Open Firing Techniques as Community-based Technology: The Case of the Ari Pottery Making in Southwestern Ethiopia

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The objective is to redefine the overall practice of pottery making by Ari potters as one of their community-based technologies. In comparison with the firing method of Japanese kiln firing, Ari's open firing was at first expected to cause an explosion or cracking of pots due to its abrupt rise of temperature. However, experiments on the ratio of contraction and water absorption of clay showed that they prevent the pots from exploding, even when the temperature of open-firing drastically goes up, by mixing plenty of ground-up broken pots with clay. They have achieved an effective way of making durable pots with minimum time and resources. In the analysis of Ari vocabularies for evaluating the traits of pots all through the process, specific folk categories, which were *malki* and *aani*, in evaluating the durability and quality were common to both makers and users. In addition, Ari potters explain the situation when pots are broken during open firing by using *aani* expression. Ari pottery making as a community-based technology was redefined that was influenced by the evaluation and social behavior are based on the various relationships, which are human-material relationships for making and classifying pots and human–human relationships for exchanging pots.

Key words: Open firing, community-based technology, pots, Ari, southwestern Ethiopia

1. INTRODUCTION

Craft workers of the Ari people in southwestern Ethiopia manufacture and sell their pots to local residents for use in their daily lives. These pots are made by female potters who belong to a special craft worker's group, called *tila mana* in the Ari language. They dig up clay in specific locations by themselves and form the pots using their hands, without the use of a potter's wheel. They divide the whole process of pot making into four stages, and they dry the pots several times at each stage in the process of pottery making. After the pots are completely dried, the potters practice open firing without using kilns by using twigs and dried grass for fuel, which they collect in farmers' fields. They also use fresh grass as additional fuel. The pots are usually fired for around 2 hours, and they are finished with a starch glue made from casaba and *ensete*, which belongs to the *Musaceae* family. The pots are ready to be sold at local markets after this stage.

At first glance, African earthenware appears to have similarities to *Jomon* and *Yayoi* pots, which are an ancient Japanese type of pottery. Dating from more than 3000 years ago, these Japanese styles bear similarities to African pottery in terms of firing temperature, the shape of the pottery, and the decorations on the pots (Mori 1992). Earthenware is classified into four categories according to firing temperature: clay pots, earthenware, stoneware, and porcelain (Magumo 1998b). Clay pots are fired at

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800°C, earthenware is fired at 1,200°C, and stoneware and porcelain are fired at 1,300°C (Mori 1992). According to the technological history of pottery making, the firing of earthenware has developed from open firing, which was practiced on flat ground, to pit firing, carried out in depressions in the ground, to the simplified updraft kiln, which has low walls and is built in a big pit, to the oven style, which is constructed on mountainous slopes, and finally to the kiln. One of the prominent features of this technological development has been the pursuit of the best technological system by which to make strong vessels by both achieving high firing temperatures and attaining production on a large scale (Yoshida 1973, Nagumo & Lodos 1979). The method of pottery firing found in much of Africa is regarded as the most basic technological system in terms of the technological history of pottery.[1]

However, nobody knows whether African pottery making will follow the same trail of technological development in the future as has occurred in other areas of the world. Mori, a ceramic artist who also taught pottery-making techniques at a university in Japan, tried to introduce the Japanese-style kiln in a small Ugandan village (Mori 1992). It was a tough challenge, and he was forced to face the fact that nobody used the Japanese style kiln after its introduction. He concluded that the social background in specific areas must be considered when introducing new technologies (Mori 1992).

Kawada (1979) also tried to make a kiln in the small Mosi village in West Africa in the 1970s, and he faced difficulties several times when he attempted to teach local craft workers the concept of technological innovation related to the basic technological elements (Kawada 1979). According to his speculation, ways of pottery making, such as forming and firing pots, must be embedded in their sociocultural environment.

Gosselain (1992a), who studied variations in the relationship between the temperature dynamics of bon firing and local ways of open firing in Cameroon, Africa, wondered why potters have preferred to practice certain methods of firing. Although the clay in his research site had a high degree of refractoriness, from 800 to 1,000°C, potters still preferred to use a firing method with a relatively low heat. He suggested that it was not enough to understand local ways of open firing in terms of scientific rationality and that local methods were actually quite efficient in terms of time and natural resource management (Gosselain 1992a).[2]

These examples show that analyzing only technical elements, such as types of fuel, firing structures, and the dynamics of temperatures, cannot provide us with a complete understanding of pottery technologies. Indeed, by focusing only on these issues, we are unable to understand the reasons that people in Africa have continued to use this technological system that is so basic from the perspective of technological history.

Ari pottery making in southwestern Ethiopia is called a community-based technology[3] (CBT) (Shigeta 1996), which is not a modern technology but is rather a traditional technology based on local practices embedded in the people's sociocultural environment.[4] In this case, CBT is based on strong locally embedded traditions that rely on local materials available in this area and adjust to local demand, producing pots for use in this area.

This paper focuses on the firing techniques of the Ari pottery-making practices.[5] In this paper, I try to characterize the pottery-making techniques as the result of mutual relationships between potters and users by analyzing the features of the clay, the dynamics of temperatures for open firings, and the potters' practices, which entail the entire process of pottery making from digging clay to selling their pots at local markets. This paper consists of five chapters. Chapter 2 places this research in the context of previous research and explains the objectives of the paper. Chapter 3 shows the characteristics of Ari open firings in terms of clay digging, forming the pots, and procedures for open firing. Chapter 4 discusses when and how potters work on firing and also analyzes the verbal expressions, such as *aani* and *malki*, used to evaluate the pots. In the final chapter, I summarize the features of Ari open-firing techniques, which are embedded in their sociocultural practices, and redefine the term CBT, which is based on the object–human relationships between people and pots as well as the human–human relationships between potters and users, mediated by the pots.

2. PREVIOUS STUDIES AND RESEARCH AREA

2.1. Previous research on pottery firing

The technological history of pottery making has been related to the history of human evolution. Human beings are believed to have started using pots in their daily lives in the Neolithic period (Yumiba 2001). Earthenware, which is fragile, is regarded to be more suited to settled ways of life, such as agrarian and urban societies, than to nomadic and foraging lifestyles (Yoshida 1973). Earthenware has been targeted as an important archaeological object that researchers examine, generate hypotheses about, and use to form conclusions about human evolution.

The Japanese technological history of pot firing has emphasized technological innovation from open firing to pit firing. This innovation enabled people to produce *sueki*, which is earthenware that is stronger than previous pots because of the high temperatures of pit firing (Mori & Kazama 1976, Morita 2001). Almost the same exact technological innovation of pit firing occurred in many areas in China, Korea, and European countries (Mori & Kazama 1976). The technology of pit firing has been treated as critical evidence to examine human and social history in an evolutionary sense.

However, many potters throughout African, Asian, and South American countries continue to use open firing techniques, and potters in these areas produce and sell various kinds of pots for daily use (Tobert 1984a, b, Woods 1984, Karamer 1985, Mori 1987a, b, c 1992, Gosselain 1992a, Shinohara 1996, Vincentelli 2000, Smith 2000). Mori (1987a, b, c 1992) classified and analyzed African bon firing. Gosselain (1992a) measured the dynamics of thermometric data on bon firing in Cameroon. He called this ethno-thermometric data, and produced data with different characteristics from experimental archaeological data. These data showed that the manner of adding fuel in bon firing had a great influence on the dynamics of temperatures; bon firing cannot produce stable temperatures, and the clay in Africa has a high pyrometric cone equivalent value.

As mentioned above, Gosselain (1992a) proposed the question of why local potters continue to practice the same open-firing procedure rather than shifting to kiln firing even though there is a high risk that the pots will explode during firing, and the clay in Cameroon has a high pyrometric cone equivalent value. However, this question views pottery making in Africa from a technocentric point of view. In contrast, Lemonnier (1993) argued that the tendency to use particular technologies results from craft workers' choices, which are influenced by cultural practices and social relationships as well as technological conditions. He proposed that the techniques of craft works be viewed as social products, noting that craft workers make technological choices at every stage of production, from selecting where clay is procured to determining how it is formed and fired. He broadened his approach to the study of technology to examine how people work with the natural environment, what the technological mechanisms of peoples' choices in their societies are, and how technologies are characterized in their cultural systems (Lemonnier 1993).

As stated above, the study of bon firing has been understood in the context of the historical process of pot firing as a sociotechnological development in archaeological and historical terms. This point of view characterizes pottery making as a method of adaptation to the natural environment. However, recent studies on open firing have uncovered new information that we cannot understand from the functionalistic perspective of technology. Rather, from the viewpoint of technologies as social productions, people who are influenced by a set of cultural practices and social relationships make technological choices in their production process. Yet, both viewpoints, i.e., the concept of adaptation to the environment and the idea of pottery as a result of technological choices, have the same attitude toward technology. From both perspectives, technology reveals the characteristics of a society, and the members of each society share common technological features by which they produce pottery.

2.2. Objectives and methods

Taking this point carefully into account, this paper not only analyzes technological elements, which excises people's socio-cultural lives from the analysis, but also examines the relationships between potters and materials of pottery making and the relationships between potters and users as social

behaviors that result in change and innovation in the techniques used. The paper conceptualizes the whole process of pottery making, including getting raw materials and forming, firing, and selling pots to users at the local markets, as "the process of pottery making." Pots are produced as the result of mutual relationships between pot makers and other agents such as raw materials, natural environments, potters' relatives, and pot users. In this paper, I term this point of view "community-based technology." The three aims of the paper are (1) to elucidate the procedure of firing pots, the raw materials of firing fuels, and the dynamics of firing temperatures; (2) to clarify the ways in which potters participate in and conduct firing; and (3) to describe the ways in which potters and users evaluate pots.

This paper also includes an analysis of potters' behavior when firing pots as well as the physical conditions of firing pots. For example, I recorded their actions when they participated in the pot firing and also wrote down the dynamics of temperatures during bon firing. Additionally, this paper examines the indigenous practices related to open firing, such as the use of specific kinds of fuel, how pots are placed in open fires, and the length of firings.

In the area where the Ari people live, there are more than 20 villages[6] where potters and their relatives live together. Of these, I observed open firings in seven of the potters' villages. I conducted interviews with over 20 potters out of hundreds who have made their pots for more than 10 years. I joined in their pottery making, and I lived with potter L and her relatives in village S and with potter M and her relatives in village G for 4 months each. I used the Ari language in my fieldwork.

I measured the dynamics of temperatures in open firings 13 times, eight times in the dry seasons and five times in rainy seasons, in two places from January 29, 2000, to June 18, 2001 (Table 1). I measured the open firings of potter L eight times and those of potter M five times. One thermoelectric couple was placed in each open-firing place. I started measuring the temperature when a potter put her pots in the fire in the open firing place and stopped recording when the potter took her pots from the fire.

Table 1. Lists of open firing in research

date D/M/Y	place	number of pots	duration of firing	heating start time	termination time	fuels
29/01/2000	S	13	2 h 57 m	8:12	11:09	*albi* (*Asteraceae, Aspilia Africana)*, dried grass, fresh grass
10/02/2000	S	22	2 h 6 m	8:17	10:23	*albi*, dried grass, fresh grass
02/10/2000	S	8	1 h 30 m	7:05	8:35	*albi*, dried grass, fresh grass
04/12/2000	S	17	1 h 40 m	7:05	8:45	*albi*, dried grass, fresh grass
07/12/2000	S	14	1 h 54 m	7:12	9:06	*albi*, dried grass, fresh grass
29/12/2000	S	18	1 h 37 m	15:50	17:27	*albi*, dried grass, fresh grass
18/01/2001	S	26	1 h 25 m	7:40	9:15	*albi* (c.a. 30 kg), dried grass, fresh grass (c.a. 30 kg)
19/03/2001	S	31	1 h 40 m	6:39	8:19	*albi*, dried grass, fresh grass
21/05/2001	G	50	2 h 6 m	7:41	9:47	*albi* (c.a. 50 kg) culms of maize (c.a. 30 kg) dried grass, fresh grass(c.a. 45 kg)
31/05/2001	G	21	1 h 25 m	7:40	9:15	*albi* (c.a. 15 kg) culms of maize (c.a. 10 kg) dried grass, fresh grass (c.a. 45 kg)
04/06/2001	G	31	1 h 40 m	8:14	9:54	*albi* (40–50 kg) culms of maize (10–20 kg) fresh grass(c.a. 45 kg)
11/06/2001	G	17	1 h 30 m	8:32	10:02	*albi* (c.a. 30 kg) fresh grass (c.a. 30 kg)
18/06/2001	G	52	2 h	7:43	9:43	*albi* (70–105 kg) dried grass, fresh grass (120–180 kg)

*Pot size in open firings: less than 50 cm in height and less than 100 cm in largest circumference

I used a K-type thermoelectric couple and digital thermometer (TNA-120, Tasko, Japan) for temperature recordings. The length of the thermoelectric couple was 100 cm. The thermometer measured from 100 to 1200°C. The temperature during open firing ranged from 50.0 to 300.0°C, and the thermometer was accurate to 0.1°C. The sampling period was two times per second, and the temperature was recorded every minute.

I conducted a preliminary experiment on open firing in Japan using the same instruments. The results of that experiment, shown in Appendix I, revealed the effects of the proportion of shamot, ground up earthenware from Ethiopia, in the clay, which was set at 10, 20, or 30%. The author formed pots with the shamot, and the shape of the pots was the same as in Ari pottery. I fired several samples in a gas-fired kiln 0.3 cubic meters in size and in a LPG fire pit to obtain the contraction percentage, coefficient of water absorption, and the refractoriness of the clay from Ethiopia (Appendix).

2.3. Research area

The research area is located in southwestern Ethiopia. The administrative area is called the South Omo zone (Fig. 1). According to the demographic census, the population of Ari is 200,000 people (Bureau of Finance and Economic 2007). The Ari speak the Ari language, which is categorized as an Omotic language. Most Ari, especially males and students, can also speak Amharic, which is the dominant language in this area.

The Ari divide their area into two ecological zones, called *dizi* and *dawla* in the Ari language. *Dizi* is located in the highlands, with an elevation of over 1,600 msl, and *dawla* is located in the lowlands, with an elevation of less than 1,600 msl. They choose and cultivate certain kinds of crops according to the ecological environment. Potters and their relatives usually live in *dawla* near rivers and wetlands. The soil in this area usually has high clay content.

The Ari people divide each year into two seasons, *haashin* in the Ari language that means dry season, and *bergi* in the Ari language that means rainy season. *Haashin* lasts from October to March,

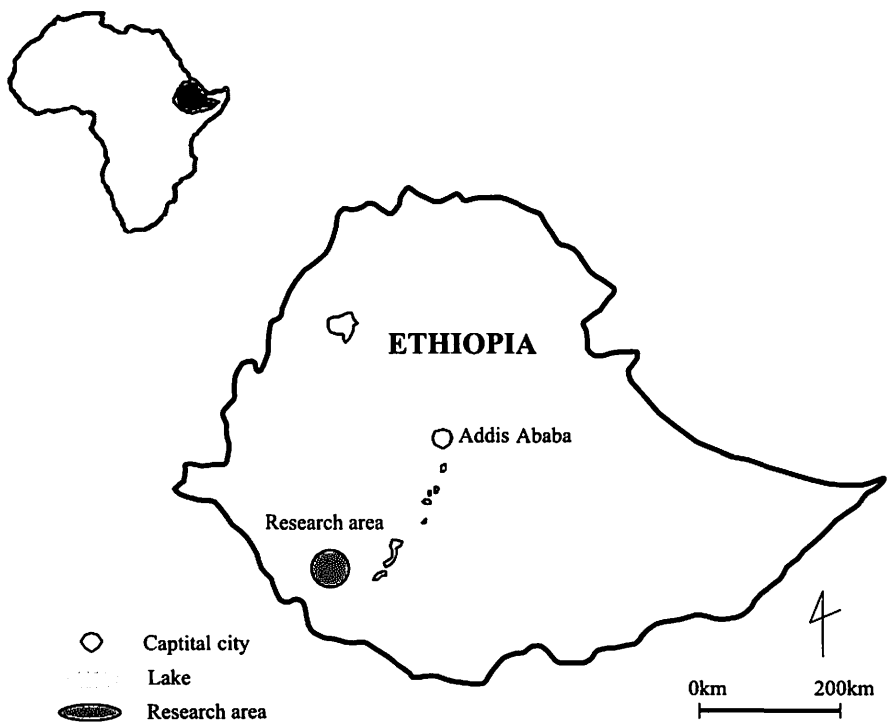

Fig. 1. Research Area

and *bergi* is from April to September. According to the 1999 data on M and S villages, which have altitudes of ~1,600 msl, the temperature in this area varies between 10 and 30°C year-round. According to the 1999 humidity data for S village, the highest humidity was 80 percent in the dry season, and the lowest was 30 percent in the rainy season.

Ari people cultivate *ensete*,[7] barley, and various kinds of pea in *dizi* and yam, taro, maize, and several kinds of vegetables in *dawla*. Ari people who live in both *dizi* and *dawla* exchange their crops in local markets twice a week (Shigeta 2002). Earthenware is also traded between potters and users at these markets.

Pots are the most numerous type of object in Ari households, followed by farming implements. The Ari use pots creatively for different kinds of cooking. According to my interviews, which included valid responses from 135 households, the average number of pots used in cooking[8] was 12.[9] According to Ari married women who had experience using ironware as cooking utensils, they cannot cook potatoes with ironware as well as with earthenware.[10] They could not bake the very thin Ethiopian bread called *injera* with ironware because iron has higher heat transferred per unit time compared with earthenware. However, they could bake *injera* without burning it in earthenware if they used a specific kind of thin twig and controlled the fire very carefully.[11] Although the Ari use plastic water containers as carrying utensils, they also prefer to use pots as water containers because it keeps the water cold.[12]

There is a social group among the Ari people known as *mana* in the Ari language.[13] The *mana* group consists of three social groups: the *gashi-mana*, *tila mana*, and *faka-mana* groups. The *tila mana* group consists of women potters and their relatives, and the *faka-mana* group consists of male blacksmiths and their relatives. When a daughter from the potter group is 6 years old, she can fully participate in making pots. Most girls observe their mothers' work and try to make pots by themselves from the very beginning. When they are 15 or 16, they can marry men who belong to the *tila mana* group. Usually girls leave their home villages and go to the villages where their future husbands were born and raised to live with their in-laws [14].

3. POTTERY-MAKING PROCEDURES: CLAY DIGGING, POT FORMING, AND OPEN FIRING

This chapter represents an analysis of the data on ethno-thermometric dynamics in open firing and evaluates the conditions of open firing to find out how Ari pots are fired without exploding.

3.1. Dynamics of open firing

Most ceramic firing in Japan uses various kilns, such as the climbing kiln, gas kiln, electric kiln, and paraffin kiln. Each kiln is distinct in terms of its fuel, structure, and the method of controlling temperatures during firings. However, it is common to all kilns that the temperature increases at a constant rate until it is above 1,000°C, where it can remain for several days. It is also common that all kiln firings must avoid exposure to air after firing because of the risk of explosions when the objects are cooling down (Nagumo 1998b). According to Hakusui (1990), clay[15] explodes when it heats to a high temperature because moisture contained in the clay boils away, and the volume and crystal construction of clay tautomerizes, creating a new crystal structure. Because of this chemical response to heat, most ceramic artists prepare their raw materials with a screen to ensure homogeneous particles.

The temperature of the Ari potters' open firings that I measured rose in temperature to 600°C over a period of up to 40 minutes from the beginning.[16] The highest recorded temperatures in all open firings ranged from 400°C to more than 800°C. After the highest temperatures were reached in the open firings, temperatures gradually decreased. The shape of the dynamic of ethno-thermometric data can be regarded as the general open firing ethno-thermographic data because all data recorded showed the same tendency, and secondary source material (Tobert 1984a, Woods 1984, Gosselain

1992, Smith 2000) also shows the same results.[17]

If climbing kilns were used for firings, the rapid temperature rise would trigger an explosion and cause cracks in the ceramics because the moisture contained between particles in the clay would evaporate, causing the ceramic itself to contract. However, when open firing is used, there are virtually no pot explosions. Some Ari households have pots over 10 years old that are still used for cooking. In the next section, the characteristics of the clay that withstands this drastic rise in temperature are examined.

3.2. Clay extraction and processing

There are at least 30 local kinds of clay to which potters have given vernacular names. The most common method of obtaining these kinds of clays is digging the ground with shovels and knives. The case of potter L and her husband shows the most common procedure for digging clay.

In village S, it is common for potters to get the clay as a couple, such as a husband and wife team. The clay is located in the wetlands, about 1.5 km northwest from the potters' houses. It took about 30 minutes for potters to get to the place. Although the distance between a clay place and potters' houses was the same for all for Ari potters, some potters occasionally took about 2 hours to walk to get the clay.

When potter L and her husband got to the clay place, they brought a locally made knife called *washi alfa*. It has a blade of about 30 cm. They also brought a plastic tube and *ensete* leaves and rachises. When I accompanied them, her husband always dug between 1 and 1.8 meters into the ground and took water out from the ground with the plastic tub. After that, he cut and removed the clay with the knife. The process took 30–40 minutes.

Whenever L's husband took the clay from the ground, he asked potter L whether the clay was good. This usually depended on the depth from which it was removed. If it was deemed acceptable, potter L collected the clay[18] and wrapped it in the *ensete* leaves. They walked back the same way to their home with about 30 kg of clay. Although potters typically used the clay for forming pots on the same day it was dug from the ground, if they assessed that the clay had too much moisture, they left it with *ensete* leaves under the *ensete* tree. In that case, most potters started making pots the next day. In the case of potter L, she often started making her pots the next day.

In general, potters make their pots in their workplaces near their main house. It is rare for potters to get together and make their pots at one place. According to their explanations, the pots would break if someone were to see them during the pottery-making process. Although potters prefer to make their pots alone, it is common for potters and their daughters to make pots at the same place.

First, potters usually put three or four handfuls of clay onto the stone, called *mula*, and hit it with a small stone for 20–30 minutes. Then they mix that clay with *shaami*, which is ground-up broken pots.[19] Potter L mixed about 7.5 kg of clay with about 2.5 kg of *shaami*. She took an hour and a half to pound the clay and *shaami* and to remove small stones and organic substances such as leaves and roots (2000/9/17). In the case of potter L, over the eight times I observed her mixing the clay, the proportion of *shaami* in the clay was 15–50%. In the case of potter M in village G, the proportion of *shaami* in the clay was 50–90% over six measurements. These differences might stem from the different sources of the clay.

In Japanese ceramic making, it usually takes 3–4 days to remove impure substances from the clay, and the clay is preserved for about 10 days after the moisture in the clay reaches a moderate level. It is said that these process avoid the cracking and explosion of ceramics because the process increase the plastic property of clay. After preservation, ceramic artists carefully rub the clay to get rid of air bubbles and to equalize the moisture contained in the clay (Nagumo 1998a, Mori & Kazama 1976). Preparing the clay in Japanese ceramics takes much longer than in Ari pottery making.

Mori (1987a) pointed out that cracking and explosions are avoided in pots in Bamessing, Cameroon, because potters mix clay with *shamot* at a ratio of about 20 percent of the clay weight. According to his explanation, if the percentage contraction of the clay decreases when the ratio of the coarse grain of the clay increases, it does not contract and expand during the drying stage and in open firing.[20]

Ari potters also mentioned that the amount of *shaami* in clay is related to the pots' cracking and exploding during open firing.

On February 10, 2000, the earthenware of potter L in village S exploded during her open firing. This was the first time I observed pots exploding, although I observed dozens of open firings. Potter L explained to me that someone who had an evil eye might have seen her pots during her forming stage. However, she reminded me that pot explosions could be avoided if she mixed clay with more *shaami* when she prepared her clay. The data below address potter L's explanation, showing the correlation between pot explosions and the amount of *shaami* in clay.

> The experiment: the correlations between pot explosions and the proportion of *shaami* in clay
>
> [Method]
> —Clay preparation and forming pots
> There were three clay samples with three different proportions of *shaami*. I made pots in the Ari way of pottery making. After forming the pots, I left them at room temperature for about 1 month. The proportions of *shaami* were as follows:
> (A) 10% *shaami* in clay for a terra-cotta pot
> (B) 20% *shaami* in clay for a terra-cotta pot
> (C) 30% *shaami* in clay for a terra-cotta pot
>
> [Open firing]
> The fuel used for open firing was scrap pieces of cherry blossom wood and fresh grasses. For pre-heating, a charcoal fire was put in each pot, and samples A, B, and C were placed around a fire for about 30 minutes. During pre-heating, another place was paved with scrap pieces of cherry blossom wood, and a charcoal fire was made on it. The pots were placed on the scrap pieces of cherry blossom wood, and the pots were covered with fresh grasses. The length of firing was about 2.5 hours. There was a drizzly rain on the day of the experiment.
>
> [Results]
> About 10 or 20 minutes after starting the open firing, I heard the continuous bang of pots from the open firing. After the firing, samples A and B exploded, but sample C was fired without any explosions or cracking.

According to the results of this experiment, there is a high possibility that putting a certain amount of *shaami* in the clay can avoid explosions and cracks in the pots. Ari potters use clay without any adjustments such as equalizing the clay particles, and mix an amount of *shaami* before forming their pots. Although these practices would promote explosions in the case of kiln firing, in the case of open firing with small amounts of fuel and lasting only for a short time, these are apparently necessary conditions to avoid pot explosions during firings.

3.3. Shaping the pots

When ceramic artists shape ceramics using a wheel, they carefully assess the moisture contained in the clay as well as water on their hands (Mori & Kazama 1976). This is aimed at avoiding cracking and explosions, as using clay with different levels of moisture to shape ceramic ware could be one of the reasons for these negative outcomes.

When the coiling method, in which clay is coiled into a rope to shape into a pot, and the pasting method, in which pieces of clay are shaped and pasted together to shape into a pot, are used, it would be preferable to use half-dried clay because it is much easier to shape into a pot (Mori & Kazama 1976). In these methods, pots are dried gradually in a shady area to avoid deformation and cracking, which would occur due to the difference in the dehydration rate if the pots were set to dry in the sun (Mori & Kazama 1976).

On the other hand, Ari potters start shaping their pots immediately after their clay is processed.

This paper uses the most popular pot, which is called *tila* in the Ari language, as an example. *Tila* pots have a rounded bottom, a rectangular upper part, and a handle. They are used to steam root crops, hold water, and brew alcoholic beverages. Potters follow common stages of forming *tila*. Forming *tila* consists of four stages: *bakushi*, *gidibul*, *gochi*, and *galtsi* (Fig. 2), words that are derived from verbs in the Ari language that express action.[21] In the first stage, *bakushi*, the pottery maker forms a shallow bowl. In the second stage, *gidibul*, the potter expands the bottom part into a ball-like shape that is more than double the size of the bowl in *bakushi*. In the third stage, *gochi*, the potter adds some clay to the surface to form the narrow-necked upper part. In the final stage, *galtsi*, she again adds clay to the surface of the upper part to form the handles.

Although all pottery makers in village S followed these four stages, each potter used different periods of time for drying the clay in each stage. For example, potter L tended to dry her pots in a shady area and put cloths on her pots during the nighttime, and she took 2 days to finish a pot. On the other hand, potter N dried her pots in the sun, and she took only 1 day to finish a pot. Both potters dried their pots in the sun before open firing. In the case of the two potters' firings, there were almost no pot explosions except for the single previously noted case with potter L. During all four stages, potters usually fixed the cracks in pots by smearing them with clay so that the clay would still be soft. They never broke their pots during the process of pottery making. Potters shine up the pots with their own crystals within 2–3 days after shaping them. This work brings out a luster on the pots. After shining up the pots, potters fire them on the next day[22] or, at the latest, within a week. Potters put their pots in the sun just one day before open firing. They turn them to equalize the dryness of the pots according to the direction of sunlight.

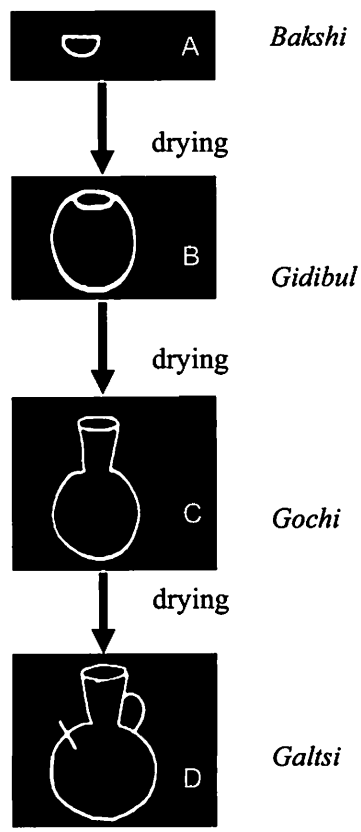

Fig. 2. Four stages of pottery making

3.4. Open firing

Each potter has her own open firing place, which is called *baka* in the Ari language, in her husband's compound. Several potters never put their pots together in one firing place, and it is common for each potter to fire her pots by herself. The scale of their open firings is diverse. A potter on one occasion fired only one pot of about 30 cm in height, whereas another potter on another occasion fired about 50 pots ranging from about 20 to 50 cm in height.

Potters put their pots around the fire, which is usually their kitchen range, to warm them before open firing, and they put a charcoal fire inside each pot to warm them from the inside. After the pots are sufficiently warm, the potter puts dried *albi* twigs (*Aspilia Africana)* in the *baka.* The *albi* twigs are arranged over a radius of 1.3 to 2 meters. Potters carefully face the mouths of the pots upward when they set out their pots on the *baka* and then put the charcoal fire on the *albi* twigs. They cover the pots with *albi* twigs and then with dried grass, followed by fresh grass. Potters pay special attention to collecting specific grass species, such as *palki* (*Cyperaceae*) in the Ari language and *garuda* (*Poaceae*) in the Ari language.

After the potters cover the pots with the different kinds of fuel, smoke from the *baka* rises, and it bursts into flames after about 10 minutes. The temperature of open firing rises to about 600°C within 40 minutes, and then the temperature increases further to 600–800°C. The *albi* and dried grass burn well in the first 30–40 minutes, and the fresh grass creates the firing condition, enveloping the pots and maintaining the high temperature for about 2 hours. To test whether the pots are completely fired, the potters remove them from the firing place even if the fire is still burning. When the pots are fired, the potters smear glue made from starch, which is in turn made from cassava and *ensete*, on the surface of the pots.[23] When the potters have finished this work, the pots are ready to be sold at the local markets.

In Japanese kiln firings, ceramic artists are careful when putting their work in the kiln and setting the fire. They are very careful to raise its temperature at a constant rate (Nagumo 1998b). Ceramic artists place their full attention on stabilizing the temperature, and they utilize several indicators such as thermometers and the color of the fire to adjust the amount of fuel and the atmosphere. On the other hand, how do Ari potters fire their pots so that they are able to produce long-lasting pots without any indicators of the temperatures of the open firing? What are the criteria by which they figure out which pots are completely fired?

4. OPEN-FIRING PRACTICES AMONG WOMEN POTTERS

4.1. Open firing techniques

4.1.1. Conditions of open firing

Most Ari potters explain that open firing is the most difficult of all pottery-making techniques. Most unmarried girls cannot perform open firing. Some young potters who are newly married ask their mothers-in-law to burn their pots together with hers in her *baka.*

There are about 20 potters' villages in Ari. Open firings were observed in seven villages of the 20. The temperatures of the open firings of potter L in village S and of potter M in village G were measured with a thermocouple (Table 1). Following her marriage, potter L, whose estimated age was around 35, moved with her husband to village S, where they have lived for more than 15 years (2002 interview). She lives with her husband and her son, who is 12 years old. She brought her pots to local markets every 2 weeks, and she made 10 to 40 pots in each open firing. On the other hand, potter M, whose estimated age was around 50 and who lives in village G, has been married for more than 30 years. She has four daughters and two sons, and two of her daughters are already married. During fieldwork in March 2002, potter M lived with her husband and their unmarried daughters. She fired her pots once every week. Potter M fired her pots as well as her daughters' and her sons' wives' pots in her open firings at that time. In each open firing, she fired approximately 50 pots.

I analyzed potter L's open firing on October 2, 2000, to examine the entire process from collecting

fuel for the firing to taking pots out from open firings. Background information underlying the case studies below will also be explained. Figure 3 shows the dynamics of firing temperatures and potter L's actions during her open firing on that day.

[Case study 1: Open firing of Potter L]

Potter L went to collect fuel for the next day's open firing on October 1, which was a fine day. She took a rope made of *ensete* rachis to bind the twigs and her sickle, and went to her acquaintance's fallow. After a 15-minute walk, L reached the fallow and collected *albi* (*Aspilia Africana*). She snapped an *albi* twig, which was about 80 cm long, in two. I tried to work with her and asked her what kind of *albi* I should collect. Potter L answered that strong *albi* turn the color of the pots' surfaces red, and pointed to twigs of about 2 or 3 cm in diameter. She bound these twigs into a bundle weighing about 30 kg and brought it home on her back.

After that, her son showed us a field with a huge amount of dried grasses, and we went to gather the grass. Because the landholder was not her acquaintance, potter L quickly collected dried grass and bound it into a bundle weighing about 30 kg within 30 minutes. That night, L polished the pots with their own crystals until midnight and put the pots around the kitchen fire to keep them warm.

On October 2, she started at 6 in the morning by putting a charcoal fire in 10 pots. Every 10 minutes, she turned the pots to equalize the heat. I asked her the reasons for putting the charcoal fire inside the pots and turning them. She replied that if she did not do this, the pots would explode. L's husband went to get more fresh grass near the wetland commons. He came back with about 30 kg of fresh grass balanced on his head within 50 minutes.

Potter L sprinkled ash in her *baka* and prepared a firing place 1 m 25 cm in radius where the *albi* twigs would be placed. In response to my question of why she sprinkled ash before putting the *albi* twigs in the *baka*, she explained that the pots would explode if the ground contained too much water. Potter L placed the pots on the *albi* twigs and then put the charcoal fire on top. After she put all the pots on the *albi* twigs, L and her husband put dried grass and then fresh grass over them. The open firing became a cone shape of 2.5 m in diameter and 1.5 m in height.

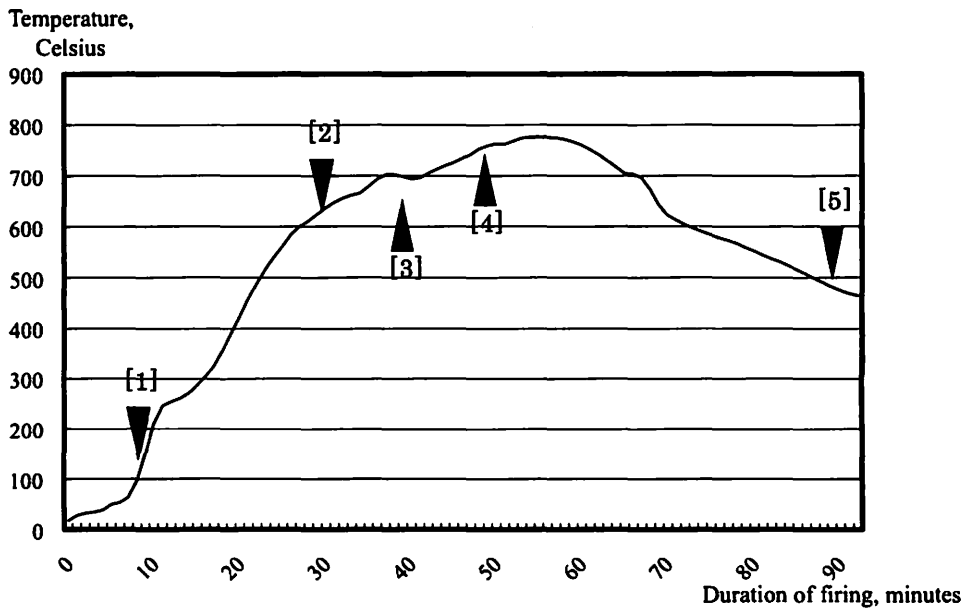

Fig. 3. Open firing on 02/10/2000

Ten minutes after beginning the firing, the thermocouple showed 202°C. The open firing burst into flames at 275°C. Potter L explained to me that the surfaces of the pots would not turn a red color if they were not fired slowly when it was rainy (Fig. 3 [1]).

About 30 minutes into firing, the pots had reached a temperature of 667°C. At this point, L peeked at the inside of the cone-shaped open firing through a hole that she made with a long wooden stick. She continued to make other holes in the cone-shaped open firing to monitor how the pots were doing (Fig. 3 [2]). She said to me that the pots were not red yet. She put the remaining fresh grass over the open firing. About 40 minutes after beginning to fire the pots, the temperature had reached 700°C. Potter L started preparing porridge from cassava flour in her kitchen to smear on the fired pots. After that, she came back to the firing place and looked inside the cone-shaped open firing through a hole (Fig. 3 [3]).

About 50 minutes after beginning the firing, L slowly turned the pots inside the center of the open firing (Fig. 3 [4]). After L served breakfast to her husband, about 90 minutes into the firing, she went to the firing place and took the pots from the firing place (Fig. 3 [5]). She explained to me that they would be cracked, *itsuri* in the Ari language, if they were left inside the firing for too long. She smeared cassava porridge on the surface of the pots. After two hours, she wrapped the pots in *ensete* leaves and brought them to local markets on her back.

4.1.2. The color of pots and firings

Pot firings in the Ari language are known as *atsu*.[24] This expression is used not only for pot firings but also for steaming pots and so on. However, they never use the expression that pots are "fired," *atsuta* in the Ari language, or "not yet fired," *atsuki* in the Ari language, when potters peek inside the cone-shaped open firing through a hole. Potters always used the expression that pots "have turned red," *zeita* in Ari language, or "have not turned red," *zeiki* in the Ari language.

At local marketplaces, potters compare their pots to see if their pots are *zeita*. For example, a potter may make a negative comment that other's pots did not become red but are black if other potters have brought pots with red and black spots. On one occasion, a potter herself mentioned that she could not make her pots red. I heard this kind of discussion from potters at many local markets.[25] The color of the surface of the pots is one of the most significant criteria for their quality.

According to potters, one of the most important influences of the color of the pots' surfaces is fuel. According to potter O in village I, who has been making pots for more than 40 years, fresh grass is a necessity for open firing to make the pots turn red. If only dried grasses are used in open firings, the fire will burn for a short time, and the heat will dissipate too quickly. However, if fresh grass is used to cover the open firing, the pots will become red because the heat will increase under the fresh grass while only some smoke dissipates.[26] According to her, the pots turn from gray, their color after they are dried in the sun, to black, and they turn from black to red when the flames spread. Pots that remain black are much more fragile than pots that have only been dried in the sun.

To make the pots turn red, it is crucial to make a hole in the cone-shaped open firing with a long wooden stick. Potter L started making holes in the open firing with a long wooden stick within 30 minutes. Other potters whose open firings I observed used the same method. According to potter L, because flames spread from inside to outside in a vorticose manner, it is easy for potters to check the color of the pots and to move and turn a pot in the open firing.[27]

However, on rare occasions, potters have been unable to turn the color of pots red even though they used fresh grass and controlled and monitored the pots in the open firing. In such cases, potters put fresh grass on the cone-shaped open firing when it is burning at high temperatures. In cases in which there is insufficient fuel, potters put *albi* twigs on the black-colored pots and cover them with fresh grass again.[28]

According to potters, the amount of fuel used for firing pots is not always the same. The amount of fuel is determined by to the materials used and the pots to be fired, such as the type of clay, number of pots in one open firing, and the climatic conditions on firing day. For example, most potters in village S specifically mentioned that pots will crack, *itsuri* in the Ari language, if the amount of fuel

is too great. According to them, *itsuri* pots will not last long. Potter L tended to take her pots out early to avoid *itsuri*.

4.1.3. Method of getting fuel for firings

Almost all of the potters I interviewed mentioned that pot firings in the rainy season require a lot of fuel and must be slow burning or else the pots do not turn red. Potter M in village G and potter L in village S collected one more bundle of about 30 kg of fresh grass in the rainy season than in the dry season. According to temperature data from open firings, there is a rapid rise in temperature within 40 minutes after beginning open firing in the rainy season (Fig. 4). On the other hand, this rapid rise in temperature occurs within 15 minutes in the dry season (Fig. 5). In the case of the October 2, 2000, firing, potter L placed more fresh grass to cool the fire when it burst into flames.

In addition to the amount of fuel, the quality of fuels is important for the pots to turn red. *Albi*, which is widely collected and used as fuel for pot firings, was easily available in the research area, and potters prefer hard and thick twigs. If potters cannot get *albi*, they use culms of maize and sorghum. According to potters and their husbands, *palki* (in the Ari language; i.e., *Cyperaceae*) is used as valuable materials for roof construction and *garuda* (in the Ari language; i.e., *Poaceae*) is the most useful type of fresh grass. On the other hand, they also know that the color of pots will not change if *ganta* (in the Ari language; i.e., *Commelinaceae*) and *zalushi* (in the Ari language; i.e., *Compositae*) are used, and they never use them as fuel for open firings.

In Ari open firings, twigs, dried grass, and fresh grass are used as fuel, and the temperatures rise from to 600–800°C. It takes about 2 hours to finish firing pots for practical use in cooking. On the other hand, the temperatures of climbing kilns rise to about 1000°C to keep the fire going for 1 week. Climbing kilns need a lot of fuel to maintain such a high temperature, and of course fuel is required for the building of the kiln itself.[29] Compared with kiln firings, open firings need less fuel. In terms

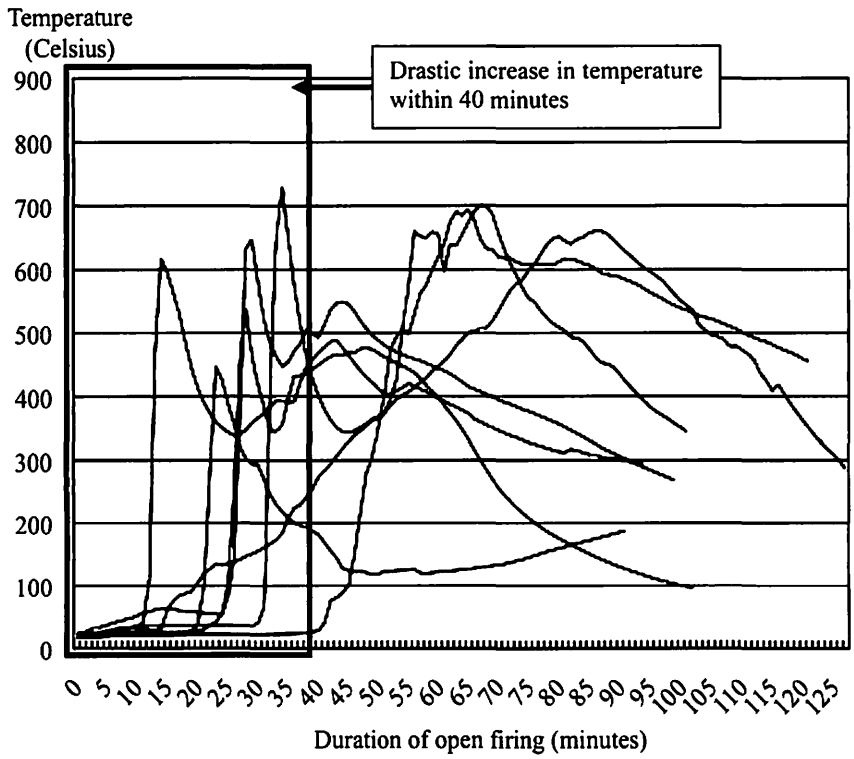

Fig. 4. Change in temperature during open firing in the rainy season

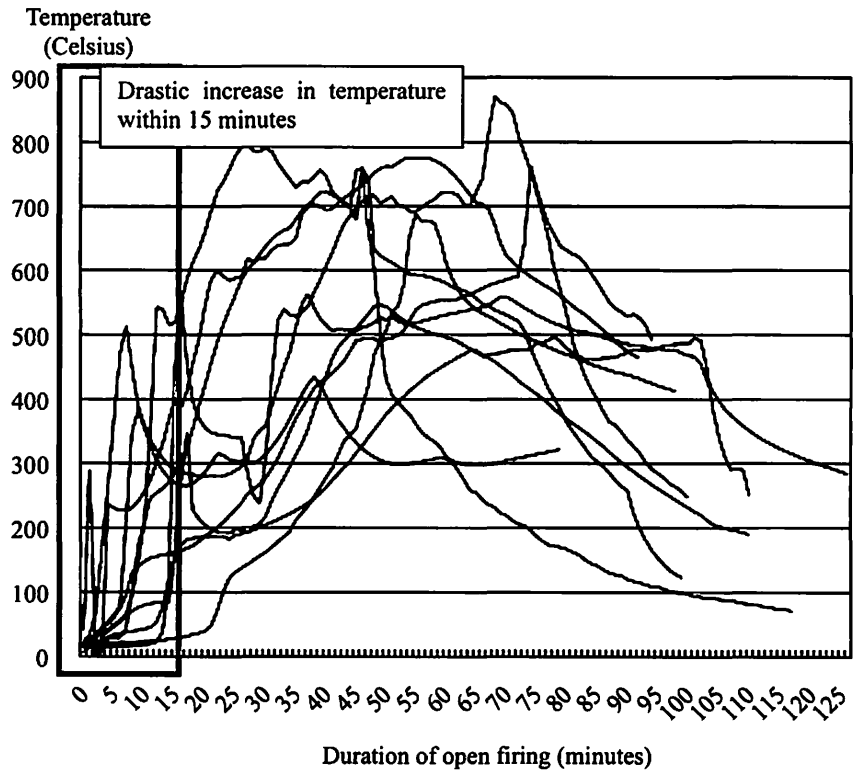

Fig. 5. Change in temperature during open firing in the dry season

of producing pots for practical use in cooking, open firing is regarded as an energy-efficient firing method.

The amount of fuel for open firings used by the Ari people cannot be compared with the fuel used for cooking in their households. Potters and their relatives make their livings from selling their pots. Because some potters' husbands have small fields, usually less than 30 acres, potters need to collect twigs and grasses from other farmers' fields. The necessary fuel for one open firing that fires about 20 mid-sized pots is at least 25 kg of twigs and about 45 kg of dried and fresh grasses. If 10 potters were to carry out open firings, the amount of twigs required would weigh at least 250 kg, and the amount of dried and fresh grasses would be 450 kg.

Conflicts having to do with collecting culms of maize and sorghum and dried and fresh grasses have occurred between farmers and potters. Although these fuels are used every day by farmers, these are very useful resources for other purposes also. For example, although culms of maize and sorghum are not suitable fuels for steaming potatoes because of their low heat, they are useful for baking thin Ethiopian bread in a clay pan. Dried grasses left in fields after weeding can be used either as mulch or as fuel for clearing the fields by burning. Fresh grasses can be also used as materials for maintenance and repair of roofs.

For these reasons, some farmers do not like to let potters collect fuel from their fields without permission. Actually, potters are unable to produce red pots in their open firings if they are unable to get plenty of fuel for their open firings even when there are twigs and dried and fresh grasses around their houses. Potters devote themselves to forming good relationships with farmers so they will receive permission to obtain fuels from their fields. They greet the landholders politely even if it means a longer walk when they collect fuel. Some potters give pots to the landholders as presents or help the farmers in cases of sickness. Other potters give celebration money to farmers when farmers' children get married or as housewarming gifts when they build new houses.

4.2. Expressions used for pots broken in firings

All potters use the same kinds of fuel and make a hole in the cone-shaped open firings with a wooden stick. They peek at the inside of the cone-shaped open firings through the hole and turn the pots inside to monitor the changing color of the pots over the 2 hours of firing. However, some potters pots break during firing even though they use clay from the same place, follow common pot-making procedures, and use the same kinds of fuels as other potters. When potters face this situation, they use the Ari expression *aani* to explain the circumstances.

The situations in which Ari people use the expression of *aani* can be classified into seven scenarios: (1) when referring to the human hand; (2) when evaluating someone's job performance;[30] (3) when learning techniques for making craftworks; (4) when describing someone's level of learning; (5) when describing innate talent; (6) when discussing the relationship between pot makers' techniques and the ways in which the pots are used; and (7) when discussing a potter's unique techniques that are seen as distinct from those of other potters. Of these seven situations, situations (1) and (2) frequently take place in Ari people's daily lives. On the other hand, situations (3) to (7) take place during pottery making and local pottery-trading markets.

(3) When learning techniques for making craftworks: "*aani kot esuta*," translated as "her hands know (pottery making)"

Potter P had been making pottery for 3 weeks. P, who lived with her children and mother, was preparing to leave her children from a previous marriage to marry another man in a different village. P's daughter had just started making two or three small pots called *bun-til* once a week. She sold her pots for two Ethiopian birr, which was equal to 25 Japanese yen at that time. At that time P planned to leave her small daughter and her elderly mother, I asked her whether she was needed to teach pottery-making techniques to her daughter, as she had just started making only one kind of pot. She answered that her mother would teach pottery making to her daughter, and her daughter's *aani* (hand) already knew (pottery making). In her answer, potter P made her daughter's hand nominative in her sentences.

It is widely said among the Ari that the very first pot made by a young daughter is of the *bun-til* style. This narrative was supported by observations of five or six small girls and interviews with more than 20 potters. Potter V explained the reasons that *bun-til* was the very first pot made by children: the technique of making *bun-til* includes almost all of the techniques needed to produce a variety of pots, and the girl would not need to learn from anybody because her *aani* (hand) would already know the basic pottery-making techniques. She also mentioned that the girls who learned how to make pots other than *bun-til* first were not able to make other kinds of pots later.

(4) When describing level of learning: "*aani kot zanmi*," translated as "hand was hard," and "*aani kot rangami*," translated as "hand was limber"

When I was making a pot, I could not equalize the thickness of the pot and sometimes made a hole in the pot. When potter M saw my pottery making, she explained to me that my *aani* was hard and I would not make any holes in my pot if my *aani* were as limber as her *aani*.[31] That same evening, when I asked two daughters of potter M the meanings of *aani* expressions, they dangled their hands in front of me and this behavior meant *aani* was limber. If the potter's *aani* is limber, that potter can make numerous pots efficiently.

(5) When describing innate talent: "*aani kot wanna*," translated as "her hand was good"

When most potters in village G make coffee pots, they dry them in their houses for more than 2 weeks after they finish forming the pots and dry them in the sun before their open firings. Then, potters put their coffee pots around their kitchen fires to warm them before they fire them. If they do not dry completely after forming or are not pre-fired in the kitchen fire, it is said that cracks would appear between the necks and the bottoms of coffee pots. However, potter Q dried coffee pots in her house for only 3 or 4 days after she finished forming them and then dried them in the sun before their

open firing. She never pre-fired her coffee pots before open firing. Her coffee pots never exploded or cracked even when she used the same kind of clay as other potters. Most potters explained that her way of making and firing was because her *aani* was good.

The pots seen at the local markets did not have any decorations. Potters did not write their names or decorate the pots. It is very difficult for most users to identify the maker of a pot at a glance. Most users who buy pots at local marketplaces called all pottery makers *tila mana*, and almost no one remembers the potters' names.

However, users could identify each potter on sight because users checked the pots and the maker of the pots together. Some users care about the correlation between a potter's unique way of making pots and the durability of pots more than about the correlation between production location and strong pots.

Potter O in village B had a very good reputation for her big clay pan for baking Ethiopian bread. The price of her clay pan was much higher than that of other potters, reaching 100–200 birr.[32] According to other potters and users, her clay pans were sold out before she put them on the ground.[33] In this case, most potters explained this situation as due to the potters' *aani* being good. In a contrasting situation, potters who did not make long-lasting pots fear bad publicity, such as people saying that their *aani* is bad. Potters explained that their pots would not be purchased if the potters were regarded as making bad pots that are easily broken.

(6) When discussing the relationship between makers' techniques and the ways in which pots are used: "*kot tilnam ist aani kan wanee*," translated as "her *aani* (pots) was good for that customers' *aani* (use)"

K, a married woman in village GW, had 19 pots with their makers' names on them as of January 16, 2001. She explained to me that the pots were not good for her *aani*, even as other users praised the ability of the potters who had made them. This shows that users also have their own *aani*, such as ways of picking pots up, putting pots on the kitchen fire, and choosing fuel for cooking. Some users insisted that there are some potters who can produce pots in their unique ways that are suited to the ways in which K uses her cooking utensils. As just described, some users are extremely aware of the existence of a few potters who can produce long-lasting pots for specific customers. Users try to look for potters who have good *aani* to buy pots for use in cooking.

(7) When discussing a potter's unique techniques, as distinct from other potters: "*aani kot gara*," translated as "her hands were different (from other potters)"

Potter R was not well on market day, and she asked her mother-in-law to fire her five clay pans. However, her mother-in-law could not fire the clay pans properly, so some pans had cracks, and others remained the color black. Potter R despaired over those failures, which arose from the differences between her *aani* and that of her mother-in-law.

Aani expressions, such as the *aani* are different, were often used by potters when they formed and fired their clay pans. Clay pans, called *aksha* in Ari language, are more than 50 cm in diameter and are used for baking thin Ethiopian bread and roasting coffee beans. This clay pan[34] is regarded among potters as difficult to shape and fire because the edges are easily cracked.

Potters M, O, and S specialized in making *aksha* for more than 30 years. According to them, nobody knows whether *aksha* are burned until they are taken out from the firing places. Potter M mentioned that *aksha* firing was difficult because potters could not turn and move *aksha* from one place to another during their open firing as could be done with other kinds of pots. Because potters could only turn them at an angle of about 20 degrees in a counterclockwise direction or clockwise rotation when they were being fired, potters took special care about the angle and direction of settling *aksha* into the firing place. Some potters prayed when the *aksha* firing was started, and some would keep other people away from their firings, even family members, because they were so nervous that someone would approach the firing place.

There are at least six patterns of *aksha* pre-firings among potters (Table 2-1).

Potter T did not learn how to make *aksha* from her mother but from other potters. At the very beginning, she could not make *aksha* without explosions and cracks if she followed the same procedure of another potter's *aksha* firing. After she continued with her trial-and-error process, she settled on her own way of firing her *aksha*, which involved drying her *aksha* in the sun for a long time before

Table 2-1. Open Firing Variations for *aksha*

I	1. put *aksha* in kitchen furnace	2. roast *aksha* in furnace	3. put the upper side of *aksha* to the flame during open firing
II	1. put charcoal fire on *aksha*	2. roast *aksha* in furnace	3. put the upper side of *aksha* to the flame during open firing
III	1. put *aksha* around furnace vertically	2. roast *aksha* in furnace	3. put the upper side of *aksha* to the flame during open firing
IV	1. put *aksha* in furnace vertically	2. Put *aksha* between *tila* during open firing	
V	1. dry *aksha* in the sun completely	2. roasting *aksha* in furnace	3. put the upper side of *aksha* to the flame during open firing
VI	1. put *aksha* in furnace vertically	2. put the upper side of *aksha* to the flame of open firing	

*Data were collected from January 2000 to June 2001.

Table 2-2. Types of *aksha* firing in terms of grandmother, mother, and daughter relationships

Relationship	types of *aksha* firing
Mother	IV
Daughter	IV
Grandmother	II
Mother	I
Daughter	VI
Daughter	—
Mother	—
Daughter	V
Mother	VI
Daughter	VI
Mother	III
Daughter	III
Mother	VI
Daughter	VI
Elder sister	I
Younger sister	I

*—: Cannot shape and burn *aksha*.
*Data were collected from January 2000 to June 2001.

pre-firing and then putting them on the kitchen fire to turn the color of the *aksha* black. She settled her *aksha* turned upside-down at the center of the open firing to heat the obverse side (Table 2-1, firing type V). Potter T did not have any problems firing *aksha* after she settled on this method, and she tried to shape and fire bigger *aksha* of more than 1 m in diameter. Similar cases in which pots cracked and exploded if a potter were to mimic others' procedure for forming and firing *aksha* were often observed. Daughters who worked in the same place as their mothers did not always follow the same procedures as their mothers (Table 2-2). Most potters explained that their *aani* were different even though they shared close mother–daughter relationships, and their pot-forming and firing methods were therefore different.

The types of fuel used for open firing and methods employed in the open firing, such as making holes in the cone-shaped open firing with sticks, were almost the same among all of the potters I observed, but potters always looked for ways to fire their pots without explosions and cracks by trial and error, often analyzing the situations using *aani* expressions. Potters paid more attention to settling on their own methods through trial and error than to following the procedure common among potters.

4.3. Expressions for the beauty of pots of the Ari people

Ari people identify more than 30 kinds of pots. They classify them into specific categories in terms of varieties of potato pots, cooking pots, and number of household members (Kaneko 2004). It is difficult for strangers to buy the right pots from among the thousands of pots at the market places.

Users explained that they like to buy pots that have *malki*[35] at the markets. According to one married woman, a pot has *malki* if (1) it is a red-colored pot and (2) all of its parts are of the appropriate size. She expressed that pots with *malki* are considered *uzumi*, i.e., beautiful in the Ari language.

Things that can be described as having *malki* include crop varieties, livestock, and aspects of craftworks, such as their height and weight. However, the expression that there is or is not *malki* is only used in relation to craftworks and is not used to describe crops and livestock.

In a pottery-making example, a potter pointed out her daughter's pots and told her daughter to continue making such pots, which have *malki*. At that time, the potter explained to me that the width of the mouth and the diameter of the bottom of her daughter's pots for cabbage cooking were appropriate. Some girls who were familiar with pottery making cared deeply about shaping their pots into the appropriate size. Potter W, who was around 15 years old, broke and reshaped the mouth of a pot for distilling alcohol repeatedly because she could not shape a more narrow mouth. One young single man, who was in search of a wife, praised a certain girl who had taken his fancy to the skies, stating that she made pots for distilling alcohol with *malki*, specifically pointing to the size of the necks and bottom of her pots.

There is no sense of standardization for assessing which pots had *malki*. Ari people creatively use various kinds of pots for various individual situations, such as cooking methods and habits, the number of people who will be sharing the meal, and the nature of meal-time situations.[36] For example, *bun til* used for coffee leaves are classified into two different types, *jagajagarudinda bun til*, which is used for boiling coffee leaves, and *chirushidinda bun til*, which is used for pouring the leaves into cups. The mouth of *chirushidinda bun til* is 1–2 cm narrower than that of the *jagajagarudinda bun til*. The kind of *bun til* used for bringing coffee and tealeaves to funerals is much smaller than the *chirushidinda bun til*. Ari people identify and use pots differently in terms of their size, and draw loose boundaries between categories to adjust for the size of crops and cooking styles. Many pot styles overlap such categories (Fig. 6).

The *malki* concept is not based on static criteria but contextualized standards that include the creative use of the pots. If potters were to make a pot of unusual size, it could be evaluated and accepted as a pot with *malki* that would be suited to someone's specific purpose. In addition to accepting pots of unusual size, users order specially sized pots, which have *malki* for that user. Potter N took an order from a customer to make an extremely wide taro pot, *asni til* in the Ari language, so that a dozen pieces of taro could be packed within it. Potter N made the pot with a mouth 10 cm wider than the

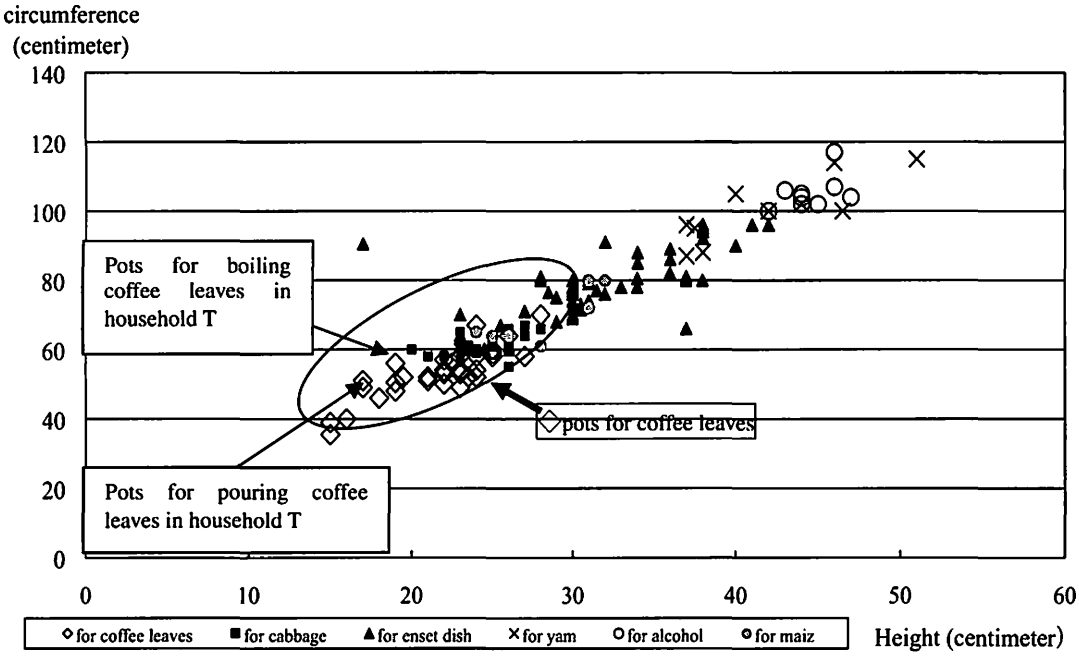

Fig. 6. Heights and circumferences of six kinds of pots in twenty three household (n=142)

most popular one. Although N's husband laughed out loud and said it was not a pot at all after N fired it, her customer loved it and paid for it gladly when she saw it.

Although potters make pots of various sizes that have *malki*, nobody will buy a pot that is blackened because most people would regard it as not durable. Moreover, both potters and users mentioned that the pots made by *galta*, elders in the Ari language, last for a long time. According to potters, *galta* cannot make appropriately sized pots because their *aani* moves slowly or is unstable. The pots that they make are not always lustrous, as they sometimes forgot to shine up the pots with their own crystals. However, their pots are judged to be strong and unbreakable, even when dropped on concrete. Actually, potters who mentioned them ordered and bought *galta* pots.

Potters must make their own judgments in every situation, considerations of climatic conditions, clay conditions, and the number of pots to be fired, and they learn these things through repeated trial and error. They practice their own methods, which are based on their own *aani*[37] to make strong and long-lasting pots. On the other hand, users try to look for pots that have *malki* to suit their contexts of use. Some users buy long-lasting pots, such as *galta* pots, even if they do not have *malki*; others make their own choices based on their own experiences and considering the differences between potters' and users' *aani*.

Expressions of *malki* influence users' behaviors in buying pots among the Ari. Both users and makers seriously care about the differences between types of pottery and methods of pottery making and have a high level of interest in these matters.

5. CONCLUSIONS: HOW CAN WE UNDERSTAND ARI POTTERY-MAKING TECHNIQUES?

I summarize the characteristics of open firing in terms of physical aspect and potters' criteria for pot firings in this chapter, and discuss Ari open firing as a community-based technology.

5.1. Technological constrains of Ari pottery-making techniques

The temperatures of the Ari open firings rise to 600°C within 40 minutes. Compared with the temperature of the Japanese climbing kiln, which increases at a constant rate until it reaches 1000°C, where it stays for several days, it is to be expected that Ari pots would explode. This is because a rapid temperature rise triggers explosions and cracking of ceramics as the moisture contained between particles in the clay would evaporate, and the ceramic itself would contract.

However, examining the whole process of pottery making from clay extractions to firings, there are several reasons that Ari techniques are able to avoid explosions and cracks. For example, in their clay processing, potters mix clay with *shaami*, which is ground-up pots. In their forming process, they shape their pots in a step-by-step manner with drying after each stage. In their open firing process, potters use specific kinds of fuel for the firings and have several methods, such as making holes and moving pots from one place to another in the open firing, to check for the completion of the pots. Each of these methods helps to avoid pot explosions, although these would not be effective in terms of Japanese ceramic practices.

At the same time, some of these methods are extremely effective at firing the pots without any problems because the maximum temperature of the open firing is 800°C. For example, clay processing that entails mixing clay with *shaami* avoids explosions of pots even when there is a drastic rise in temperature within a short time. The results of the experiments reported in Chapter 2 showed that clay mixed with 30% *shaami* did not explode, whereas clay mixed with less than 20% *shaami* exploded.

The use of twigs and dried and fresh grasses from fields as fuels for open firings would be expected to produce fragile vessels because these fuels have low heat energy compared with the fuel used in kiln firing in Japan. However, as Gosselain pointed out, Ari open firing is regarded as an energy-efficient firing method in terms of producing items for practical use in their cooking. Also, the background for maintaining this method include two elements: (1) potters control the amount of fuel used for open firings by adjusting the number of pots, responding to changes in climate, and choosing specific kinds of fuel; and (2) potters pre-fire their pots. Their methods, such as moving pots from one place to another inside the firing places to turn the pots red, are effective at producing durable red pots. Previous studies have shown that successful open firings rely on the specific location of the open firing and that temperatures in open firings can vary. However, this study showed that potters' methods equalized the heat for all pots in a single open firing. Thanks to their techniques, they produce long-lasting pots, which have lasted for more than 10 years.

These findings are based on rational correlative relationships among the technological elements, such as the change in temperatures, duration of open firings, nature of clay processing, qualities of fuels, amounts of fuels, and potters' methods in open firings. If Ari open firings are misunderstood as consisting of primitive technological elements that produce fragile vessels compared with vessels produced by kiln firings, it is because their firing techniques are being analyzed according to technological elements only. We also evaluated potters' behavior from a scientific perspective, which focuses on the rational combination of organic and technological elements. Pots among Ari people are produced, used, distributed, and sold in this area. Potters do not pay attention to technological data to make pots but use trial and error to meet users' needs. In terms of these criteria, potters concentrate on meeting the scientific and rational needs for producing pots.

5.2. Open firing as community-based technologies

Users tend to select pots that have *malki*, and they are eager to buy from potters who have good *aani* and can produce long-lasting pots suited for their unique cooking needs. Some users could identify which potter of the many was suited for their specific needs, and they loved to buy her pots. Information that users call upon in buying pots includes not only the shapes and colors of the pots but also their previous experiences using the pots. Some users care about buying pots made by potters whose *aani* are suited to the user's *aani*. No one can make long-lasting pots for every user, but there are various potters who make long-lasting pots for various users.

Potters fire durable pots suited to their *aani* in open firings. Although girls learned pottery making from their mothers, they do not always follow their mothers' methods of firing after they start supporting their families with their pottery making. Potters accept that there is not just one way for firing pots with *malki* but that there are rather various ways for firing durable pots to suite their *aani*.

For example, as potter R explained (4.2.), her mother-in-law made R's pots explode and turned them black in the open firing although they used clay from the same place and the same twigs and grasses as fuel. In this situation, potters explained that the use of the expression of *aani* has a different meaning. Moreover, as potter Q noted, her pots would not break even without drying them for a long time; on the other hand, other potters' pots would break even when they followed potter Q's way of firing (4.2 (5)). When potters faced this situation, they used the expression that her *aani* was good. However, they never try copy potter Q's procedure by trial and error. Instead, they keep practicing their own ways of firing pots.

Aani can be replaced by techniques and physical factors. However, the term *aani* does not apply to the technological aspects of potters' work, such as the qualities and quantities of fuels, the ways of placing pots in open firings, and climatic conditions on open firing days. *Aani* expressions show the close socio-technical relationships between the ways of making and ways of using the pots, and they also reveal the respect potters and users have for the process of trial and error used by the potters. The differences between potters' open firing techniques and the expressions for respecting the differences among their unique ways of firing pots reveal the innumerable close socio-technical relationships between potters and users. Also, *aani* expressions refer not only to the technological aspects of pottery making but also to social relationships between potters and users formed through the pots and the techniques of pot making and using.

Potters fire their pots to adjust for physical factors and users' individual demands for cookware. Ari pottery making as a community-based technology can be redefined as social behavior that is based on relationships between humans, through pots, and between humans and objects. Each potter understands when pot making is successful, which is contextualized in their sociocultural practices, and accepts the evaluations of users expressed in terms of social relationships to help them, through continuing trial and error, to fire durable pots that have *malki*.

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NOTES

(1) According to Gosselain (2008b), the bonfire technique, also known as open firing, is one of the simplest and most widespread techniques used in Africa.

(2) Gosselain has examined various aspects of African pottery techniques and socio-cultural conditions (Gosselain 1992b, 1999, 2000, 2008a).

(3) Yoshida (1984) proposed the idea of integrating modern technologies, such as decontextualized material and resource management, disposal of waste materials, and recycling of energy, into people's lives in remote areas.

(4) Shigeta (1994) researched African people's experiences and knowledge of indigenous agriculture and agricultural science for an extensive period of time. He pointed out that the logic underlying agriculture is

based on people's unique forms of standardization, which are not absolute but are contextualized in social situations.

(5) See my other papers and my book on the process of learning, change, and innovation in potters' body techniques and pots in sociocultural contexts (Kaneko 2005, 2011, in Japanese).

(6) These numbers show all of the villages I visited and the subjects interviewed.

(7) *Ensete* is a perennial Musaceae plant. Ari people use *ensete* as a staple food. Because *ensete* looks like banana plants, it is also called false banana. For more information, see Shigeta's 1988 paper on ethnobotanical studies of *ensete* and Brandt et al.'s 1997 *Tree against Hunger* on the general background *of ensete.*

(8) A total of 130 students in grades 6, 7, and 8 gave valid responses to these questions, which focused on their use and purchase of pots (Kaneko 2004, in Japanese).

(9) The varieties of pots in this paper are based on vernacular names.

(10) According to Ari women in each household, they can cook taro and *ensete* in a clay pot. However, yams and mashed *ensete* cannot be cooked in a clay pot.

(11) Lyone and D'andrea (2003) pointed out that the clay pan called *Mogogo* at their field site was more functional in terms of maintaining a constant temperature for baking the thin Ethiopian bread *injera* than was an iron pan.

(12) After pot firings, the surfaces of the pots have small air holes (Mori & Kazama 1976: 132). This releases heat from evaporating liquids so that the pots can cool water.

(13) Craft workers, such as potters, blacksmiths, and wood workers, are all called *mana* in this area where the *Gofa*, the *Maale*, the *Malo*, and the *Basketo* live (Freeman & Pankhurst 2001). *Mana* people among the Ari sell their craftworks directly to users, who are mostly farmers, to make their livings. *Mana* people are culturally marginalized (Gebre 1995). For example, Ari farmers consider it taboo to share meals with *mana* people. Farmers have also considered it taboo to establish kinship relationships with *mana* people. Even among the *mana* people, marriages between members of the potters' group, called *tila mana*, and members of the blacksmiths' group, called *faka mana*, are considered taboo.

(14) Kinship among the Ari is paternal and is divided into two moieties, *indi* and *ashenda.* Field research revealed that there were more than 16 clans among the 12 potters' villages as of February 2002. The males in village S were from that village and belonged to the *diru* clan. On the other hand, 19 of 23 females came from other villages, and they belonged to seven groups other than the *diru* clan.

(15) According to the criteria of the International Soil Science Society, a particle with a diameter of less than two micrometers (one micrometer is one centesimal millimeter) is called clay (Hakusui 1990: 30–31).

(16) Conditions of measurements, such as the place where instruments were placed in open firings, wind velocity, and potters' attitudes toward open firings, have a great influence on the results of measurements. The maximum temperature in the center of an open firing was different from the temperature outside the firing (Gosselain 1992a). The results of my measurements of open firings, shown in the graphs, are almost exactly the same as the data obtained by Gosselain and Smith in their studies.

(17) The largest number of pots in the open firings that I observed was about 50 pots, and the smallest was about 10 pots. Measurements of the maximum temperatures and shape of the graphs depicting changes in temperature for large and small firings showed no major differences.

(18) Mori (1974: 29), who taught ceramic techniques to college students in Uganda and also researched traditional pottery techniques, pointed out that one of the reasons for the lack of kilns was that there was almost no clay with fire endurance. According to his research in Uganda, the clay that was dug up in Uganda was vitrified at more than 1300°C, and after that, it dissolved. The clay in the Ari area was vitrified at more than 1300°C, but it did not dissolve (Appendix).

(19) It is well known that the method entailing incorporating the powder of ground broken pots into the clay results in low heat-energy requirements. It produces vessels with high practical utility and also conserves energy. For example, the ceramic association in Aichi prefecture has been trying to develop a recycling program for ceramic production that involves re-using the powder of ground broken ceramics as half of the materials used in pots (Asahi.com, Aichi 2004.3.11, in Japanese).

(20) The pot-firing techniques in oven firings among the Moba people in northern Togo involve firing pots for a short time to avoid explosions while producing vessels with high practical utility. Mori (1987c) noted that it was an unexpected technique when compared with the standard Japanese ceramic techniques, and he insisted that the clay used by the Moba must have some special properties.

(21) *Bakshi* is translated literally as making a basic form; it is only used in pottery making. *Gidibul* is a com-

pound word derived from *gidi*, referring to the inside, and bul, meaning to extend. This word is also used in pottery making. *Gochi* means pulling and is a term used in their daily lives. *Galtsi* means to smear, and is also used in their daily lives, such as smearing cow dung on the house walls. Potters use these words to express the stages of making pottery.

(22) After drying the pots in the sun, potters placed them around the furnace and turned them to dry and warm the pots.

(23) Potters pour water containing special species of tree resin to just-burned pots to produce black pots in Bamessing, Cameroon (Mori 1992). According to Mori, compared with the techniques of the smoking process for producing black pots, this method produces robust pots because the water sinks into the insides of the pots thereby avoiding water leaks.

(24) *Atsu* means firing in the Ari language and is a verb stem.

(25) The type of clay depends on where it is acquired. There are several kinds of clay, including a whitish red clay (*tsanmi zeida*) and a deep red clay (*gaasha zeida*). Potters identified each kind of clay related to the color of the pots after open firing.

(26) When she was a small girl, most potters only used big tree trunks as fuel. These days, big tree trunks have high cash values, making them too expensive to use as fuel for firing pots.

(27) Mori (1987b) pointed out that potters in the Nyamtug area of northern Togo made holes in the cone-shaped open firing with long wooden sticks because this process allows more oxygen to enter to finish firing the pots.

(28) Potter L in village S put fuel on the open fire again because the pots did not turn red (January 29, 2000). At 140 minutes after beginning the second firing, the temperature had risen from 400 to 600°C. At 30 minutes from the beginning of the second firing, potter L started making holes in the open firing as usual.

(29) About 70% of the heat of a kiln firing goes to the kiln walls and ceiling, while 20% goes to the ceramics itself (Nagumo & Rords 1979: 152).

(30) For example, *aani jookuta* in the Ari language refers to one's inferior work abilities in farming and cooking compared with others. For example, in one case, a husband gave his land to his two wives equally. When one wife used up the harvested crops before the next harvesting and the other wife did not, people said that the wife who finished the crops was *aani jookuta.*

(31) Sentences such as "*Aani anto zanmi. Ist aani mishi rangami maatsinku durufu durufuai*" were used, meaning, "Your hands are stiff. If your hands were soft, you would not make holes in your pots." *Rangami* is used in many situations in daily life. *Rangami* can be translated as weak: *zena ist rangami* means one's body has weakened. It can also be translated as to soften: *ekena rangami* means cabbage that has softened from cooking.

(32) *Aksha* is a clay pan for baking thin Ethiopian bread, *injera.* This pan is round in shape and about one meter in diameter. It is 3–10 times more expensive than the cheapest pots.

(33) Her *aksha* were so popular among users because *injera* could be baked in her *aksha* without burning. Most *aksha* need to be treated with oily plants, such as sunflower seeds, before they can be used, but her *aksha* could be used to bake *injera* without such treatment.

(34) It is said that *aksha* are difficult to shape if young potters do not acquire proficiency in pottery making because young potters have small hands. On the other hand, *aksha* were regarded as the easiest kind of pot to make among some potters of the *gashinama* group, which is a different social group from *tila mana.* For some *gashinama* potters, *aksha* was said to be learned first. This is a good example of indigenous technology in that the difficulties of making pots relate not only to the complexities of technological elements but also to the interactions between socioculturally embedded common technologies among potters and individual creativity, which are stimulated by social relationships between potters and users.

(35) This word comes from the Amharic word *melk. Melk* is used when discussing craftworks and cattle.

(36) Even in big households, small pots are used for cooking a portion for one person. On the other hand, very small households have a huge pot for cooking large amounts of food to be consumed on ceremonial occasions and for group farming work.

(37) Potters mentioned that they did not always make durable pots and that they produced pots with different features every time.

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APPENDIX

Experiment 1. Shrinkage ratio, water absorption, and pyrometric cone equivalents of clay

Method:
There were eight samples of clay. Samples 1 to 5 were from Ethiopia, and samples 6 to 8 were from Japan.

- Shrinkage ratio:
  - Dried size: Measurements of eight sample sticks, which were dried at air temperature, were made. After that, they were fired at 800°C, the maximum temperature of open firings using a gas kiln.
  - Firing size: Measurements of eight sample sticks, which were fired in the gas kiln, were made.
  - Shrinkage ratio: Measurements were made by subtracting the firing size from the dried size and dividing by the dried size.
- Water absorption: Measurements of eight sample sticks were made by dividing the amount of moisture by the dried weight. The amount of moisture was calculated by subtracting the dried weight from the weight before drying.
- Pyrometric cone equivalent: Eight samples shaped cylindrically with a height of one cm were placed on one plate. Four such plates were used to examine pyrometric cone equivalents of clay at four different temperatures: 600°C, 800°C, 1000°C, and 1200°C.

Results:

- Shrinkage ratio: Sample 1: 11%; sample 2: 13.4%; sample 3: 13.2%; sample 4: 16.6; sample 5: 10.2%; sample 6: 6.8%; sample 7: 7.4%; sample 8: 7.6%. The shrinkage ratio of Ethiopian clay was higher than that of the Japanese clay.
- Water absorption: Sample 1: 23.7%; sample 2: 22.6%; sample 3: 26%; sample 4: 25.3%; sample 5: 21.1%; sample 6: 18.8%; sample 7: 17.3%; sample 8: 18%. The water absorption of Ethiopian clay was higher than that of the Japanese clay.
- Pyrometric cone equivalent: Neither Ethiopian nor Japanese clay melted at 1200°C. However, the surfaces of all samples were vitrified.

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