Ran-thok and Ling-chhom: indigenous grinding stones of Shertukpen tribes of Arunachal Pradesh, India

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Abstract:

The Shertukpens are an Indigenous tribal group inhabiting the western and southern parts of Arunachal Pradesh, Northeast India. They are accomplished carvers of carving wood and stone. The paper aims to document the rich cultural heritage of grinding stone implements, *Ran-thok* (grinding stone) and *Ling-chhom* (nutting stone) used by the Shertukpens for grinding and nutting of cereal grains, fruits, rhizomes, and other food products. The study employed an interview-based survey followed by focused group discussion and observations during June and July 2019. A simple *chaine operatoire* was applied to understand the entire process of manufacturing grinding stones. The results reveal that the grinding implements are examples of endangered material culture, the use of which may produce better quality flour from both nutritional and gustatory perspectives.

Keywords: India; Arunachal Pradesh; Shertukpen tribe; Indigenous culture; Grinding stone

1. Introduction and background

The study of traditional knowledge systems for sustainable development is of immense importance to understand the hidden practices of tribal communities that are not exposed much to the rest of the world (Tsering *et al.* 2015). The knowledge-holding community needs to ensure that its knowledge systems and practices are supported and recorded and that they are not locked out of the research agenda of the major institutions (Singh & Sureja 2006). The study is the first attempt to document the cultural heritage of grinding stones practiced by the Shertukpen tribes of Northeast India from an ethnographic and anthropological view of point. The term 'grinding stone' in this paper refers to the stone tools that are used to grind and pound a variety of materials, most often cereals. Terminologies used in the study included traditional mills (rotary quern and nutting stone) and mechanical mills. The terms *Chakki* (rotary quern ~~/~~ /millstone in Hindi), *Ran-thok* (a type of *Chakki* used by the Shertukpens) and *Ling-chhom* (nutting stone) have been used to represent the traditional mills.

Stone tools that played a crucial role in the daily life of hunter-gatherers, settled agriculturists, and pastoralists for centuries are used by few people in the world today. These tools are the fundamental component of food- production necessary to human survival during the past years (Ebeling & Rowan 2004). The stone tools from Upper Paleolithic were used to process plant foods, and they constitute the earliest evidence for this activity (De Beaune 1993; Piperno *et al.* 2004). Such tool kits commonly include either saddle stones or rotary querns turned by hand (Revedin *et al.* 2010). Saddle querns are the most ancient and widely used type of quern-stone which was superseded around the 5th to 4th century B.C. by the more efficient rotary querns (McLaren & Hunter 2008). Rotary querns were a common type of mill~~s~~ in Europe and the Mediterranean basin during the middle iron age that was supposedly introduced from Spain (Curwen, 1937; Moritz, 1958: 109). The earliest published example of a rotary quern in the Middle East is from 1st Century A.D. Masada, Israel (Ebeling 2019). In Central Asia including India, the introduction of rotary querns has been determined by the Soviet scholars as 3rd and 4th Century A.D. (Stančo 2018). Rotary quern~~s~~, which is ~~is~~ based on the principle of a fixed lower stone and a rotating runner stone ~~has~~ have changed very little in thousands of years (Catterall 1999; Rajasthan Agricultural Competitiveness Project 2019). On the other hand, stone tools used for ~~nut~~ nut-cracking are also known as pitted stone cobbles, anvil or nutting stones, pitted stone hammers and cupstones (M'guire 1891; Odell 1998; Adams 2002; Goren-Inbar *et al.* 2002; Roda Gilabert *et al.* 2012). Such stone tools have been presumed to be used prehistorically for crushing nuts such as hickory, etc. as foodstuffs (Walters *et al.* 2015). Nutting stones are typically small flat stones made of limestone, sandstone, or other sedimentary types of rock that could be carried by hand and the bottom stones have flat surfaces or feature one or more ground or pecked cups of various sizes, shapes, and depth (Davis 1995: 334). These stone tools have distinct local traditions laden with social as well as functional importance (Shoemaker *et al.* 2017). The surfaces of such objects may be intentionally modified during the manufacturing process, altered exclusively by use, or by a combination of these forces (Peterson 2008). Ethnographic studies documented the multiple functions of ground stone implements that are either related to or unrelated to food processing. For instance, mineral pigments, hides, small mammals, legumes, hydrophytic tubers, ferns, as well as a variety of substances for consumption such as coffee, sugar, chili, salt, and herbs (Adams 1988; Davis 1995; Dubreuil 2004; Fullagar *et al.* 2008; Hayden 1987; Jones 1986; Perry 2004; Yohe *et al.* 1991).

In India, *Chakki* ~~are~~ is used to grind grains and spices. *Chapati* (in Hindi) or unleavened bread is the staple food of the majority of the population in the Indian sub-continent. It is popularly known as *Atta* (in Hindi) or wheat flour which is obtained by grinding wheat in *Chakki* (Haridas Rao *et al.* 1986). *Chakki* ~~are~~ is attrition mill~~s~~ consisting of two circular stones mounted on a vertical axis which consists of a stationary stone cylinder upon which a smaller stone cylinder rotates (Barbosa-Canovas *et al.* 2006). The smaller ones, for household use, are operated by two people and the larger ones for community or commercial purposes use livestock to rotate the upper cylinder (Yallappa *et al.* 2019).

Arunachal Pradesh is a diverse state of India in terms of ethnicity. The state is inhabited by about 26 major tribes and more than 100 sub-tribes. In addition to the Shertukpen other major tribes are the Adi, Aka, Apatani, Bugun, Digaru Mishmi, Galo, Hill Miri (Now Nyishi), Idu Mishmi, Khamba, Khampti, Memba, Miju Mishmi, Mishing, Monpa, Nocte, Nyishi, Puroik, Tagin, Tangsa, Singpho, Sajolang, Sartang, Wancho, Yobin, and Zakhring which makes the state panoramic and distinct from the other states. The Shertukpen tribe consists of small communities residing towards the far western corner of the state in the West Kameng district (Figure 1). Agriculture is the mainstay of life for the Shertukpens who

practice both shifting and permanent cultivation. They are also keen traders. And while they have adopted Buddhism of the Mahayana sect, their religion is an interesting blend of Buddhism and Indigenous magico-religious beliefs. They are also good at wood carving and stone sculpting. The availability of raw materials such as stone and wood in the surroundings has encouraged the Shertukpen artisans to become skilled experts in making stone tools. Shertukpen livelihoods are heavily dependent on agriculture, and thus they have a long tradition of making stone tools to grind cereals like wheat, maize, millet, etc. which became invaluable to meet their food requirements. Here we attempt to document the significance of grinding stones to their livelihood, and also discuss the feasibility of improvements using modern technologies and the necessity of its preservation.

2. Study area

The study area is the West Kameng district of Arunachal Pradesh, Northeast India (Figure 1.) The district shares an international border with Tibet and Bhutan. The topography of the district is mostly mountainous with tangled peaks and valleys. Bichom, Dirang Chu and Tenga are the main rivers flowing through the district. The forest types of West Kameng range from tropical semi-evergreen to alpine, and they are a storehouse of more than 500 species of plants of medicinal and pharmacological significance. On average, the area receives 1743 mm of annual rainfall and has a mean monthly maximum and minimum temperature of 21.44˚ C and -1.24˚ C. West Kameng district has a total population of 87,013 (Census of India 2011). The inhabitants of the district are comprised mainly of Aka (Hrusso), Bugun (Khowa, Monpa), Sajalong (Miji), Sartang and Shertukpen ethnic groups. The Shertukpens largely depend on agriculture and animal products for their livelihood. The district is divided into 260 villages, 5 administrative blocks, and 13 administrative circles. The administrative circles of the district are Balemu, Bhalukpong, Bomdila, Dirang, Jamiri, Kalaktang, Kamengbari-Doimara, Nafra, Rupa, Shergaon, Singchung, Thembang, and Thrizino.

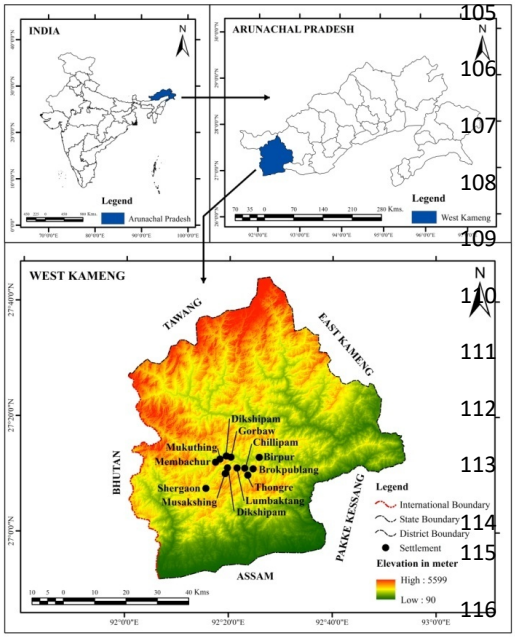

Figure 1. Location map of the study area (Source: Bapu & Nimasow, 2021)

3. Methods

The study is based on primary data collected through questionnaires, personal interviews and field observations that occurred during June and July 2019. A total sample of 120 households - 10 each from 12 Shertukpen inhabited villages - was randomly selected to carry out the survey. The names of the surveyed villages are Birpur, Brokpublang, Chillipam, Dikshipam, Gorbaw, Jigaon, Lumbaktang, Membachur, Mukuthing, Musakshing, Shergaon, and Thongre. The questionnaire consists of pertinent questions on the usage, manufacturers, manufacturing process, parts and function and other relevant information of grinding stones (Supplementary 1). The elderly people and artisans (above 60 years of age), both men and women, were also interviewed to understand the history ~~and usage~~ of grinding stones. Information on the significance of this practice and the materials used for grinding was also obtained through Focus Group Discussion with the villagers. Participant observation was another important tool for understanding the antique traditional grinding stones. Besides, the three surviving craftspeople ~~craftsperson~~ have been interviewed to understand the entire process of manufacturing grinding stones. A simple *chaine operatoire* (operational chain) was used by paying attention to the selection of raw materials, energy spent and techniques applied for shaping and converting a stone into usable products – *Ran-thok* and *Ling-chhom*. *Chaîne opératoire* is a means to break down each technological process into its elements (links in the chain). The interrelationships between the links of the chain focus on the technology itself, the socio-cultural, the political, and the ideological aspects that are expressed through human courses of action and speech (Leroi-Gourhan 1993).

4. Results

Manufacturing *Ran-thok* (rotary quern) and *Ling-chhom* (nutting stone)

The grinding stones are manufactured by specific professionals known as *Zyopo* (Figure 2) in the Shertukpen dialect. These tools are made for their own use and also sold to other members of the village on requisition. The interview with the surviving manufacturers reveals that the manufacturing process of grinding stones is an arduous and ~~time~~ time-consuming task. The time taken in manufacturing these tools depends on the consistency and the number of men involved in the work. For example: when we asked about how long it took to make a *Ran-thok*, the answer during the interview ranged between one month if two to four men are involved and two months if the manufacturer work single-handedly every day. On the other hand, the manufacturing of *Ling-chhom* is easier and less ~~time~~ time-consuming i.e. about 10 to 15 days of daily work. The manufacturing process involves the collection of raw materials, processing and finishing. The *Zyopos* informed during the interview that there are no differences between the villages in terms of the raw materials used in making stone tools. They collect ling-say (gneiss rock) from the surroundings as the preferential material for making the grinding stones. Such suitable stones are generally available in the area but sometimes they also excavate or break it from the rocks. Besides, the wooden mortar and pestle are made from *Pinus roxburghhi* (pine tree) or *Castanopsis* spp. (oak tree), depending on the availability in the vicinity. ~~Majority~~ The majority of the time is spent in the processing of the materials as they use indigenous tools like hammer, hoe, chisel, etc. for shaping, polishing and finishing the grinding stones. These tools are made of iron with wooden and plastic handles. Name of some of the common tools in their dialect are *Chapzee Achandu* (Figure 3a), *Chanzee* (Figure 3b), *Nzongbee* (Figure 3c), and *Thung* (Figure 3d). The mean size of the finished product slightly varies in

different villages due to wear and tear during the manufacturing process. The details of stone tools, average mean size and raw materials used are shown in Table 1.

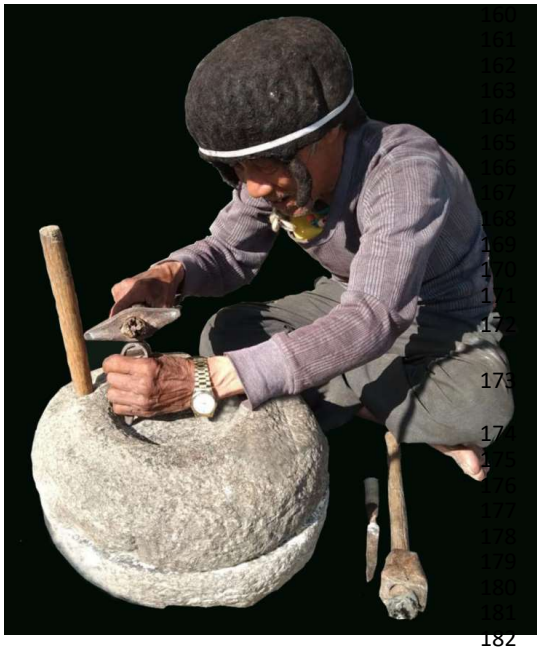

Figure 2. Rinchin Dorjee Megeji (*Zyopo*) at work

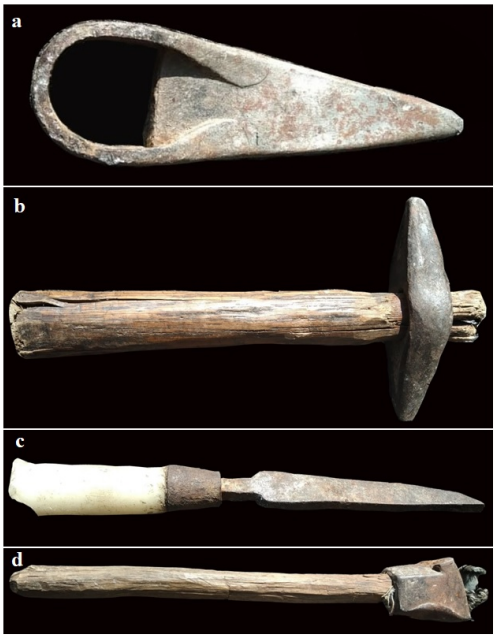

Figure 3(a). *Chapzee Achandu* (b). *Chanzee* (c). *Nzongbee* (d). *Thung*

(Photo by K. D. Thongdok)

Table 1. Types of grinding tools, average size and raw materials used

Types of grinding stones	Parts	Average size (in cm)	Raw materials used
Ran-thok (Rotary quern)	Lower stone	Diameter = 40 Thickness = 10	Gneiss stone
	Upper stone	Diameter = 40 Thickness = 15	Gneiss stone
	Wooden plank	Length = 115 Breadth = 75	*Castanopsis* spp.
Ling-chhom (nutting stone)	Nutting stone	Length = 60 Width = 30 Height = 45	Gneiss stone
	Wooden pestle	Length= 150	*Pinus roxburghii*

Parts and function of *Ran-thok* and *Ling-chhom*

The traditional *Ran-thok* (grinding stone) comes in pairs (Figures 2a). The base consists of wooden planks (made of *Castanopsis* spp.), 115cm x 75cm, which form a bent structure known as *bleng* (Figure 2b). The *bleng* stabilizes the stones while also collecting the flour that comes out of grinding. The rounded base or lower stone, diameter 40cm, thickness 10cm, and known as the *uukhu*, is stationary (Figure 2d). Above

the lower stone is the *getheng* (upper stone), diameter 40cm, thickness 15cm. The *getheng* does the actual grinding (Figure 2c). The upper stone spins above the stationary lower stone creating the grinding action of the stones. It is generally slightly concave, while the lower stone is slightly convex. This helps to channel the flour that comes out of grinding to the outer edges of the stones where it can aggregate for collection. A wooden handle known as the *enyi* is fixed on a corner of the runner stone for turning it. A short lever on the centre of the lower stone connects with a small hole at the centre of the runner stone as a support for holding both the stones. A small hole is made on the upper stone where the grains are poured to be slowly ground. *Ran-thok* is mostly operated by the women either single or double in sitting gestures (Figure 3).

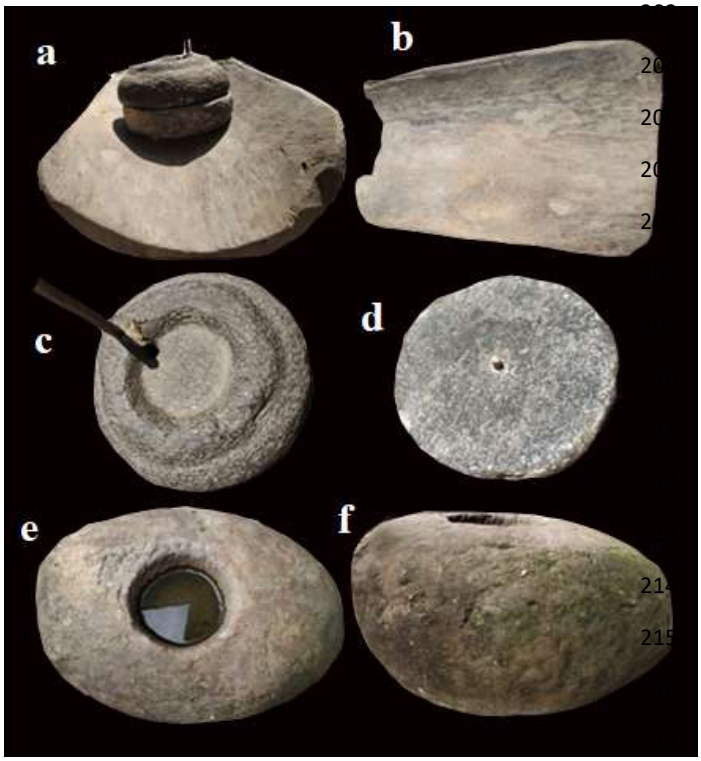

Figure 2(a). *Ran-thok* (b). *Bleng* (wooden plank) (c). *Getheng* (Upper stone) (d). *Uukhu* (lower stone) (e&f). *Ling-chhom* (nutting stone). Photos by N. J. Thongdok

There are two types of nutting tools used by the Shertukpens – one made of gneiss, ~~and~~ known as *Ling-chhom* and another, made of wood, known as *Hing-chhom* (Figures 2e, 2f). The nutting stone is oval in

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shape with a length, width, and height dimensions of 60cm, 30cm, and 45cm, respectively. –The ~~the~~ wooden tool is 20cm in diameter and 60cm in height. Interactions with the villagers revealed that these tools were largely used for breaking corn grains into coarse-ground cornmeal and cracking nuts. The grains are put into the hole and pounded by a wooden pestle (made of *Pinus roxburghii*) known as *chang-khey* – which is about 150cm. Some nutting stones and pestles can be quite large. Generally, women either single or double in standing gesture pounds corn grains or crack nuts (walnut) in the *Ling-chhom* (Figure 4).

Figure 3. Shertukpen woman grinding millet using *Ran-thok* (Photo by N. J. Thongdok).

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Figure 4. Shertukpen girl pounding corn grains in a nutting stone (Photo by N. J. Thongdok).

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According to villagers, the use of these tools is not specific to them, as the neighboring tribes also used similar tools. During the survey, the grinding stones especially *Ran-thok* was observed in the majority of the households. The grinding and pounding activities are mostly performed by the women (Figure 3 & 4). However, it is not specific to them only as men occasionally help them. They further reported that the usage and importance of these grinding stones in recent years has declined due to convenient access to commercially produced flour and mechanical mills. Traditionally, wheat, millet, corn, and barley were important crops for food but nowadays rice and other readily available food items are preferred more by the younger generations. Consequently, changing food habits have limited the use of these tools to ~~the~~ remote and inaccessible villages only. The villagers, particularly in rural areas, reported that they still largely depend on the grinding stones for processing food items as it is linked to their age-old tradition. They also reported that grinding and pounding activities provide opportunities for social interactions such as merrymaking, and performing folk songs with fellow friends. So, the interviewed villagers expressed interest to continue grinding and pounding practices into the future for both meeting food requirements and ~~to develop~~developing interpersonal relationships in traditional ways.

5. Discussion

The Shertukpens pay attention while sculpting and selecting the type of stones for easy and quick grinding of cereals as the right profile and accurate gap between the stones is important for the better quality of flour that comes out of grinding. However, the traditional grinding stones are increasingly lacking in proper sculpting and maintenance of the gap between the stones as the tools are very old and handed over from one generation to another generation. The accurate gap between the stones is an important consideration because *too big* a gap or *unbalanced stones* result in coarse or poorly ground flour. Through this study, it is learned that the manufacturing of grinding stones is a complex process that requires skills, knowledge and hard work. Nixon-Darcus & Meresa (2020) also reported similar findings in northeastern Tigrai. The study found that grinding traditions have been impacted by changing livelihoods and new grinding technologies. However, the villagers in rural areas have retained the use of some grinding stone ~~grinding stone~~ tools despite these not always being the most efficient options. This is consistent with similar findings on grinding stone studies in Africa (Shoemaker *et al.* 2017). The stone used for a quern needs to be resistant to wear and durable. Generally, manual querns are made from different rock types; preferably of igneous origin. The reported use of gneiss in rotary querns by the Shertukpens ~~is in conformity~~conforms with the Celtic rotary querns of the Czech Republic (Waldhauser 1981). These stone tools are environment-friendly in compare to the mechanical mills because it is manufactured from the natural resources that are easily available in the area and operates through manual labour that produces less noise. These traditional mills have been reported to develop flour of the highest quality. Stone milling has been found to have very little effect on macro-element losses and no effect on micro-element losses thereby producing flours with high nutritional value (Albergamo *et al.* 2018). Traditional *Chakki*-milled flour is preferred over mechanical-milled by the consumers of the Indian sub-continent for its taste and texture due to the burning effect and carotenoid content which noticeably improve the flavour. However, despite the taste people tend to consume more flour from mechanical mills as it is cheaper and easily available. Stone grinding breaks the starch sufficiently to release extra sweetness while burning it slightly gives a subtle smokey flavour (McKee 2012). It also has nutritional

superiority in terms of higher dietary fiber, Vitamin E content and dietary minerals (Rajasthan Agricultural Competitiveness Project 2019). Thus, the flour produced by traditional grinding stones has a nutritional and gustatory advantage over the mechanical mills. However, the considerable heat generated due to friction in stone milling was found to damage the starch, protein, and unsaturated fatty acids which have impacted shelf-life and product quality (Prabhasankar & Rao 2001).

The grinding stone tool assemblages are useful in reconstructing the past human, plant, and other substance interactions and interpreting the objects as materializing aspects of social life (Shoemaker *et al.* 2017). The study found that grinding traditions have been impacted by changing livelihoods and new grinding technologies. However, the villagers in rural areas have retained the use of some grinding stone ~~grinding stone~~ tools despite these not always being the most efficient options. This is consistent with similar findings on grinding stone studies in Africa (Shoemaker *et al.* 2017). Grinding practices in many societies, including the Shertukpens, are linked with the socialization process which is crucial for sustaining interpersonal relations (Hamon & Le Gall 2013). Ethnographic studies in Ghana (Goody 1982) and Ethiopia (Nixon-Darcus & D'Andrea 2017) stated that ~~woman~~ women working together can result in beneficial social interactions such as singing, chatting about community and family, getting more *other* work done, and enjoying each other's company. Nixon-Darcus (2014) emphasized that the move to mechanical mills has largely relaxed the strenuous and difficult work of grinding in Northern Ethiopia but it may have significant implications on the community engagements and cooperation that was previously facilitated through grinding practices. Therefore, local mechanical mills can be set up with reasonable prices and working procedures to create cooperation opportunities and socialization process.

6. Conclusions

The indigenous grinding stones reported in this study are considered to be laborious and time-consuming (Hayden 1987; Searcy 2011) but the manufacturing and operating monetary costs are zero, in terms of cash outlay. They are also environment-friendly tools made from ~~the~~ natural resources that produce less noise. The Shertukpens, in rural areas, are still dependent on the grinding stones for food processing. It is linked to their age-old tradition and also provides opportunities for social interactions. However, with the advent of globalization, traditional practices have been diluted by the external actors of modern milling technologies, and mass production of affordable, mechanical mills (Bapu *et al.* 2020). The introduction of mechanical mills (Nixon-Darcus & Meresa 2020) and affordable access to readymade flours in the markets have largely decreased the utilization of grinding stones in recent years. So, there is a need for efforts that encourage villagers to continue such sound and healthy practices with little modifications to ensure high-quality flour. The possibilities of modifying indigenous grinding stones with modern power tools could be disseminated to the Shertukpens for sustaining such endangered material culture.

Glossary

Shertukpen	***English***
bleng	curved wooden plank
chang-khey	wooden pestle
enyi	wooden handle
getheng	upper stone
hing-chhom	wooden nutting stone
ling-chhom	nutting stone

ling-say	gneiss rock
ran-thok	grinding stone
Shertukpen	Indigenous tribal group, Arunachal Pradesh, India
uukhu	lower stone
zyopo	grindstone makers

Hindi	***English***
atta	wheat flour
chakki	mill stone
chapati	unleavened bread

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Data accessibility statement

All data used in the manuscript are accessible and included in the text. The data is unrestricted and the authors are ready to comply with the journal's policy regarding data availability and research reproducibility.

List of supplementary files

Nil

Conflict of interest

The authors of this article declare that they have no financial conflict of interest with the content of this article.

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