B**	**V**	**VI**	**VII**	
Simple Quern		1							**1**
Saddle Quern						4			**4**
Legged Quern				3		3	2		**8**
Rotary Quern					1	7	1	6	**15**
Total		**1**		**3**	**1**	**14**	**3**	**6**	**28**

At Vadnagar, rotary querns were introduced around the 9th -10th century CE onwards. Furthermore, the saddle querns have not been found at the site from period VI onwards, which might indicate towards the efficiency of the rotary querns. While comparing the stages and the findings of Vadnagar with the querns found from Adam, it can be stated that basic blocks of stones were probably used in the initial stages (Nath, 2016; Sankalia, 1977). With time and continuous use/ grinding, saddle shape was achieved. But evidence from Vadnagar also suggests that the legged querns developed or evolved from the saddle quern because of their first appearance around the early phase of period IV.

Following the classification of legged querns reported from Adam, there are different stages involved in the evolution of the legs. These stages are stated as underdeveloped legs, stumpy legs, and then fully developed. The legged querns from Vadnagar have evidence of both stumpy and fully developed legs.

The introduction of the rotary querns substantiates towards the fact of change in household grain processing. Many scholars, including H. D. Sankalia, have suggested that the rotary querns could not have developed from the saddle quern and is believed to be a foreign influence (Indo-Greek / Romans), as the first rotary querns were introduced in Europe (100 BCE-50 BCE). It was earlier also opined that the rotary querns appeared during the Silahara Yadva period (Sankalia, 1977). Dhavalikar (1999) elaborated upon two types of rotary querns, one with a horizontal handle dated between 1st century BCE and 2nd century CE and the other with a vertical handle placed between 5th and 7th century CE. The excavation at Adam does not report rotary querns, whereas the site has reported legged and saddle varieties of querns.

Legged querns from Vadnagar have further been classified based on variations in projections, legs, and decoration. These are yielded from period IV to period VI deposit. While digging to build an underground water sump at the Darbargadh locality of Vadnagar (the highest cultural deposition area), it revealed a rotary quern along the structural remains. And the cultural deposit and structural remains belong to period IVB and period V. Similarly, another specimen was reported earlier from the eastern bank of the Sharmistha lake. Both the findings are datable to period IVB and period V.

Excavations show that rotary querns were introduced in Vadnagar around the late phase of period IV. They are of two types. One is with a horizontal handle, and the other is with a vertical handle. R.N. Mehta (1979) describes rotary quern of vertical handles as being used for removing the chaff from the pulses or making flour. As per their uses, the size of the rotary querns varies between 30 cm to 1 m.

Based on the archaeobotanical data from Vadnagar, the shift in agriculture patterns led to the adoption of a completely different variety of grains. The data obtained from Vadnagar offers a clear insight into the local environmental conditions that evolved over two thousand years, extending from the Early Historical period characterised by rice, wheat, and barley cultivation to the early post-Medieval eras when small-grained millets such as sorghum and pearl millet dominated the agricultural landscape. Notably, these shifts in agricultural practices align with the findings of paleoclimate studies conducted at the site (Sarkar et.al 2024).

The archaeo-botanical evidence collected from Vadnagar underscores the resilience of the agricultural system. An example is the shift from a diverse cropping system to a highly drought-tolerant millet-focused regime, as the region faced a decline in the Indian Summer Monsoon from around 1400 CE (Pokharia et. al 2024). The changes introduced to agricultural patterns by the settlers respond to the changing climatic conditions. Changes in the agricultural pattern may have altered the culinary behaviour resulting in modification of the grinding tools. This provides compelling evidence for the necessity of rotary querns as a new technology used for domestic grain processing (Figure 17).

One of the most unique finding from Vadnagar is an upper part of rotary quern, which is comparatively light in weight. Such a lightweight quern was probably used as a mobile quern carried by caravans or travellers.

Apart from the simple querns, two more specimens of legged querns have ornamentations in the form of leafy patterns and petal flowers on the sides from the site. These specimens could be used for pounding spices or medicinal herbs rather than grinding grains in decorated specimens. Marshall (1975) discusses the utilization of grinding stones for crushing spices or herbs. Such decorated querns have been reported from Taxila, Mathura, Adam (Nath, 2016), Pauni, Tripuri, Nasik, Jorwe, Nandur, Surkotda, Rangpur, Bhokardhan and many more (Ghosh, 1989).

To find the utilisation of the quern, an elderly lady, Smt. Savita Ba from Vadnagar was consulted regarding the utilisation of the querns. She attested that her ancestors used the saddle and legged types of querns, to chaff pulses, make paste from those grains or cereals (after soaking them overnight in water), and produce flour from those grains or cereals (after roasting the grains). Typically, pulses like mung bean, black gram, pigeon pea, and spices were–processed on these querns. The coarse surface and maximum grinding surface of the rotating querns produced finer flour, and was preferable used for wheat, pearl millet, gram flour, etc. Hence, it may be deduced that the modification of quern patterns in Vadnagar was intentional. The change in processing methods was

influenced by the shifting grain pattern of dietary habits. The observation about grinding grain at Vadnagar by rotary quern reveals that it is useful for making fine wheat flour, removing chaff, and separating the pulses.

Conclusion

The excavation at Vadnagar yielded a variety of querns, including saddle querns, legged querns, and rotary querns. The presence of these querns suggests that the inhabitants of Vadnagar processed their grains using these tools. The querns became more sophisticated over time, with the introduction of rotary querns around the 9th-10th century CE. This shift in grinding technology likely coincided with a change in the dietary habits of the people, as they began to cultivate more small-grained millets. The rotary querns were more efficient for processing these millets into flour. The archaeobotanical data from Vadnagar supports this conclusion, as it shows a shift from rice, wheat, and barley cultivation to sorghum and pearl millet cultivation. This change in agricultural practices was likely a response to changing climatic conditions. The querns found at Vadnagar also provide us with insights into the culinary practices of the people. The decorated legged querns were probably used for pounding spices or medicinal herbs, while the saddle and legged querns were used for processing pulses and cereals. Overall, the study of querns from Vadnagar provides valuable information about the food processing practices, dietary habits, and agricultural practices of the people who lived there.

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