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ORIGINAL ARTICLE

Back to the Grindstone? The Archaeological Potential of Grinding-Stone Studies in Africa with Reference to Contemporary Grinding Practices in Marakwet, Northwest Kenya

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Abstract This article presents observations on grinding-stone implements and their uses in Elgeyo-Marakwet County, northwest Kenya. Tool use in Marakwet is contextualized with a select overview of literature on grinding-stones in Africa. Grinding-stones in Marakwet are incorporated not only into quotidian but also into more performative and ritual aspects of life. These tools have distinct local traditions laden with social as well as functional importance. It is argued that regionally and temporally specific studies of grinding-stone tool assemblages can be informative on the processing of various substances. Despite being common occurrences, grinding-stone tools are an under-discussed component of many African archaeological assemblages. Yet the significance of grinding-stones must be reevaluated, as they hold the potential to inform on landscapes of past food and material processing.

Résumé Cet article présente des observations ethno-archéologiques sur les outils de pierre meulière et leur utilisation dans le comté d'Elgeyo-Marakwet, au nord-ouest du Kenya. En s'appuyant notamment sur des exemples issus de la période néolithique pastorale en Afrique de l'Est, il contextualise l'utilisation d'outils à Marakwet en termes d'études sélectionnées portent sur les pierres de meulage en Afrique. Nous soutenons que les études spécifiques à la région portent sur les assemblages d'outils de pierre meulière peuvent aider à avancer nos connaissances sur le traitement de diverses substances. Par ailleurs nous constatons que la pierre meulière fait partie non seulement de la vie quotidienne, mais aussi des aspects performatifs et rituels de la vie à Marakwet. Les outils de pierre meulière font partie des traditions locales distinctes, chargées d'importance sociale et fonctionnelle. Malgré le fait qu'ils soient banals, les outils de pierre meulière sont des composants significatif et pourtant peu discutés de nombreux assemblages archéologiques africains. Nous avançons que la signification de la pierre meulière doive-t-être réévaluée, car elle est essentielle pour mieux comprendre les circonstances de l'alimentation et du traitement des matériaux dans le passé.

Keywords Marakwet · Grinding-stones · Food processing

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Introduction

Grinding-stone tools are a long-established technological tradition embedded in the livelihoods of hunter-gatherers, pastoralists, and agriculturalists alike. Throughout Africa, these implements come in a variety of morphological forms differing in functional and

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symbolic importance, though the interpretive potential of these seemingly self-evident tools has yet to be fully realized. This paper presents data from observations of grinding implements and processing techniques in Marakwet, northwest Kenya. We offer technical descriptions of Marakwet grinding-stone assemblages and discuss the myriad of determinants impacting the relationship between their form and function. We identify distinct "communities of grinding practice" amongst the Pokot and Marakwet people. Grinding-stone tools are considered here as objects of material culture intrinsically linked to traditions of food, health, socialization, and socializing. This study is offered as a general contribution to the ethnographic literature and as a more detailed source of quantitative data against which other archaeological grinding-stone studies may be compared.

We begin with a review of the broader literatures on African grinding-stone tools in order to contextualize our findings from Marakwet and emphasize some of the inherent assumptions in and potential points of intersection with previous work. The African archaeological record hints at associations between the proliferation of grinding-stone tools, intensified plant resource consumption, and transitions to food production. The presence of grinding-stones has been used as proxy evidence for the exploitation of ground cereal grains and the subsequent development of food production in Africa (e.g., Camps 1980; McBurney 1967; Robertshaw and Collett 1983) and elsewhere (e.g., Byrd 1989; Diehl 1996; Gilman 1988; Hard et al. 1996; Henry 1989; Lancaster 1984; Mauldin 1993; Morris 1990; Plog 1974; Willcox and Stordeur 2012). However, the intensified processing of plant resources with grinding-stone tools does not always have to be evaluated as an indicator of cereal domestication. Grinding-stone tools are used in the processing of wild species, or plants that are cultivated but not morpho-genetically domesticated, offering insights into these oft-overlooked resources. In some communities, the manufacturing of pigments, metal implements, and ceramics are also tasks featuring grinding-stones. Grinding-stones are multipurpose tools at their core, and there is no simplistic relationship between form and function. Interpretations of grinding-stone tool assemblages have to take into account factors such as access to raw materials, regularity of tool use, and the symbolic importance of grinding in different cultural contexts. Grinding-stones defy categorization to such realms as ritual or technical. Like other artefacts, grinding-stones have biographies, and ethnographic studies have shown how their functions, forms, contextual association, and meaning can all change over time.

Standardized descriptive and classificatory reports are essential to the study of grinding-stone tools and to understanding the links between morphology, manufacture, and function (Rowan and Ebeling 2008, p. 11). Also important, however, are studies of grinding-stone tools that examine their use as aspects of performative and social participation in human relations as "technology produces more than things" (Dobres 2000, p. 109). While focusing on technical, functional, and morphological aspects of grinding-stone assemblages, we also provide examples of African grinding-stones in archaeological contexts that evoke grinding as a socially and culturally embedded practice. We hope that this study will encourage novel analyses of grinding-stone materials in eastern Africa and further afield.

A Note on Terminology

Basic distinctions between grinding-stone tool types are often not clear, and there is a lack of agreed-upon typological classification (see Wright 1992). For the purpose of clarity in this paper, *grinding-stones* will be used as a catchall term for stone tools used to pound and grind a variety of materials, including plant matter, but also other organic and inorganic substances such as clays, pigments, and metals. Grinding-stones are also distinguished in this article from the broader category of ground-stone tools which are any lithic artefacts formed through abrasion. Lower grinding-stones predominantly utilized in a back and forth motion will be called *grinding-slabs*, and their upper stone counterparts will be referred to as *flat-handstones*. The term *mortar* refers to any deeply concave lower stone predominantly used with an upper mobile *pestle* for pounding and/or rotary grinding.

Grinding-Stones in the African Archaeological Record

African archaeological assemblages attest to the importance of grinding-stones for pounding vegetative matter and other materials since the first appearance of

anatomically modern humans and continuing into current times (e.g., Ambrose 1998; Clark and Kleindienst 2001; De Beaune 1993; Leakey 1971; Maguire 1965; Rosso et al. 2016; Van Peer et al. 2003; Yellen et al. 1995). There are, of course, differences between the grinding-stone tool repertoires used by foragers during the Middle Stone Age and those used more recently in Africa. In general, there has been a proliferation of grinding-stone tool forms used for activities other than "pounding" and "pestling" (de Beaune 2004). Yet there is also evidence for deep continuity and resilience in tool-use traditions. Grinding-stone tools have been grinding ochre for hundreds of millennia (Zipkin et al. 2016). Grinding-stones may have even been used in the processing of wild cereal grains such as sorghum as early as ca. 100,000 years ago (Mercader 2009; Nic Eoin 2016). Intensification in the use of resources and incorporation of plant species into livelihoods and culinary ranges throughout African history has no doubt been influenced by millennia of related processing and consumption traditions involving grinding-stone tools.

Relationships between plants and people wherein plant species are harvested and processed, and some degree of mutual dependence develops, establish the conditions for plant domestication to potentially occur. The processing of plant foods with grinding-stone tools is one such avenue of subsistence intensification that could generate dependence (Stahl 1989). In southwest Asia during the late Pleistocene, increases in grinding-stone tools are taken to indicate a prelude to cereal domestication (Wright 1994) and Hodder (2012, p. 199) has argued that grinding-stones in this region were part of an entangled web of plant-use intensification leading to domestication.

The proliferation in the number and distribution of grinding-stone tools from the late Pleistocene/early Holocene in the Sahara/Sahel region is frequently interpreted as evidence for the intensive processing of wild geophytes and grasses such as sorghum and small millets (di Lernia 2001; Haaland 1995; Huysecom et al. 2004; Kuper and Riemer 2013; Wasylikowa et al. 1995; Wendorf et al. 1989; Wendorf and Schild 2001). The Sahara is also the region where Africa's first indications of domesticated plants are found. In Egypt and Sudan, southwest Asian cereal crops such as wheat and barley were consumed along with wild savannah-adapted millets ca. 7500–6500 BP (Madella et al. 2014; Wetterstrom 1993). The earliest archaeobotanical evidence for an African domesticate similarly comes from the western Sahara/Sahel region, in the form of pearl millet (*Pennisetum glaucum*) ca. 4500 BP (Manning et al. 2011). The long-established grinding-stone tool traditions and early transitions to agricultural lifeways in the Sahara/Sahel region suggest links between plant resource processing, using grinding-stone tools and an intensified reliance on cereals, that have yet to be fully understood.

Grinding-stone tools also provide insight on the relationships between people and plants characterized by intensification, but not necessarily farming of domesticated species. Plant species have been harvested and processed with grinding-stone tools for millennia without becoming morpho-genetically domesticated. Amongst Kintampo communities in sub-Saharan West Africa ca. 5000 years ago, a concomitant increase in grinding-stone tools with the presence of domesticated crops and livestock and more pronounced degrees of trade and sedentism are taken together as evidence for intensified food production (Stahl 1993). Some of these Kintampo grinding-stones are grinding grooves, thought to be used for finishing ground-stone axes (Casey 2013). Other grinding-stones were likely used to process plants such as pearl millet and cowpea (*Vigna unguiculata*), though the importance of wild tropical forest margin species such as oil palm (*Elaeis guineensis*), incense tree (*Canarium schweinfurthii*), and hackberry (*Celtis*) are also noted in the archaeobotanical record (D'Andrea et al. 2001, 2007; D'Andrea and Casey 2002; Flight 1976, pp. 216–217; Stahl 1985). Kintampo oil palm exploitation was significant, and the recovery of often highly fragmented pericarp remains may be due to the crushing of endocarps with grinding-stones to produce palm oil (D'Andrea et al. 2006). Grinding-stone tools can provide insight into the largely unknown ways in which African people chose to invest in the processing of wild plant resources in the past.

Grinding-stone tool repertoires also have the potential to reveal patterns in plant resource use in societies long after transitions to farming have occurred. This is evident in the Gulo Makedo region of northern Ethiopia where research has demonstrated that the surface of grinding-stones can be indicative of both the type and quantity of grain being processed (Nixon-Darcus and D'Andrea 2017). As has been noted elsewhere, variations in the size of grinding-stone tools are linked to changes in the capacity and efficiency of grinding activities (Dubreuil 2004; Hard et al. 1996; Mauldin 1993). At the pre-Aksumite site of Mezber in Gulo Makedo, the flat-handstones with the largest use-surface areas were found to date to the

occupation period characterized by the grandest architecture, when inhabitants may have been producing flour "beyond the needs of the immediate household" (Nixon-Darcus and D'Andrea 2017, p. 219). Nixon-Darcus and D'Andrea (2017) further observed that amongst contemporary people in Gulo Makeda, lower grinding-stones and, to a lesser extent, handstones with coarse use-surfaces are used to process large cereal grains such as sorghum (*Sorghum bicolor*), wheat (*Triticum* spp.), barley (*Hordeum vulgare*), and maize (*Zea mays*), while other grinding-stones with smoother articulation surfaces are used for grinding t'ef (*Eragrostis tei*) and finger millet (*Eleusine coracana*). Grinding-stones recovered from Mezber were found to have both coarsely textured and finely textured working surfaces, suggesting both large- and small-grained cereals were being processed here throughout the pre-Aksumite period. The smooth articulation surfaces of some grinding-stones from Mezber raise the possibility that t'ef and finger millet were being processed at the site from 1600 BCE, prior to the earliest archaeobotanical evidence for the cultivation of these crops (Nixon-Darcus and D'Andrea 2017). In southern Africa Late Iron Age grinding-stone typologies have also been used as proxy evidence for the processing of either sorghum and millet or maize (Huffman 1996, 2004, 2006; Walton 1953). Huffman (2006, p. 67) states that earlier tool-kits used to process sorghum and millet are characterized by flat-handstones held in one hand with at least two articulation surfaces resulting from use-wear against a lower grinding-stone bearing a long groove (ellipsoid grinding-hollow). In contrast, maize-grinding tool kits, which appear after the introduction of the American domesticate ca. 1500 CE, are comprised of longer, wider, and heavier two-handed upper stones used with a wide, concave, and specially pitted grinding-slab (Huffman 2004, p. 104, 2006, p. 67). The appearance of novel grinding-stone tool assemblages contemporaneous with the introduction of maize agriculture is certainly suggestive, and these maize-grinding tool kits are useful chronological markers in archaeological contexts.

Of course, the relationship between form and function is not straightforward; it is not always possible to distinguish the processing of certain materials based solely on grinding-stone tool form. For instance, while ethnographically the most cited use for grinding-stone tools in Africa is plant processing (e.g., Boshier 1965; Lee 1973; Roux 1985; Walton 1953), other southern African ellipsoid lower grinding-stone forms reminiscent of those Huffman identifies as sorghum and millet grinding-hollows may have also been used for sharpening metal implements, for the preparation of clay for pottery making, or for grinding ochre (see Sadr and Fauvelle-Aymar 2006; Walker 2010). What is more, purely technical approaches to the study of grinding-stone tools can only advance so far, as people may choose to adopt, modify, or curate grinding-stone technology for reasons that depart from functional explanations.

Grinding-stone tools may be such common archaeological artefacts, however, that they are somewhat invisible in their mundanity, even when they appear in contexts that are decidedly not. Grinding-stones that are elaborately decorated (e.g., Le Quellec et al. 2009) or found with rock art (e.g., Gast 2003) are more obviously analysed as symbolic objects. Grinding-stone tools when ubiquitous and abundant in domestic contexts are, however, more often taken to be representative of functionality and of the daily life of women than of objects belonging to any wider social and symbolic world (Holmberg 1998; Last 1996). Yet even the most quotidian displays of grinding can still be conceptualized as "maintenance activity" (González-Marcén et al. 2008), performed as an essential task of living. Grinding in many societies is critical for sustaining networks of interpersonal relations through its role in processing and socializing (Hamon and Le Gall 2011, 2013). Grinding-stone tools, though seemingly "mundane objects," can serve as material items that actualize performative aspects of social life (Lemonnier 2012, p. 14), including healing.

In West Africa, for example, a large number of grinding-stones have been recovered from excavations at figurine mound sites in Koma Land, Ghana (Anquandah 1998; Kankpeyeng and Nkumbaan 2008). These mound sites, dating to ca. 1500–800 BP, are associated with human burials and may have been shrines (Insoll et al. 2012; Kankpeyeng et al. 2013). Koma Land mound site grinding-stones, initially considered as evidence of cereal grain reduction (Anquandah 1998), have also been taken to indicate the processing of medicinal substances in healing rituals (Kankpeyeng et al. 2011). Kankpeyeng et al. discuss how these grinding-stones may have been powerful objects that needed to be deposited at the mound sites as a matter of safety (2011). The spiritual and social significance of grinding-stone tools and grinding is perhaps most obvious in their associations to funerary contexts, a common but largely unexplored occurrence in African archaeological records.

Focusing on how grinding-stones are intrinsically associated with the performative act of grinding stimulates novel interpretations of these objects in archaeological contexts. Fendin has argued that many of the same transformative and reproductive aspects associated with early metallurgy can be related to grinding (Fendin 2006). In Eastern Tigray, Ethiopia, Lyons (2014, p. 169) has explored how male blacksmiths, through grinding and other practices that transgress normative gender roles, disassociate with binary male/female categorizations and take on "the dangerous capacity to consume fertility, landscape, and people." Grinding-stones commonly feature in the technical repertoire of iron production in Africa, for example, in the breaking up and mechanical fining of iron blooms on the Sukur plateau, Nigeria (David 1998), or encountered amongst the remains of a fifteenth- to sixteenth-century metallurgical workshop in Banda, Ghana (Stahl 2015). However, the symbolism of grinding has yet to be examined to the same extent as other aspects of smelting and smithing in Africa.

When considering grinding as more than just a means to an end, we again draw inspiration from Lemonnier, advising that "a social theory of material culture should deal with technologies in their most physical aspects" (1992, p. 3). Grinding as both a technical action and sensorial movement is suggested at archaeological sites on Lolui Island, Lake Victoria (Posnansky et al. 2005), in southern Zimbabwe (Cooke 1964) and northern Botswana (Walker 2010) where grinding-stones have been found together with rock gongs. Rock gongs are stones that resonate melodically and bear evidence of deliberate percussion. As González-Ruibal et al. (2013) have documented, the engagement of the body while grinding is inherently rhythmic, the contact of stone on stone produces specific sonorities, and songs are often sung to facilitate the flow of milling. While the content of many grinding songs will never be known, Evans-Pritchard's (1929) documentation of different examples in the recent ethnographic past raises interesting possibilities regarding the soundscapes associated with grinding.

Attention to the movements and gestures involved in grinding has the potential to reveal the entrenched attitudes and values of the people engaged in this activity. According to González-Ruibal (2014) the upright bodily hexis of Gumuz women in Ethiopia while grinding, which is done on an elevated grinding-stone, reflects their comparatively higher status in relation to men (2014, p. 132). In contrast, women living in neighbouring communities of Amhara and Oromo people, who embody a strongly patriarchal ideology, grind while bent and kneeling (González-Ruibal 2014, p. 133). Different bodily approaches to grinding are potentially visible archaeologically as grinding-stone forms and installations are used in diverse ways.

The African archaeological record holds a deep and varied history of grinding-stone tool traditions. Studies of these items of material culture are amenable to a similarly wide range of analytical and theoretical approaches, a handful of which we draw attention to here. Contemporary communities of grinding-stone users in Africa hold a wealth of knowledge on the diverse roles these tools play in resource processing and livelihoods, as well as their inseparable relation to social and spiritual practices. While cautioning against direct ethnographic analogies, interpretations of archaeological grinding-stone tools may benefit a great deal from engaging with such knowledge sources.

Grinding-Stones in Marakwet, Kenya

In what follows, we present a brief study of the variety and functions of grinding-stone tools in Marakwet, northwest Kenya. Marakwet is an ideal location to undertake this programme of ethnoarchaeological research as it has already been the focus of extensive investigations into the cultural contexts in which plant resources are cultivated and maintained (e.g., Davies 2008, 2012; Davies et al. 2014; Moore 1986). Fieldwork was conducted in the commercial centre of Tot, the associated village of Sibou, and in the Kerio Valley in Elgeyo-Marakwet County, northwest Kenya (Fig. 1), during April and May, 2013. The study was conducted as part of larger ongoing research into the history of Marakwet farming, community, and landscape (http://www.marakwetheritage.com). Fieldwork was greatly assisted by the presence of a local research team with considerable experience in translation and facilitating researcher-community relations.

Observations and interviews were carried out with the aid of an interpreter. Questions were formulated to understand the range of materials processed, any morphological, material, or functional variability in grinding-stones, the use-life of tools, and patterns of disposal. In addition, cursory observations were made on the incorporation of grinding-stone tools into the social and ceremonial lives of people in Marakwet.

Eleven extended semi-formal interviews were conducted with Marakwet women, and one man, all from

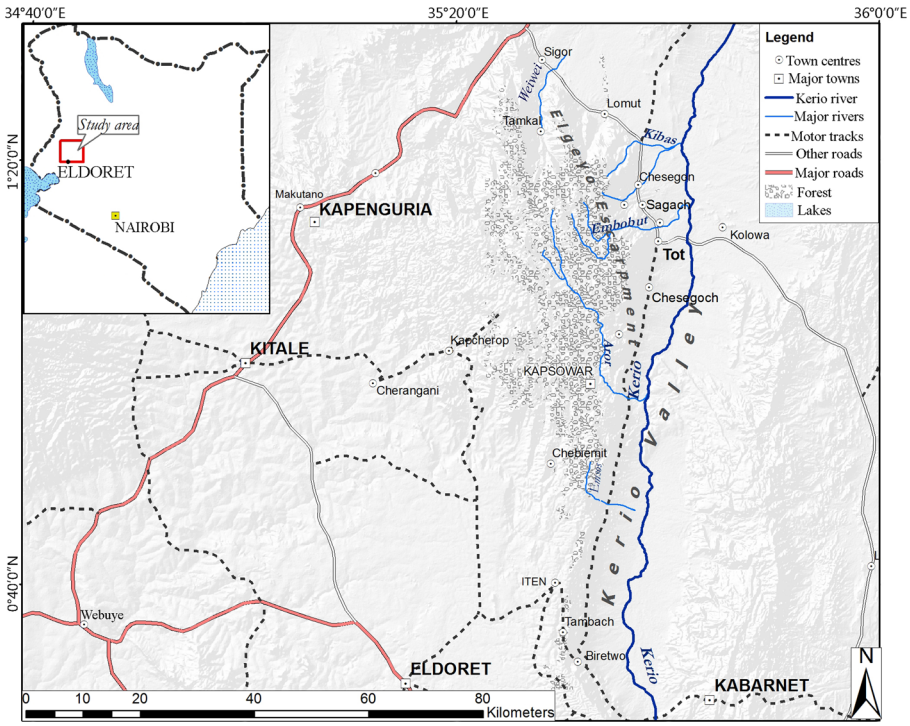

Fig. 1 Study region

farming households living on the foothills of the Lagam Escarpment in the village of Sibou. Seven Pokot women from ostensibly pastoralist communities residing in the Kerio Valley to the east of Tot were also interviewed to further explore differences in grinding-stone traditions across communities of practice. Grinding implements encountered were photographed, measured, and a sub-sample of rock and botanical specimens was collected for further analysis.

Measurements of tools were rounded to the nearest half-centimetre and represent the maximum distance along their respective axis. Length was measured along the proximal and distal edges inferred from the position of the user, width then being the distance of the edges perpendicular to this line. Height or thickness is defined as the extent between the articulating surface and opposite face of flat-handstones and lower stone tools. The depth of the hollows on some implements was also obtained by measuring down from a straight edge placed over the concavity.

Forms and Functions

Since the introduction of diesel-powered grinding mills (*posho* mills) in the 1980s, the use of grinding-stone tools for processing plant materials has declined in Marakwet. However, distance and monetary constraints render diesel mills less accessible for many, so grinding-stones remain important processing tools. Stone-ground flour is also still preferred to milled flour on the Lagam Escarpment, especially, and grinding-stones continue to be required to process products other than cultivated cereal grains. A number of morphologically diverse grinding-stone tool types are encountered in Marakwet today.

Grinding-stones in Marakwet are most often used in the processing of cereal grains, but they are best characterized as multipurpose tools. As presented in Table 1, this study documented a range of materials processed, though this list is by no means exhaustive. People in Marakwet use either grinding-stones or other more expediently available stones to crush ochre, or to crack the endocarps and grind the seeds of non-cultivated plants. Some of the edible plant species that are processed using stone tools include *Balanites pedicellaris*, *Balanites aegyptiaca*, *Ziziphus mauritiana*, and *Sclerocarya birrea*. In addition, specialist grinding-stone tools are used to make castor oil (*Ricinus communis*), which has medicinal and ritual importance. *Ximenia americana*, valued for treating livestock diseases, was another non-cultivated plant species processed using stone tools.

Table 1 Plant species processed with grinding-stone tools in Marakwet

Marakwet plant names	Latin name	English name	Associated grinding implements	Preparation and use
Chepknur, *kipokitin*, *serena*, *mosong*	*Sorghum bicolor* (L.) Moench	Sorghum	Stone pestle and wooden mortar for dehusking. Grinding-slab, flat-handstones (smooth and rough) for flour production	Grain is ground for flour and used to make porridge, *ugali*, and beer. Grain must be ground twice. Flour often mixed with millet, cassava, and/or maize
Kptot, *chepkorit*, *kiptkonis*/*chorongo*, *kulwu*, *kptukani*	*Eleusine coracana* (L.) Gaertn	Finger millet	Stone pestle and wooden mortar for dehusking. Grinding-slab, flat-handstones (rough or smooth) for flour production	Grain is ground for flour and used to make porridge, *ugali*, and beer. Flour often mixed with cassava, sorghum, and/or maize
Chepolos, *katumonu*/*ksim*	*Zea mays* (L.)	Maize	Grinding-boulders, stone mortars, and grinding-slabs used with flat-handstones and rounded pestles for crushing. Grinding-boulders and grinding-slabs used with flat-handstones (rough and smooth) for flour production	Grain is crushed and then ground repeatedly and used to make porridge, *ugali*, and beer. Flour often mixed with millet, cassava, and/or sorghum
Cassava	*Manihot esculenta* (Crantz)	Cassava	Stone pestle and wooden mortar or flat-handstones and rounded pestles on grinding-boulder for fragmentation. Grinding-slab and flat-handstone (rough and smooth) for flour production	Starchy tuberous roots are peeled, dried, fragmented with wooden mortar/stone pestle, and finally added to millet, sorghum, and/or maize grain during flour production. Consumed as porridge and *ugali*.
Maan	*Ricinus communis* (L.)	Castor oil plant	Specifically designated grinding-slab and expediently available flat-handstone (rough) or rounded pestle to crush. Unshaped quartz for oil extraction	Seeds are crushed and placed on direct heat in clay pot. Heated quartz stones are then added to further extract and sieve oil. Oil is topically applied for ceremonial purposes or ingested medicinally
Loom	*Balanites pedicellaris* (Mildbr. & Schlecht.)	–	Grinding-slab, stone mortar, or expediently available stone surface and flat-handstone or rounded pestle used to remove endocarp	Endocarp is pounded with stone tools to release oleaginous cotyledons, which are then repeatedly washed and boiled to remove bitterness before being consumed. Milk is frequently added
Kinyat	*Ximenia americana* (L.)	Yellow plum/ tallow wood	Grinding-slab, stone mortar, or expediently available stone surface and flat-handstone or rounded pestle used to remove endocarp	Endocarp is pounded with stone tools to release seed, which is then rendered into oil. Oil is applied to leather during tanning process and to the mouths of animals to treat hoof-and-mouth disease
Tuyun	*Balanites aegyptiaca* (L.) Del.	Desert date	Grinding-slab, stone mortar, or expediently available stone surface and flat-handstone or rounded pestle used to remove endocarp	Endocarp is pounded with stone tools to release oleaginous cotyledons which are then cooked and consumed with beans or leafy greens
Tilam	*Ziziphus mauritiana* (Lam.)	Jujube, Chinese date, Indian plum	Grinding-slab, stone mortar, or expediently available stone surface and flat-handstone or rounded pestle used to remove endocarp	Endocarp is pounded with stone tools and seeds are consumed
Oroluo (sing.), *arol* (pl.)	*Sclerocarya birrea* (A. Rich.) Hochst.	Marula	Grinding-slab, stone mortar, or expediently available stone surface and flat-handstone or rounded pestle used to remove endocarp	Endocarp is pounded with stone tools and seeds are consumed

Grinding-slabs and flat-handstones are the most ubiquitous grinding-stone tools in the region. Other forms observed include large stone pestles and a host of expediently available lithic tools with minimal morphological conformity. Stone mortars and large grinding boulders were also encountered, though they are no longer in use in Marakwet. The relative importance placed on grinding-slabs and flat-handstones reflects the fact that they are relied on to produce flour. Flour rendered from sorghum, finger millet, and maize, and sometimes supplemented with cassava (*Manihot esculenta*), is a culinary staple in Marakwet, being the principal ingredient in *ugali* (a boiled, flour-based doughy staple) and beer.

Grinding-Slabs and Flat-Handstones

Grinding-slabs (*korpo paar*) and flat-handstones (*ngisha paar*) range in shape from sub-triangular to sub-rectangular to discoidal (Fig. 2). Grinding-slab and flat-handstone tool types have articulating surfaces that have been ground flat, sometimes on both the ventral and dorsal faces.

In the study area, grinding-slabs and flat-handstones are predominantly used to render flour from sorghum, finger millet, maize, and dried cassava fragments. During grinding activities, grinding-slabs are placed on two sub-angular cobbles so that the long axis of the articulation surface slopes at an approximate 10° angle downwards from where the operator grinds in a kneeling position. When grinding, the long axis of the flat-handstone is moved rhythmically back and forth at a right angle to the long axis of the grinding-slab. The flat-handstone is clasped in one hand, with the other hand positioned overtop to provide more power to the strokes (Fig. 3). Woven trays covered with cow dung, pieces of cardboard, leather, or grain sacks are laid down at the far end of the grinding-slab to collect flour. Grinding-slabs and flat-handstones (as opposed to separate mortars) are also used to grind and crush substances such as maize, ochre, castor oil seeds, and other wild plants (see Table 1). During crushing activities, the flat-handstone is held in one hand and brought down

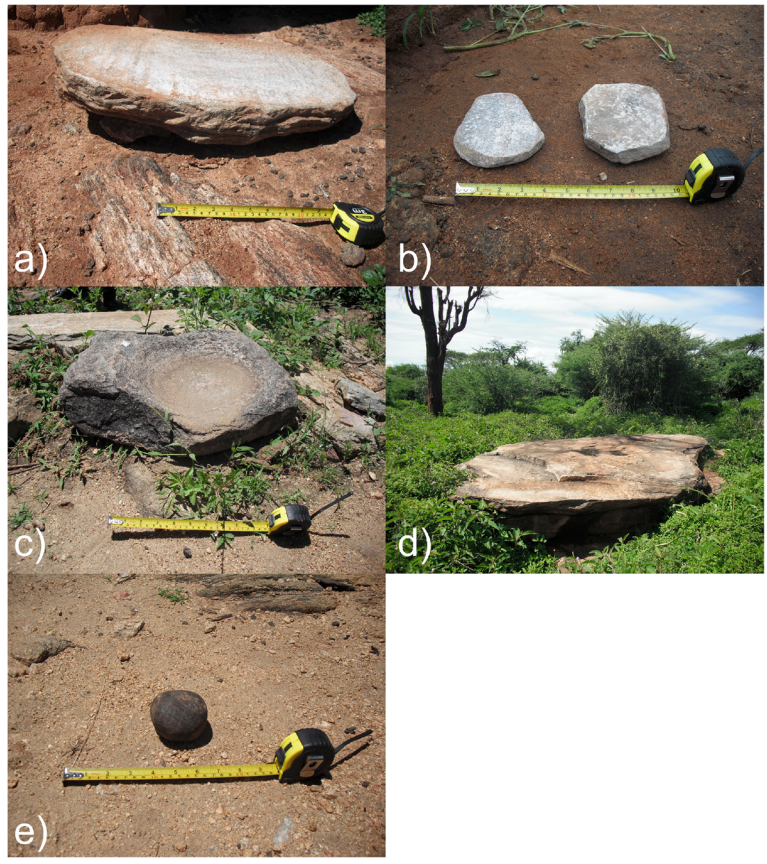

Fig. 2 Grinding-stone tool types of Marakwet. **a** Gneiss grinding-slab used for processing millet, sorghum, and maize. **b** Flat-handstones; tool on the *right* is more roughly textured, and used for initial grinding of sorghum, tool on the *left* is more smoothly textured, and used for millet and the second grinding of sorghum. **c** Water trough/stone mortar used to crush maize. **d** Communal milling boulder. **e** Handstone used for sharpening grinding-slabs and handstones, as well as for crushing maize and other plant materials. (photos: A. Shoemaker)

Fig. 3 Grinding-stone tool use. **a** Grinding millet flour. **b** Grinding millet flour. **c** Large stone pestle and wooden mortar being used to dehusk millet. (photos: A. Shoemaker)

repeatedly on the substance being reduced. Maize grains are crushed in this manner before being ground into flour.

Interview questions attempted to determine if there were significant differences in the size and texture of grinding-stone tools based on factors such as the function of the tool, lithic resource availability, or the person doing the grinding. Figure 4 shows the mean length, width, and thickness of various grinding-slab and flat-handstone tools. In all, grinding-slabs vary between 39 and 65 cm in length (mean = 54 cm), 30–52 cm in width (mean = 38 cm), and 4–8 cm in height (mean = 6 cm). Some variation was noted in the size of these tools: adult-sized grinding-slabs from the Kerio Valley and Lagam Escarpment are comparable in size, while child-sized and specialty castor oil tools are smaller.

In Marakwet, the production of flour from the larger, and in the words of interviewees "harder" sorghum and maize grains is made considerably easier by dividing the grinding into two stages. The first stage, or initial grinding, involves using a slightly larger, heavier flat-

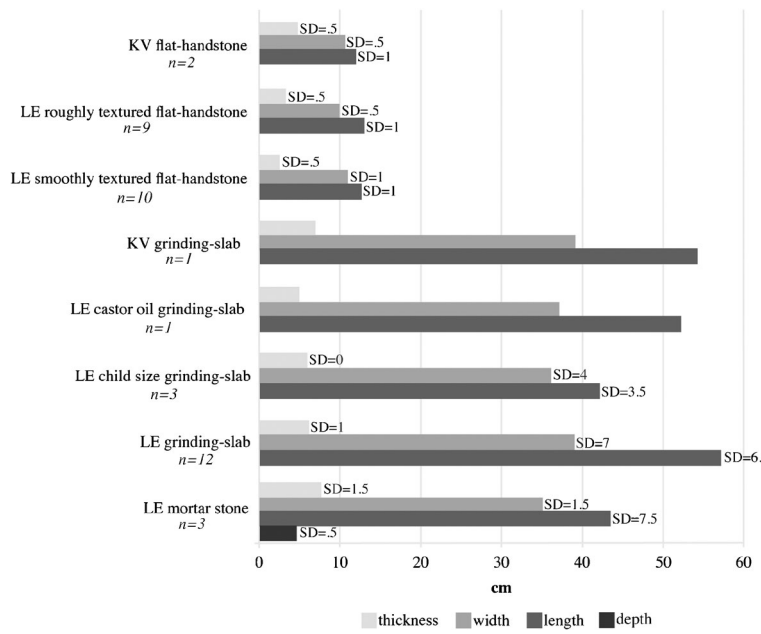

Fig. 4 Average grinding-stone tool dimensions. *KV* Kerio Valley, *LE* Lagam Escarpment

handstone with a roughly textured articulating surface. A second grinding follows, using a smaller and lighter flat-handstone with a smoother articulating surface. Finger millet, which has smaller and "softer" grains only needs to be ground once, and this single grinding is most often done using just a smaller smoothly textured flat-handstone. Women who grind either sorghum or maize tend to have at least one roughly textured, heavier flat-handstone and one smoother, lighter flat-handstone in their tool kit. Roughly textured flat-handstones were observed to be more angular and irregular in shape in comparison to the thinner, more rounded and discoidal, smoothly textured flat-handstones (Fig. 2). The use of rougher and more smoothly textured grinding-stones for coarse and fine grindings parallels that seen amongst the Sukur of Nigeria (David 1998). Also in northern Ethiopia, rougher grinding-stones are known to be used to process sorghum and maize while smoother stones are used for finger millet (Nixon-Darcus and D'Andrea 2017). In all, flat-handstones vary between 10 and 15 cm in length (mean = 13 cm), 9–13 cm in width (mean = 11 cm), and 1.5–4 cm in height (mean = 3 cm). Slight size variations were noted in these tools with smoothly textured child-sized flat-handstones being smallest, followed by smoothly textured flat-handstones, then roughly textured flat-handstones from the Lagam Escarpment and flat-handstones from the Kerio Valley.

Tools intended for children are smaller in size than their adult counterparts. Child-sized tools are either repurposed from broken adult stones or specially manufactured. Grandmothers in Sibou are the primary owners of these child-sized grinding-stone tools, keeping them at the ready for visiting grandchildren. Child-sized tools are in some cases more amenable to repurposing. One woman in Sibou indicated that she had recently used her grandchild's grinding-slab to crush ochre for body paint during a wedding ceremony (Fig. 5). This was done as a matter of convenience: the smaller stone was more easily transported, she did not need it for her daily grinding, and it was deemed more expendable.

On the Lagam Escarpment, small lower grinding-stones may signify children's tools or indicate less-specialized implements. However, the use of some smaller-than-average grinding-stones in Marakwet is also restricted to adult women for a highly specialized

Fig. 5 Child-sized grinding-stones, repurposed for ochre processing. **a** Child-sized flat-handstone. **b** Child-sized grinding-slab. Photos: Shoemaker

purpose: castor oil production. To render oil, castor oil seeds are first crushed and roughly ground on a grinding-slab with a roughly textured flat-handstone or small, rounded pestle. In Sibou there are taboos against castor oil being produced by anyone other than post-menopausal women, using anything other than these particular grinding-stone tools.

Other Handstone Types

A number of handstones with more strictly percussion-related functions are also present in the study region. Round stone balls (Fig. 2) and unmodified elongated river cobbles are used to crush maize grains and other plant materials and to sharpen (by pecking) grinding-stone surfaces. We hypothesize that these round stones and readily available cobbles may be sometimes preferred over flat-handstones for more percussive activities, as the round stones are less likely to fracture and unmodified cobbles are more easily replaced if broken. Large cylindrical stone pestles used with wooden mortars (Fig. 3) are valued in Marakwet for dehusking finger millet and sorghum grains and to fragment starchy tuberous cassava roots.

Concave Mortar Stones

Large "mortar" stones with circular concavities possessing mean dimensions of 44-cm length, 35-cm width, 8-cm thickness, and concavities 4 cm deep are also found throughout the study area (Fig. 2). Marakwet and Pokot women acquire these stones from abandoned habitation sites in Lagam and the Kerio Valley. The exact age of these mortar stones is unknown, though estimates range from 100 to 200 years old; women born in the 1940s relayed that their grandmothers had not known the people who first made these stone tools. Today such stones are only rarely used for grinding or pounding and are instead repurposed as water basins for washing or watering chickens and young goats. One woman suggested that her stone had once been a grinding-slab and had become concave after many years of use, at which point it was repurposed as a mortar, and the depression became subsequently more enhanced. David (1998) has noted similar concave mortar stones amongst Sukur communities in northeastern Nigeria and northern Cameroon and suggested that these stones are heavily worn grinding-slabs. However, when asked about this use-wear formation explanation, other women in Marakwet said it was unlikely because the flatness of grinding-slabs can be maintained (see below), so there is no reason for a cavity to form if the user does not desire it. In Marakwet, people also regularly use wooden, not stone mortars. Earlier functions of these mortar stones are inconclusive, though they hint at the deep history of grinding traditions in this landscape.

Grinding Boulders

On the Lagam Escarpment immobile boulders (ca. 2–3 m in diameter) that have grinding/crushing surfaces prepared on them were used historically as communal grain processing stones (*chemosho*) (Fig. 2). Women in Lagam explained that the predominant function of grinding boulders is the crushing (rather than grinding) of maize, though some people also use the stones to further grind crushed maize kernels. The articulation surfaces on these grinding boulders are flat.

Manufacture

The material attribute of grinding-stone tools of utmost importance to informants is "hardness." Hard stones necessitate a greater labor investment during the shaping and transportation process, as they are heavy and do not easily fragment when struck, but they have long use-lives, do not shed grit when abraded, and nor do they require frequent resharpening. Visual examination, weighing, and hitting potential stones with metal hammers or quartzite cobbles are techniques used to evaluate the hardness of a stone. Informants explained that a "hard" rock is dense and resistant to abrasion, though the material is not overly brittle.

Lithic resources in Marakwet are of high quality for grinding-stone tool production, though they are not evenly distributed. Pokot women in the Kerio Valley may have to travel several kilometres to a riverbed to look for suitable quality stone, while Marakwet people on the Lagam Escarpment are able to access hard stones more easily. Outcrops of hard Precambrian basement rocks such as gneiss, schist, quartzite, and marble litter the base of the Lagam Escarpment. During fieldwork, a Marakwet man demonstrated how slabs of stone to be shaped into grinding-slabs and handstones were easily peeled off the bedding plane of the rock on the Lagam Escarpment, using a crowbar. On the floor of the Kerio

Valley, inferior quality sandstones, siltstones, basalts, phonolite, and trachyte dominate.

The reduction of lithic nodules to form grinding-slabs and flat-handstones involves battering, pecking, pounding, and grinding until a stone is of a desirable size, and use surfaces are flat. The initial stages of grinding-stone tool production take place at the site that the stone is located, and only when the individual is satisfied that the stone is of suitable quality, and has been reduced to a transportable size, will it be moved to the place where it is intended to be used. Both Pokot and Marakwet people explained that raw lithic material may be quarried from the Lagam Escarpment or located in dried riverbeds throughout Marakwet.

Informants disclosed that they may spend anywhere from 2 h (Lagam Escarpment) to 2 days (Kerio Valley) locating a suitable grinding-slab stone and preparing it for use, while the production of a flat-handstone may take 30 min to 2 h. Of the women interviewed, the majority had crafted their own grinding-slabs and flat-handstones and had acquired these skills from elder female relatives. Some Marakwet women who either never learned how to create these tools or were unwilling or unable to transport stone themselves employed Marakwet men known to be skilled in manufacturing grinding-stones. Pokot women also "hired" Marakwet men to manufacture and transport grinding-slabs, a practice incentivized by the lack of quality lithic raw material available in the Kerio Valley area. Pokot men, in contrast, were reported to never involve themselves in making grinding-stone tools, this being socially taboo. In acknowledgement for assistance, Marakwet women said they typically prepare a meal of milk, meat, and *ugali* for the tool-crafter. A Pokot woman may instead exchange a grinding-slab for a portion of goat meat or money.

Both Pokot and Marakwet women disclosed that using grinding-slabs found at long-abandoned habitation sites was a common and preferred practice, indicating that archaeological material is often reworked in the present. The challenges of locating appropriate lithic material for manufacturing stones may motivate the practice of salvaging stones from habitation sites. Through the sale or exchange of grinding-stones, the repurposing of abandoned tools, and the movement of people from place to place during the course of their lives, implements can travel around the landscape for several kilometres from their point of origin.

Maintenance and Disposal

Distinctive use-wear develops on tool surfaces depending on the motions of the tool during use. Wear patterns observed on Marakwet grinding-stone tools are presented in Table 2. Grinding-stone form is a partial byproduct of use-wear, but tools are also actively maintained and reshaped through sharpening. The frequency with which tools require resharpening is dependent on how often they are used and how hard the stone is. Generally, women reported having to resharpen both grinding-slabs and flat-handstones every 1 to 3 weeks. Tools are resharpened by pecking the articulation surface with a hard, sub-rounded cobble, usually of a locally abundant quartz material. Women will also grind surfaces that have become too smooth with a rough flat-handstone or expediently available rock. Informants reported the use life of grinding-slabs to range anywhere from 10 to 60 years or more, depending on the hardness of the lithic material (Fig. 6), though tools are not necessarily in continuous use during this time period.

Some women stated that soft stones will become concave after a few years of use and must be abandoned, though others stressed that only poor-quality grinding-slabs develop this kind of wear, and depression formation can be avoided by grinding the entire use surface. Thinning and breakage is more common amongst flat-handstones than grinding-slabs, as reflected in the use-life of these tools (Fig. 6). When grinding-slabs fracture, fragments can either be recycled as child-sized tools, used for the grinding of materials other than cereals (such as ochre), or repurposed as building materials, hearthstones, or seats.

Communities of Grinding Practice

Regional and temporal differences were noted between grinding-stone tool form, manufacture, and use on the Lagam Escarpment and in the Kerio Valley. Of the Pokot women interviewed, none manufactured special grinding-stones for producing castor oil, made child-sized grinding-stone tools, or used communal grinding boulders. Pokot women were more likely to use just one flat grinding-stone instead of both a roughly textured and a smoothly textured stone to process flour. A more multipurpose, less-specialized grinding-stone tool kit appears to be embraced in the Kerio Valley compared to the Lagam Escarpment, a difference that may in part

Table 2 Grinding-stone tool operation and associated wear patterns in Marakwet

Tool types		Activity	Motor pattern	Wear patterns	
Immobile element	Mobile element			Immobile element	Mobile element
Grinding-slab/grinding-boulder	Flat-handstone/ rounded pestle	Grinding	Back and forth	Striations on the articulation surface parallel to the long axis of the stone. Thinning and eventual depression formation if stone is not abraded	Striations on the articulation surface perpendicular to the long axis of the stone. Thinning
Grinding-slab/grinding-boulder	Flat-handstone/ rounded pestle	Crushing	Up and down	Crushing and pitting of articulation surface, eventual circular concavity formation	Crushing and pitting on all contact surfaces. Rounding and size reduction of tool.
Grinding-slab/flat-handstone	Rounded pestle/ quartz stone	Pecking (sharpening)	Up and down	Crushing and pitting of articulation surface	Crushing and pitting of all contact surfaces. Rounding and size reduction of tool.
Grinding-slab/flat-handstone/grinding-boulder	Flat-handstone/ rounded pestle	Abrading (sharpening)	Back and forth/ circular	Multiple striations on articulation surface in random directions. Overall flattening and thinning	
Stone mortar	Rounded hand-stone	Crushing	Up and down	Crushing and pitting of articulation surface and enlargement of circular concavity	Crushing and pitting on all contact surfaces. Rounding and size reduction of tool
Wooden mortar	Large pestle	Crushing	Up and down		Rounding and burnishing of contact surface

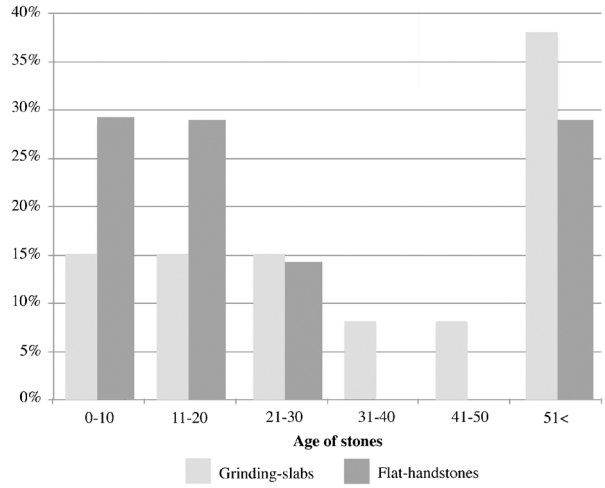

Fig. 6 Reported age of grinding tools in years as percentage of assemblage encountered in Marakwet

be explained by the fact that Pokot women were faced with more difficulty in manufacturing grinding-stones compared to Marakwet due to the lack of hard stones in the Kerio Valley. Perhaps most telling was the revelation that all Marakwet women preferred flour ground with grinding-stone tools over flour from *posho* mills which was said to be lacking in taste and texture. Pokot women on the other hand preferred flour from the *posho* mill because stone-ground flour contained grit introduced during grinding on "soft" stones. Yet on closer examination, there are differences in how Marakwet and Pokot people interact with grinding-stone tools that cannot be attributed to differential access to raw material.

While it may seem that grinding-stone tools are objects of concern mainly to women, there are nuances in the gendered control of various aspects of grinding. As already noted, it is said to be taboo for Pokot men to manufacture grinding-stones, though it is acceptable for Marakwet men to do so. It is forbidden for anyone other than post-menopausal Marakwet women to produce castor oil, though amongst the Pokot people interviewed, no such prohibition exists. To explain why grinding traditions differ between the pastoral Pokot and the agricultural Marakwet, it might seem de rigueur to look to the users' degree of mobility or reliance on animal versus agricultural products.

Pokot and Marakwet people do not conform simplistically to rigid agriculturalist/pastoralist behavioural patterns, however. Many Marakwet families maintain significant numbers of livestock—often sending boys to herd with the Pokot or loaning animals to Pokot friends. Similarly, many Pokot are now sedentary and rely on farming as their primary source of subsistence. At the same time, marriage partners and occasionally whole families shift from one community to the other, significantly blurring the distinction between the two (Davies 2015; Pollard et al. 2015). As Hodder (1987) demonstrated for the neighbouring Baringo region, select material forms may be utilized to maintain ethnic boundaries, even when significant interaction exists between two communities. While differences in regional assemblages may therefore be conditioned by the availability of raw material, and by mobility patterns, it also seems likely that deeper ideas about identity and traditions of "doing" and "making" play into these variations.

We found that with regards to grinding, Marakwet and Pokot people may be conceived as belonging to fluid but distinct "communities of practice" (Lave and Wenger 1991) united in a larger "constellation of practice" (Roddick and Stahl 2016; Wenger 1998). Pokot and Marakwet communities are in many ways distinct, though continuously shifting and intersecting. Amongst these dynamic communities of grinding-stone tool users on the Lagam Escarpment and in the Kerio Valley, the practice of grinding has been continuously produced and reproduced, creating variability through time and space.

Grinding-stone tools that have been obtained from abandoned habitation sites are objects capable of bridging past and present communities of practice. The movement, experience, and skill of those who shaped and maintained tools in the past go on to influence the bodily postures and stances of contemporary grinding-stone users in Marakwet as they incorporate abandoned grinding-stones into their own daily routines. Grinding-stones made by Marakwet men from rocks sourced on the Lagam Escarpment and acquired by Pokot women

through sale or trade are also objects that link Pokot and Marakwet communities of grinding. In these instances, the transportation of grinding-stones across the landscape acts to diffuse stark contrasts in tool assemblages and grinding practices between contemporary and past, and between Marakwet and Pokot people.

Interpretations of the relationship between form, function, quantity, and significance of grinding-stone tools amongst Marakwet and Pokot people need to be further substantiated by expanding the sample size. However, our preliminary results do suggest that grinding-stone tool assemblages are conditioned in part by the availability of lithic resources. Furthermore, the routine of grinding articulates with traditions of food, gender, healing, and socializing, traditions with unique and changing expressions amongst Marakwet and Pokot people. Grinding-stone tools both materialize the social distinctions between communities of grinding practice through time and space in Marakwet and serve to bring these communities together.

Change and Continuity Through Time

As we allude to above, grinding practices in Marakwet have not remained stable through the years. Factors such as transformations in livelihoods and grinding technology have had impacts and will continue to do so. Despite this, grinding is a practice with a certain "cultural resilience" (Davies and Moore 2016). Grinding-stone tool forms and grinding as a social skill both exhibit a significant degree of continuity amidst the dynamism of life in Marakwet.

Of all the grains in Marakwet today, maize is the least likely to be processed into flour using grinding-stone tools. Maize is also the most recently introduced cereal and the most labour-intensive to grind using stone tools. In the early colonial period (ca. 1930), cultivation of the maize variety *chepolos* was initiated, but it was not widespread and only grew gradually in popularity. In the 1960s, a new maize variety called *ksim* began to replace *chepolos*; *ksim* grows very well on the stony Lagam Escarpment and is more drought-resistant. While *ksim* was favoured for its higher yields, it was also recognized to be much harder and difficult to grind into flour compared to the softer-grained *chepolos* variety. To process 1 kg of flour from finger millet takes approximately 30 min, sorghum requiring anywhere between 30 min to an hour, while maize varieties necessitate 45 min to 2 h of work. A calculated trade-off appears to have been made between time/effort and flour quality, resulting in the recently introduced maize now being ground mostly at the diesel-powered mills.

Yet another factor here is the comparatively shallow historical relevance of maize in contrast to cereals like sorghum and millet in Marakwet. There may be more traditional importance attached to processing sorghum and millet grains with grinding-stone tools than is extended to the recently introduced maize. The significance of hand-ground sorghum and millet flour over that of maize was hard to miss during fieldwork. A wedding ceremony was taking place on the Lagam Escarpment, and amongst the other guests at the home of the betrothed, three older women were gathered together with their grinding-stones. They were taking turns processing large quantities of sorghum and millet into flour for brewing *busa* (beer), their rhythmic grinding accompanied by singing and talking. The performative and social aspect of grinding for Marakwet people was evident here.

Even before the introduction of diesel mills and hard-to-grind maize varietals, the diversity of grinding tools in Marakwet captures a history of successive displacements and incorporation of exotic elements. Large multifaceted grinding boulders, still seen around people's homes in Sibou, reveal a communal aspect of food production that is no longer practiced in the same way on this landscape. This may reflect a greater shift from communal to more homestead-oriented food preparation. A similar trend was observed in Gulo Makeda, Ethiopia, where grinding, valued as a cooperative community activity, has been declining due to the arrival of mechanical mills and increasing household independence (Nixon-Darcus and D'Andrea 2017, p. 204). In addition, the original use of old mortar stones is unknown, though they are curated on the Lagam Escarpment today, having often been repurposed as water troughs. These mortar stones hint at transformations in grinding activities beyond living memory, tentatively speaking to a deeper history of changeable grinding practices. The expansion of diesel-powered mills and changing agricultural practices in Marakwet further promise to bring modifications to grinding traditions, although there is resistance to the total abandonment of grinding-stone tools.

As flour is increasingly milled with diesel-powered machines, the continued manufacture of child-sized grinding-stones shows that some grandmothers still place a high importance on the intergenerational inheritance of grinding knowledge. Today, as in the past,

these child-sized stones help ensure the preservation of this skill and the embodied *habitus* of grinding in Marakwet. Child-sized grinding stones highlight that apprenticeship and participation are fundamental in learning the social skill of grinding and integrating generations into communities of practice (Hughes 2007; Lave and Wenger 1991). Grinding traditions in Marakwet are adaptive to changing agricultural practices and newly available technology, but some grinding-stone tool forms are also significant enough to be retained despite not always being the most efficient option. In this sense the social, symbolic, and knowledge-transfer aspects of grinding appear resilient even when their functional role is diminished.

Discussion

This paper explores only a fragment of the diversity of grinding-stone tools used throughout time in Africa, a diversity that mirrors the multitude of regional grinding traditions. In Marakwet, we found that grinding-stones are predominantly used with cereal grains, yet they are also essential for processing a variety of materials with nutritional, medicinal, and social importance. There is more scope to explore how symbolic referents are entwined with both quotidian and exceptional acts of grinding within the constellation of grinding practices in Marakwet.

In conversation with people in Marakwet, it was found that variability in stone-tool morphology is partially conditioned by function, the stature and strength of the intended user, and lithic-resource availability. For example, rougher, heavier flat-handstones are used for initial flour grindings of larger grained cereals, while smoother, lighter flat-handstones are used for final flour grinding, or the grinding of smaller grained cereals like finger millet. Pestles are not used to grind flour but are instead used with wooden mortars to fragment tubers and dehusk cereals. Smaller grinding-stones are made for children. There are also advantages to having alternative grinding-stones available to grind non-edible substances such as ochre, or even potentially poisonous material like castor oil seeds. If these materials were processed with the same tools used to grind flour, they would impart undesirable residues on working surfaces. Products like castor oil and ochre that are consumed less regularly in comparison to flour are conveniently processed on small grinding-stone tools. We cannot conclude that smaller-than-average grinding-stones in an archaeological assemblage are representative of children's tools or alternative material processing kits, but a diverse range of grinding-stone tool sizes and forms may indicate a certain breadth of grinding activities taking place (see also Arthur 2014). They may signify a certain breadth and significance of grinding activity (see also Arthur 2014).

Differences in the procurement of quality lithic resources also seem to be a conditioning factor resulting in less standardized and, from the perspective of the archaeologist, more complicated to interpret grinding-stone tool assemblages. In Marakwet, access to alternative milling technology is another consideration increasingly influencing grinding-stone tool users. So too are the personal- and community-level preferences for products rendered with specific tool types on different occasions.

The history of grinding-stone tool use in Marakwet is complex. We encountered grinding-stones that were purposefully manufactured, their shapes actively modified and maintained through sharpening. Also seen were more passively formed and pragmatically used implements. Grinding-stones no longer used for grinding may be completely repurposed as seats, watering troughs, or building stones. Some grinding-stone tools, like grinding-boulders, may fall out of use entirely and remain untouched in the midst of inhabited spaces. Abandoned tools may also be reclaimed, for instance, when grinding-slabs are found at old settlement sites and used again for grinding.

As other archaeologists working with grinding-stone assemblages have found, there is a host of factors to take into account when understanding these tool types. While some grinding traditions appear to be more volatile, grinding-stones can exhibit morphological continuity over millennia regardless of changes in materials being processed (Fuller and Rowlands 2011). Even associations of certain tool types with particular motor actions are not simplistic. Flat-handstones can be used in a percussion motion on grinding-slabs while deeper mortars have been used for grinding (David 1998; Hovers 1996), and the morphology and function of tools frequently change as use-wear becomes more pronounced (Kraybill 1977). Other factors known to effect variability in grinding-stone assemblages include raw-material scarcity (Fratt and Biancaniello 1993; Stone 1994) and regularity of use (Nelson and Lippmeier 1993). Differences in the pre-treatment (e.g., drying or wetting of grain) and desired qualities of the product being prepared must also be considered (Adams 1999).

Grinding-stones may exhibit more standardized forms if quarried (e.g., Rahtz and Flight 1974; Storemyr 2014) or less standardized if sourced more expediently. Further complicating interpretations of grinding-stones in archaeological assemblages is the tendency for people to reuse long abandoned stone tools or completely repurpose stones as building materials (Roux 1985; Schlanger 1991; Simms 1983). Ethnographic studies of grinding-stone tools in Africa (e.g., David 1998; Gosselain and Livingstone Smith 2005; Rudner 1979) not only hint at the potential variety of tool forms but also reveal the essential multifunctionality of these items of material culture.

The implication that grinding-stone types are reliable indicators of the processing of particular materials in certain ways may therefore be valid in some temporally and regionally specific archaeological assemblages, though similarities or dissimilarities in grinding-stone morphology should not be interpreted uncritically as representing specific processing activities. Challenges of equifinality in interpreting grinding-stone tool assemblages have no doubt contributed to the superficial consideration given to grinding-stone tools in many archaeological assemblages. The merit of contextual data for working out the significance of grinding-stone tools in the archaeological record cannot be understated. For example, whether grinding-stones were recovered from burial or shrine contexts or found in metallurgical workshops or domestic settings matters for understanding their utility and symbolic value to people in the past.

Experiments in use-wear analyses also have the potential to move beyond inferred understandings of function based on form (Adams 2014a, b; Adams et al. 2009; Dubreuil 2004; Dubreuil et al. 2015; Mauldin 1993; Nixon-Darcus and D'Andrea 2017; Pritchard-Parker and Reid 1993; Pritchard-Parker and Torres 1998; Wright 1993). Unfortunately, the coarseness of the lithic material that grinding-stones are often made from makes microscopic use-wear analysis challenging (Rowan and Ebeling 2008, p. 7). Such coarse-grained stone is amenable to residue and trace analysis, though, and progress made in isolating and identifying phytoliths and starch grains from grinding-stone tools found in archaeological contexts is encouraging (Ball et al. 2016; Garciá-Granero et al. 2017; Lucarini et al. 2016; Mercader 2009; Radomski and Neumann 2011). Systematic sampling and analysis of sediments and trace residues from archaeological contexts will further expand understandings of processing activities in Africa through time.

Our data substantiate the idea that grinding practices have rather distinct local forms and traditions (communities of practice) that are only partially determined by the specific cereal crops or other substances being processed. Tool morphology and ground substance may not only always be directly and functionally correlated but also may intersect indirectly through the lithic resources available and the livelihoods amenable to different landscapes, and through distinct understandings of the grinding process, its implements, and products rendered. Though only minimally touched on in this study, actions of grinding (standing, kneeling, swaying, pounding) are culturally specific and learned. As was found in Marakwet, grinding practices and bodily engagements may be transmitted not only through apprenticeships, as is the case with child-sized tools, but also through the adoption of abandoned stone tools. Appreciating such variation and optimizing the archaeological potential of grinding-stone studies can only be achieved through the detailed recording and publication of grinding implements from archaeological and contemporary contexts.

Conclusions

Interviews and observations in Marakwet have substantiated the importance of critically evaluating simple statements correlating grinding-stone tool types and the exploitation of specific plant species and other substances. Yet we still believe that studies of grinding-stone assemblages that take into account the host of factors acting on tool morphology can be highly informative. Allied with other lines of evidence, grinding-stone tool assemblages can be used in reconstructing locally and historically specific past human, plant, and other substance interactions and be interpreted as objects that materialize aspects of social life. It is both possible and fruitful to better understand morphological variation in grinding-stone tool types (ethnographically and archaeologically) and how this relates to the processing of certain substances, including plant resources. More detailed recording, analysis, and reporting of grinding-stone tools will aid in drawing more complex conclusions concerning the functional, performative, metaphorical, embodied, and gendered correlates of grinding.

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Compliance with Ethical Standards

Conflicts of Interest The authors declare that they have no conflict of interest.

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