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. This paper reports on the use of traditional stone implements, ran-thok (grinding stone) and ling-chhom (nutting stone) for the grinding and nutting of grains, fruits, rhizomes, and other food products. These grinding implements are examples of endangered material culture, the use of which may produce better quality flour from both nutritional and gustatory perspectives.

Keywords: Indigenous; Grinding stone; Flour; Shertukpen tribe; Arunachal Pradesh

1. Introduction and background

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 components of food production necessary to human survival during the past years (Ebeling & Rowan 2004). The term *grinding stone* in this paper refers to the use of two stone grinding plates between which the materials, most often cereals are ground. The process of using stones to grind cereals into flour or meal is an ancient tradition. Neolithic and Upper Paleolithic people used millstones to grind grains, nuts, rhizomes, and other vegetable food products for consumption (De Beaune 1993; Piperno *et al.* 2004). These implements are often called grinding stones. These tools have distinct local traditions laden with social as well as functional importance (Shoemaker *et al.* 2017). Grinding stone tool kits commonly include either saddle stones or rotary querns turned by hand (Revedin *et al.* 2010). 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).

Nutting stones have long been presumed to be used prehistorically for crushing nuts such as hickory, etc. as foodstuffs (Walters *et al.* 2015). According to Davis (1995: 334), it is typically a small flat stone made of limestone, sandstone, or other sedimentary types of rock that could be carried by hand. The bottom stones may have flat surfaces or they may feature one or more ground or pecked cups of various sizes, shapes, and depth. He further postulated that these stones were used for various purposes such as cracking nuts, mixing pigments, milling herbs and seeds, or as an anvil for flint knapping.

In India, chakki (mill stones) are used to grind grains and spices. Chapati (unleavened bread) is the staple food of the majority of the population in the Indian sub-continent. It is popularly known as atta (wheat flour) which is obtained by grinding wheat in chakki (Haridas Rao *et al.* 1986). Chakki are attrition mills 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 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, Galo, Khampti, Mishmi, Monpa, Nocte, Nyishi, Tagin, Tangsa, Singpho, Sajolang, and Wancho, etc. which makes the state panoramic and distinct from the other states.

The Shertukpen tribe consists of small communities residing in Jigaon, Kamengbari-Doimara, Rupa, Shergaon, and Thongre, 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. However, declining availability of raw materials such as wood and bamboo has encouraged Shertukpen artisans to adapt to their environment and 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. These skills and the grinding stones they created became invaluable to villagers for grinding different products to meet their food requirements. Here we attempt to report the significance of traditional grinding stones to tribal livelihoods, and also discuss the feasibility of improvements using modern technologies.

2. Methods

The study is based on primary data collected through 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 elderly people and artisans, both men and women, were 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.

2.1. Study area

The study area is 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.

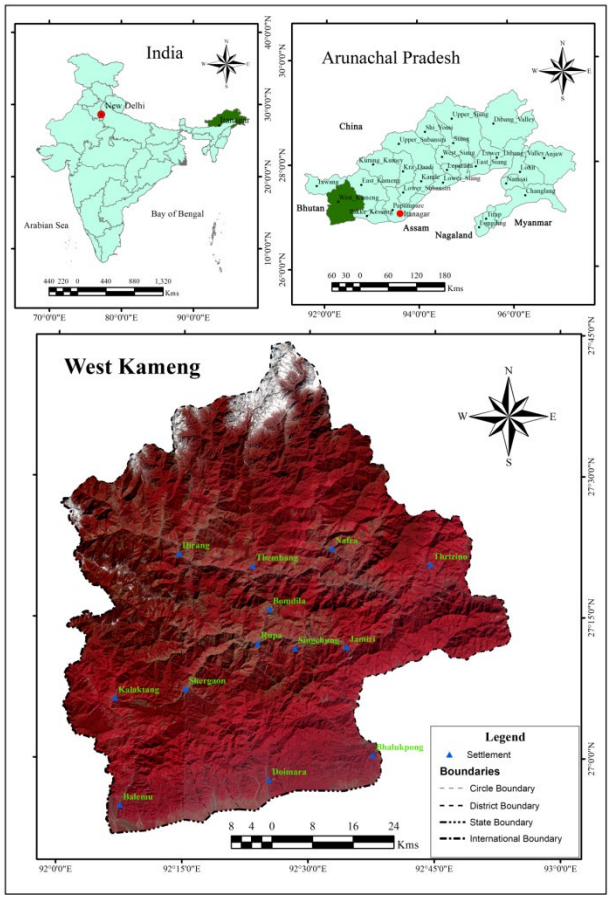

Figure 1. Location map of the study area (Source: Bapu & Nimasow 2021).

3. Results

The makers of grinding stones are known as zyopo in the Shertukpen dialect. The traditional ran-thok (grinding stone) comes in pairs and the dimensions vary slightly in different villages based on the availability of materials (Figures 2a). The base consists of wooden planks, 115 cm x 75 cm, which form a bent structure known as bleng (Figure 2b). The bleng stabilizes the stones while also collecting the flour. The rounded base or bedstone, diameter 40 cm, thickness 10 cm, and known as the uukhu, is stationary (Figure 2c). Above the bedstone is the getheng (turning runner stone), diameter 40 cm, thickness 15 cm. The gething does the actual grinding (Figure 2d). The runner stone spins above the stationary bedstone creating the grinding action. It is generally slightly concave, while the bedstone is slightly convex. This helps to channel the flour 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 bedstone 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 grounded by the stones. Villagers reported that they collect ling-say (gneiss rock) from the surroundings as the preferential material for making grinding stones.

Figure 2. Ran-thok and Ling-chhom.

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 shape with a length, width, and height dimensions of 60cm, 30cm, and 45cm, respectively. 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. The grains are put into the hole and pounded by a wooden pestle known as chang-khey – which is about 150cm. The nutting stones are made from gneiss and wooden mortar & pestle are made from pine or oak, depending on available in the vicinity. Some nutting stones and pestles can be quite large (Figure 3). According to villagers, the use of these tools is not specific to them, as the neighboring tribes also used similar tools. Further reports identified that declining usage and importance of these grinding stones in recent years due to convenient access to commercially produced flour and diesel operated grinding mills.

Figure 3. Shertukpen girl pounding grain in a nutting stone.

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 (Figure 4). They also reported that grinding and pounding activities provide opportunities for social interactions such as merrymaking, and performing folk songs with fellow friends. So, they expressed interest to continue grinding and pounding practices

into the future for both meeting food requirements and to develop interpersonal relationships in traditional ways.

Figure 4. Shertukpen woman grinding cereal.

4. Discussion

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 present study is based on the principle of a fixed bedstone and a rotating runner stone which has changed very little in thousands of years (Catterall 1999; Rajasthan Agricultural Competitiveness Project 2019).

The Shertukpens take care 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 better quality flour. 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 flour due to poorly ground cereals. The traditional method of grinding cereals between stones has 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). Chakki-milled flour is preferred over roller-milled flour 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. Stone grinding breaks the starch sufficiently to release extra sweetness while burning it slightly gives it a subtle smoky flavor (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 modern roller 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 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 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. The move to mechanical mills has largely relaxed the strenuous and difficult work of grinding but it may have significant implications on the community engagements and cooperation that was previously facilitated through grinding practices (Nixon-Darcus 2014). Therefore, local mechanical mills can be set up with reasonable prices and working procedures to create cooperation opportunities and socialization process.

5. Conclusions

The indigenous grinding stones reported in this study are considered to be laborious and time-consuming (Hayden 1987; Nixon-Darcus 2014; Searcy 2011) but the manufacturing and operating monetary costs are *zero*, in terms of cash outlay. They are also environment-friendly. 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	turning runner 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	bedstone
zyopo	grindstone makers
Hindi	***English***
atta	wheat flour
chakki	mill stone
chapati	unleavened bread

Acknowledgements

The authors are thankful to all the villagers for cooperation and sharing information about grinding stones during the field survey. We are also thankful to the Department of Geography, Rajiv Gandhi University, Rono Hills, Doimukh for infrastructural support in accomplishing the work.

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 journal's policy regarding data availability and research reproducibility.

List of supplementary files

Nil

References

Adams, J.L. 1988, Use-Wear Analyses on Manos and Hide-Processing Stones. *Journal of Field Archaeology*, 15(3): 307–315. https://doi.org/10.1179/009346988791974394

Albergamo, A., Bua, G.D., Rotondo, A., Bartolomeo, G., Annuario, G., Costa, R. & Dugo, G. 2018, Transfer of major and trace elements along the "farm-to-fork" chain of different whole grain products. *Journal of Food Composition and Analysis*, 66: 212–220. https://doi.org/10.1016/j.jfca.2017.12.026

Bapu, T.D. & Nimasow, G. 2021, An assessment of the population status of the threatened medicinal plant *Illicium griffithii* Hook.f. & Thomson in West Kameng District of Arunachal Pradesh, India. *Journal of Threatened Taxa,* 13(1): 17504–17512. https://doi.org/10.11609/jott.6082.13.1.17504-17512

Bapu, T.D., Nimasow, G. & Nimasow, O.D. 2020, Role of indigenous belief systems in conservation of animals among the Monpa and Shertukpen tribes of Arunachal Pradesh (India). *Shodh Sanchar Bulletin*, 10(38): 155–162.

Barbosa-Canovas, G.V., Ortega-Rivas, E., Juliano, P. & Yan, H. 2005, *Food Powders: Physical Properties, Processing, and Functionality*. Springer-Verlag, US. 372 p.

Catterall, P. 1999, Flour milling. In: *Technology of Breadmaking* (Cauvain, S.P. & Young, L.S., Eds.), Springer, Boston: p. 296-329. https://doi.org/10.1007/978-1-4757-6687-5_12

Census of India, 2011, *Primary Census Abstracts*. Registrar General of India, Ministry of Home Affairs, Government of India, Retrieved: 10 December 2020. URL: https://www.censusindia.gov.in/2011census/PCA/pca_highlights/pe_data.html

Davis, D.J. 1995, *Prehistoric Artifacts of Texas Indians*. Pecos Publishing Co., Ft. Sumner, New Mexico. 449 p.

De Beaune, S. 1993, Non-flint stone tools of the early Upper Paleolithic. In: *Before Lascaux: The complex record of the Early Upper Paleolithic* (Knecht, H., Pike Tay, A. & White, R. Eds.), CRC Press Inc., Boca Raton: p. 163–191.

Dubreuil, L. 2004, Long-term trends in Natufian subsistence: a use-wear analysis of ground stone tools. *Journal of Archaeological Science*, 31: 1613–29. https://doi.org/10.1016/j.jas.2004.04.003

Ebeling, J.R. & Rowan, Y.M. 2004, The Archaeology of the daily grind: Ground stone tools and food production in the Southern Levant. *Near Eastern Archaeology*, 67(2): 108–117. https://doi.org/10.2307/4132366

Fullagar, R., Field, J. & Kealhofer, L. 2008, Grinding stones and seeds of change: starch and phytoliths as evidence of plant food processing. In: *New Approaches to Old Stones: Recent Studies of Ground Stone Artifacts* (Rowan, Y.M. & Ebeling, J.R., Eds.), Equinox Publishing, London: p. 159–172.

Goody, J. 1982, *Cooking, cuisine, and class: A study in comparative sociology*. Cambridge University Press, Cambridge. 253 p.

Hamon, C. & Le Gall, V. 2013, Millet and sauce: The uses and functions of querns among the Minyanka (Mali). *Journal of Anthropological Archaeology,* 32: 109–121. https://doi.org/10.1016/j.jaa.2012.12.002

Haridas Rao, P., Leelavathi, K. & Shurpalekar, S.R. 1989, Effect of damaged starch on *chapati* making quality of whole wheat flour. *Cereal Chemistry*, 66: 329–333.

Hayden, B. 1987, Past to present uses of stone tools in the Maya Highlands. In: *Lithic Studies Among the Contemporary Highland Maya* (Hayden, B., Eds.), University of Arizona Press, Tucson: p. 160–234

Jones, C.E.R. 1986, Archaeochemistry: fact or fancy? In: *The Prehistory of Wadi Kubbaniya* (Close, A.E., Eds.), Southern Methodist University Press, Dallas: p. 260–266.

Mckee, D. 2012, Lifting the screen on Indian milling. *World Grain*, 30: 40–45.

Nixon-Darcus, L. & D'Andrea, A.C. 2017, Necessary for Life: Studies of Ancient and Modern Grinding Stones in Highland Ethiopia. *African Archaeological Review,* 34(2): 193–223. https://doi.org/10.1007/s10437-017-9252-4

Nixon-Darcus, L. & Meresa, Y. 2020, Men at work: Grinding stone production by the experts and others in northern Ethiopia. *Journal of Lithic Studies*, 7(3): 1–24. https://doi.org/10.2218/jls.3091

Nixon-Darcus, L. 2014, *The cultural context of food grinding equipment in Northern Ethiopia: an ethnoarchaeological approach*. Master of Arts thesis at the Archaeology Department, Simon Fraser University, Burnaby, 343 p.

Perry, L. 2004, Starch analyses reveal the relationship between tool type and function: an example from the Orinoco valley of Venezuela. *Journal of Archaeological Science*, 31: 1069–1091. https://doi.org/10.1016/j.jas.2004.01.002

Peterson, J. 2008, New insights from old stones: a survey of ground stone studies. In: *New Approaches to Old Stones: Recent Studies of Ground Stone Artifacts* (Rowan, Y.M. & Ebeling, J.R., Eds.), Equinox Press, London: p. 361–370.

Piperno, D.R., Wiess, E., Holst, I. & Nade, D. 2004, Processing of Wild Cereal Grains in the Upper Palaeolithic revealed by starch grain analysis. *Nature*, 430: 670–673. https://doi.org/10.1038/nature02734

Prabhasankar, P. & Rao, P.H. 2001, Effect of different milling methods on chemical composition of whole wheat flour. *European Journal of Food Research and Technology*, 213: 465–469. https://doi.org/10.1007/s002170100407

Rajasthan Agricultural Competitiveness Project, 2019, Detailed project report on Aata Chakki and Roller Flour Mill, Prepared by Grant Thornton India LLP, New Delhi. Retrieved: 25 December 2020. URL: http://www.agriculture.rajasthan.gov.in/content/dam/agriculture/Rajasthan%20Agricultural%20Competitiveness%20Project/ABPFTechDPR/RACP_ABPF_Tech%20DPR_Wheat%20flour%20Mill.pdf

Revedin, A., Aranguren, B., Becattini, R., Longo, L., Marconi, E., Lippi, M.M., Skakun, N., Sinitsyn, A., Spiridonova, E. & Svoboda, J. 2010, Thirty thousand-year-old evidence of plant food processing. *Proceedings of the National Academy of Sciences of the United States of America*, 107(44): 18815–18819. https://doi.org/10.1073/pnas.1006993107

Searcy, M.T. 2011, *The Life-Giving Stone: Ethnoarchaeology of Maya Metates*. University of Arizona Press, Tucson. 168 p.

Shoemaker, A.C., Davies, M.I. & Moore, H.L. 2017, Back to the Grindstone? The Archaeological potential of Grinding-Stone studies in Africa with reference to contemporary grinding practices in Marakwet, Northwest Kenya. *African Archaeological Review*, 34: 415–435. https://doi.org/10.1007/s10437-017-9264-0

Singh, R.K. & Sureja, A.K. 2006, Community knowledge and sustainable natural resources management: Learning from *Monpa* tribe of Arunachal Pradesh. *The Journal for Transdisciplinary Research in South Africa*, 2(1): 73–102.

Tsering, G., Nimasow, G. & Nimasow, O.D. 2015, Chuskor: an indigenous watermill for sustainable resource utilization by the Monpa tribes of Arunachal Pradesh, India. *Current Science*, 109(2): 247–250.

Walters, M., Bozarth, S. & Guderjan, T.H. 2015, An examination of six “Nutting stones” from East Texas for plant phytoliths. *Index of Texas Archaeology: Open Access Gray Literature from the Lone Star State*, 54: 93–100. https://doi.org/10.21112/.ita.2015.1.37

Yallappa, D., Mathad, P.F., Nidoni, U.K., Gururaj, T., Roopabai, R.S., Ambrish, S.G. & Kenchappa, C. 2019, Performance evaluation of pedal operated flour mill with multi-applications. *Journal of Pharmacognosy and Phytochemical*, 8(2): 1250–1254.

Yohe, R.M., Newman, M.E. & Schneider, J.S. 1991, Immunological identification of small-mammal proteins on aboriginal milling equipment. *American Antiquity*, 56: 659–666. https://doi.org/10.2307/281543