TANZANIA

From Fipa to Nyiha Case Study: The Bloom Refining Process in Mbozi, Tanzania

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Introduction

In general, the bloomery technology of ironworking in sub-Saharan Africa involved two different technical and functional processes, namely smelting and smithing. The product of the smelting process was directly or ultimately taken to the smithing stage for processing of both utilitarian and symbolic implements. Nevertheless, traditional iron smelters in central and eastern Africa often situated another process between smelting and smithing, which functioned to purify the smelted bloom in a separate small furnace (Brock and Brock 1965; Chaplin 1961; Davison and Mosley 1988; Greig 1937; Mapunda 1995a, 2010; Wembah-Rashid 1969; Wise 1958). In order to verify the presence of this intermediate process, fieldwork research was carried out in Fipa (Lyaya 2009), to determine the presence and nature of the products of this refining process, and to compare these products with that of smelting debris. In the field, smelting sites appeared different from refining sites especially in terms of size, area, texture of furnace slag, and furnace design. Preliminary laboratory analyses on the Fipa slag, indicate that both processes are more or less similar chemically, which would be expected because it was the same bloom from the smelting furnace that was refined in the small furnace (Lyaya et al. forthcoming). However, there is a systematic metallographic difference between them. Smelting slag contains irregular wustite and iron metal particles, while refining slag contains round iron droplets (3-12 prills per analysed surface), an indication of the production of carbon-rich steels for quality iron tools. Thus these processes are different. In order to demonstrate these differences, we carried out fieldwork this summer in Itaka and Kapele wards in Mbozi district (Figure 1), where the refining process was also practised by the Nyiha (Brock and Brock 1965). The aims of the present research were: (1) to find out evidence of refining sites in the field, based on Fipa fieldwork experience (Lyaya 2009), and (2) to map systematically, the spatial distribution of refining sites in relation to smelting sites. If these two processes were not separated in the field, then endeavours to differentiate them through analysis in the laboratory would be a nightmare. This work presents results of fieldwork investigation of ironworking of the Nyiha people. It appears certain that traditional iron workers in Mbozi used the refining process, because refining sites discovered from these wards resemble the Fipa refining sites. The next step in this direction will be metallographic analysis of the slag to find out whether Nyiha slag is similar to, or different from, Fipa refining slag.

Background Information to the Nyiha People

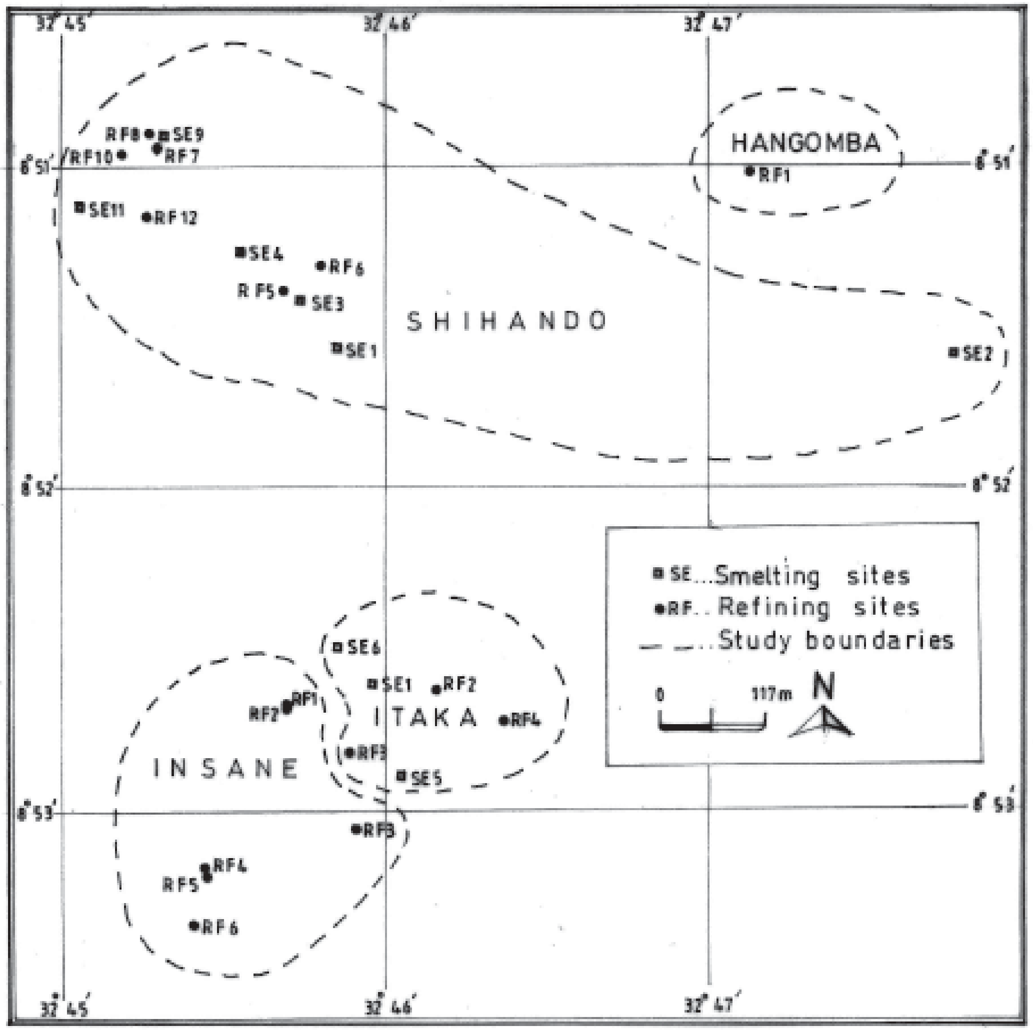
Geographically, the Nyiha people live in a strategic area, part of the narrow belt of land between two lakes, namely Tanganyika and Nyasa. Its topography allows movement to or from central Africa via three main routes: (1) north along the Fipa plateau, (2) northeast across the Mbozi plain to Lake Rukwa and eventually, to central Tanganyika, and (3) east across Mbozi through the gap between Mbeya Mountain and the mountains of the Rungwe block. This last route provides a more significant avenue of communication between east and central Africa, and Brock (1966) writes that it was followed by Arab slave caravans, the first German road, and the present main road connecting Zambia with east Africa.

The central portion of Unyiha is a flat plain lying at an elevation of approximately 1500-1600m asl. This is important because ironworkers possibly obtained their iron ore for iron smelting from these plains which contain flat marshy land characteristic of bog-iron ore (e.g., Brock and Brock 1965:97; Greig 1937:78; Wise 1958:106). The southern portion of these plains and the mountainous region are covered with volcanic ash, and receive an average annual rainfall of 1270mm, all of which provides suitable conditions for the cultivation of Arabica coffee, the main economic and cash crop of the Nyiha people of Mbozi.

Figure 1: Map of Mbozi showing Itaka and Kapele Wards.

Historically, we do not know when the Nyiha arrived in Mbozi because of contradictions and inconsistencies between the legends and the genealogies of the first chiefly lines. We understand their origin is attributed to two traditional chiefly lines: (1) Nzowa and Mwamlima (generally referred to as the Simbaya group), and (2) Mwashambwa and Mwezimpwa (generally referred to as the Mwashiuya line) (Brock 1966). Based on oral traditions, the first line is believed to have come from northeast of Mbozi, possibly from Congo (Brock and Brock 1965:100), but the second line arrived from the south-west possibly from Zambia or Malawi (Brock 1966). Apparently, the second line is more likely, because the Nyiha language is identical to that of the Lambia people to the south. Because the Nyiha people were

Figure 2: Spatial distribution of some sites in Itaka Ward.

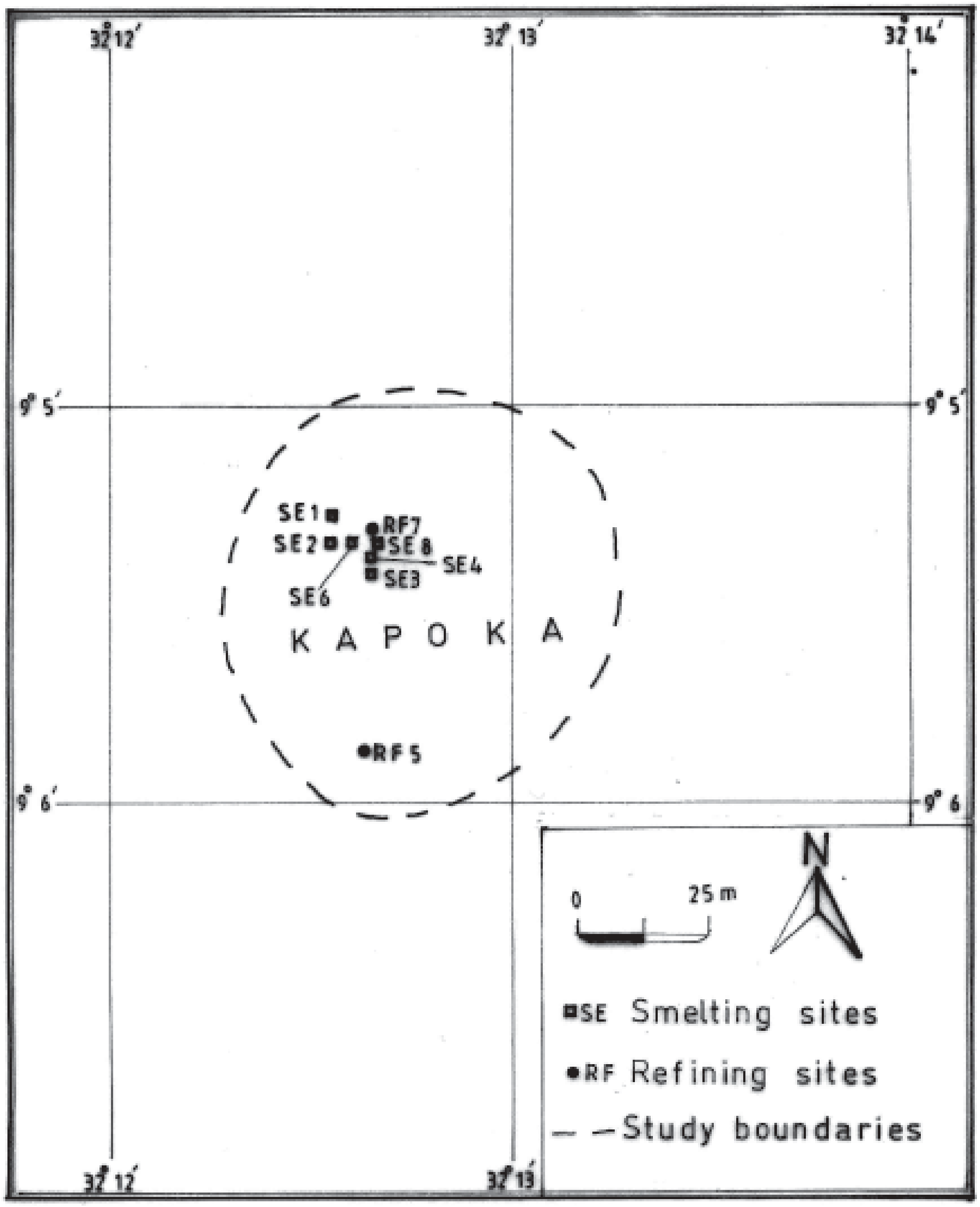


traditionally ruled by independent petty chiefs, they cannot be called a "tribe" if this term is taken to mean a clearly definable group sharing a social structure, culture, and language distinct from its neighbours (Brock 1966:1). This region has been subject to external influences of diverse types, possibly because of its geographical location.

The Ngoni from South Africa crossed Unyiha *ca*. 1840 and arrived in Ufipa by 1842. They crossed the land again when sweeping back out of Ufipa to Songea, and this time Jere, the Nzuma chief, fought the Ngoni raiders (Brock 1966:3). In the second half of the 19th century, Sangu were raiding slaves, especially from the Mwashambwa chiefdom, from the coast of Tanzania. The aftermath of these raids was famine and the movement of refugees. Towards the end of the century, one of the main trade routes from the Bemba and other central African raiding tribes crossed the Mbozi highland. Some of the Nyiha people resisted these raids and defeated the raiders, recovered prisoners, and confiscated ivory brought from the Bemba. While other tribes, including the Hehe of Iringa and Bena of Njombe, grew into solidified kingdoms from trade crossing Unyiha, some petty chiefs of Nyiha were affected differently because they lacked the discipline and a centralized organization, a fighting characteristic of their enemies: the Sangu, the Ngoni, and the Bemba (Brock 1966:4).

The question of the origin of ironworking in Mbozi is yet to be resolved because there is no solid

Figure 3: Spatial distribution of some sites in Kapele Ward.



evidence to establish whether or not the Nyiha worked iron before the arrival of the first traditional chiefly lines, such as the Nkota. So it is correct for one to speculate that the arrival of Nkota may have had only improved upon, or introduced new techniques, for iron smelting rather than providing the first introduction of ironworking. The association of new techniques with migrants explains the introduction of Fipa *malungu* technology, which is different from the old *katukutu* technology (Mapunda 1995a, 2010). *Malungu* technology is associated with the use of tall (2-3.5m high) truncated-cone furnaces with

Figure 4: Nyiha iron smelting furnace.

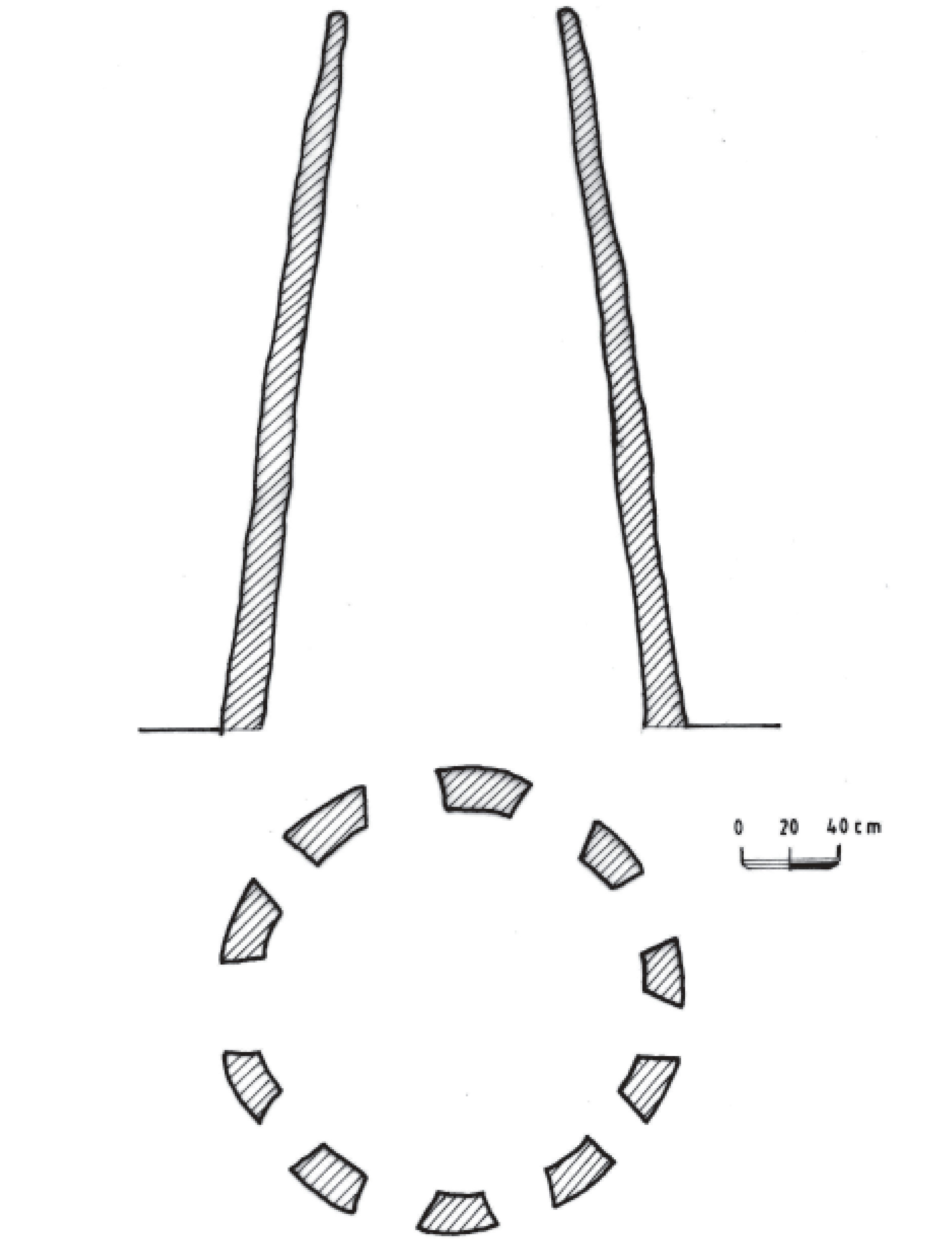


Table 1: Sites from Itaka (ITA) village.

Site Name	GPS Location	GPS Acc. (m)	Site Materials	Site Area (m^2)	Discovered by
ITASE1	S(8⁰ 52.594'), E(32⁰ 45.964')	4.0	smelting slag and tuyere pieces, furnace walls	295.4	Kaminyoge Gabriel
ITARF2	S(8⁰ 52.621'), E(32⁰ 46.168')	3.7	tapped slag and tuyere pieces, furnace walls	92.6	Michael Sianga
ITARF3	S(8⁰ 52.820'), E(32⁰ 45.905')	3.4	tapped slag, tuyeres and furnace walls	113.0	Michael Sianga
ITARF4	S(8⁰ 52.721'), E(32⁰ 46.371')	3.4	tapped slag and tuyere pieces, furnace walls	201.0	Michael Sianga
ITASE5	S(8⁰ 52.885'), E(32⁰ 46.047')	4.0	smelting slag, tuyeres, and furnace walls	63.6	Michael Sianga
ITASE6	S(8⁰ 52.484'), E(32⁰ 45.852')	4.0	smelting slag and tuyere pieces, furnace walls	147.3	Salum Muya

10 tuyere-slits, and which were operated by natural draft (Mapunda 1995b). The bloom from the smelting furnaces was refined in miniature furnaces called *vintengwe* (Mapunda 1995a:50). While the *katukutu* technology emerged in the 16th century, the *malungu* technology appeared in the 19th century, and lasted until the mid-20th century (Mapunda 1995a:46,52). The fact that *malungu* terminology is common in Tanzania, Zambia, Malawi, and Congo, strengthens the idea that cultural interaction across this region might be responsible for the spread of this technology. But what remains for future research is this question: where exactly in the malungu region or elsewhere did the technology originate if they were not multiple independent inventions?

Nyiha iron smelting was secluded from settlements, but women were allowed to take food to the working sites. The Nyiha employed tall furnaces (*malungu*, plural) ranging from 2.7-3m height with 8-10 tuyere-holes (Brock and Brock 1965), and smelting required a great deal of labour. The Nyiha used small furnaces, called *ishitenwi*, for the second purifying process which refined the product of the smelting process (Brock and Brock 1965:98). The secondary furnace was operated by forced draft, and had three holes for drafting and one large hole for slag tapping (Brock and Brock 1965:98). Brock and Brock (1965) argue that this process was done to produce high quality iron. Like iron smelting, the refining process may have had taboos because, as the chief smelter prayed, cocks were killed and their blood spread on the large [*ilungu*] and small [*ishitengwi*] furnaces (Brock and Brock 1965), although Davison and Mosley (1988:61) have a different view. The refining process has been reported elsewhere in Zambia by Chaplin (1961:54), Malawi by Davison and Mosley (1988:61-77), and Congo by Mapunda (1995b). The product of the refining process was taken eventually to the smithing process to forge implements.

Traditional iron smelting and refining died out in the middle of the last century, primarily because of competition with mass-produced goods, and possibly because of governmental suppression. Because the study of Nyiha by Brock and Brock (1965) was based on oral information, and no analysis of slag and other metallurgical remains were envisaged, this project aims at doing both macro- and microscopic analyses with the ultimate goal to improve our understanding of the significance of the refining process in relation to the smelting and smithing processes.

Fieldwork Research in Mbozi

Fieldwork was part of the author's PhD research in collaboration with the University of Dar es Salaam

Table 2: Sites from Shihando (SHI) and Hangomba (HAN) villages.

Site Name	GPS Location	GPS Acc. (m)	Site Materials	Site Area (m^2)	Discovered by
SHISE1	S(08^0 51.555'), E(32^0 45.849')	3.7	smelting slag and tuyere pieces, furnace walls	50.2	Edwinus Lyaya
SHISE2	S(08^0 51.575'), E(32^0 47.772')	3.7	smelting slag, slag-coated tuyere pieces	57.3	Edwinus Lyaya
SHISE3	S(08^0 51.405'), E(32^0 45.733')	4.0	smelting slag, slag-coated tuyere pieces, furnace walls	78.5	Edwinus Lyaya
SHISE4	S(08^0 51.247'), E(32^0 45.550')	3.7	smelting slag and tuyere pieces, furnace walls	102.0	Edwinus Lyaya
SHIRF5	S(08^0 51.359'), E(32^0 45.681')	4.0	tapped slag and tuyere pieces, furnace walls	113.0	Rashid Ndongaje
SHIRF6	S(08^0 51.324'), E(32^0 45.797')	3.4	tapped slag and tuyere pieces, furnace walls	116.8	Rashid Ndongaje
SHIRF7	S(08^0 51.916'), E(32^0 45.307')	3.7	tapped slag	102.0	Leticia Tweve
SHIRF8	S(08^0 51.886'), E(32^0 45.282')	3.7	tapped slag, slag-coated tuyeres	145.2	Kaminyoge Gabriel
SHISE9	S(08^0 51.888'), E(32^0 45.275')	3.7	smelting slag, slag-coated tuyere pieces, furnace walls	145.2	Chalamila Ditrick
SHIRF10	S(08^0 51.936'), E(32^0 45.185')	4.0	tapped slag , tuyeres, furnace walls	201.0	Khatibu Tagalile
SHISE11	S(08^0 51.098'), E(32^0 45.062')	4.0	smelting slag and tuyere pieces,	158.3	Pamela Felix
SHRF12	S(08^0 51.127'), E(32^0 45.265')	3.7	tapped slag	132.7	Kaminyoge Gabriel
HANRF1	S(08^0 51.017'), E(32^0 47.133')	4.0	Tapped slag, tuyeres, and furnace walls	132.7	Salum Muya

archaeological field school training. Before starting actual fieldwork, we reported to the District Administrative Secretaries (DAS) who wrote an introduction letter to executive officers for Itaka and Kapele wards. We were welcomed by villagers, and it was the villages' leaderships that aided us in short-listing the most relevant informants for this study prior to actual archaeological survey. Informants were interviewed in order to explore the selection criteria of smelting parameters such as furnace design, tuyeres, and wood-species selected for charcoal-making. From the informants shortlisted by the village leadership, we selected four descendants of ironworking clans namely Rashid Ndongaje (67 years old), Michael Sianga (56), Thomas Nkota (68), and Kunzitwe Mwashilingi (98) from Itaka ward, and Elias Mkupa (62) was selected from Kapele ward. The search for these key informants was based on knowledge of the practise of ironworking and awareness of the available archaeological evidence for this technology. This small number of knowledgeable iron smelters is justifiable because almost all actual iron smelters are gone (Killick 2004).

Not all the informants were aware of smelting or refining sites, so in such cases we conducted random walkover survey to discover sites. By design, we attempted systematic walkover surveys around

Table 3: Sites from Insane and Malolo villages.

Site Name	GPS Location	GPS Acc. (m)	Site Materials	Site Area (m^2)	Discovered by
INSRF1	S(8^0 52.681'), E(32^0 45.702')	4.3	tapped slag and tuyere pieces	153.9	Michael Sianga
INSRF2	S(8^0 52.675'), E(32^0 45.702')	4.3	tapped slag	22.9	Michael Sianga
INSRF3	S(8^0 53.056'), E(32^0 45.912')	3.4	tapped slag, tuyeres and furnace wall	52.8	Michael Sianga
INSRF4	S(8^0 53.187'), E(32^0 45.455')	4.0	tapped slag and tuyere pieces, furnace walls	379.9	Michael Sianga
INSRF5	S(8^0 53.194'), E(32^0 45.454')	4.0	tapped slag and tuyere pieces, furnace walls	113.0	Michael Sianga
INSRF6	S(8^0 53.355'), E(32^0 45.414')	4.0	tapped slag and tuyere pieces, furnace walls	314.0	Michael Sianga

Table 4: Sites from Kapoka village.

Site Name	GPS Location	GPS Acc. (m)	Site Materials	Site Area (m^2)	Discovered by
KAPSE1	S(9^0 5.277'), E(32^0 12.558')	4.0	smelting slag and standing furnace	1145.5	Kaminyoge Gabriel
KAPSE2	S(9^0 5.342'), E(32^0 12.553')	4.0	smelting slag, slag-coated tuyeres, standing furnace	201.0	Kaminyoge Gabriel
KAPSE3	S(9^0 5.412'), E(32^0 12.648')	4.0	smelting slag, standing furnace, slag-coated tuyeres	75.4	Chalamila Ditrick
KAPSE4	S(9^0 5.386'), E(32^0 12.648')	4.0	Pile of smelting slag, standing furnace, tuyeres	237.7	Kaminyoge Gabriel
KAPRF5	S(9^0 5.882'), E(32^0 12.646')	3.4	tapped slag, slag-coated tuyeres	19.6	Chalamila Ditrick
KAPSE6	S(9^0 5.362'), E(32^0 12.601')	3.0	smelting slag, standing furnace, slag-coated tuyeres	32.2	Kaminyoge Gabriel
KAPRF7	S(9^0 5.325'), E(32^0 12.662')	4.0	tapped slag, slag coated tuyeres	28.3	Kaminyoge Gabriel
KAPSE8	S(9^0 5.349'), E(32^0 12.671')	3.7	smelting slag and slag-coated tuyeres, standing furnace	706.5	Kaminyoge Gabriel

Table 5: Sites from Iyendwe village.

Site Name	GPS Location	GPS Acc. (m)	Site Materials	Site Area (m^2)	Discovered by
IYESE1	S(8^0 59.242'), E(32^0 12.299')	4.0	smelting slag, standing furnace, tuyeres	81.7	Elias Mkupa
IYESE2	S(8^0 59.289'), E(32^0 12.329')	4.0	smelting slag, standing furnace, tuyeres	113.0	Elias Mkupa
IYESE3	S(8^0 58.278'), E(32^0 13.417')	4.0	smelting slag, standing furnace, tuyeres	113.0	Khatibu Tagalile

sites identified by informants in order to discover more metallurgical sites. The field identification of refining sites was based on the Fipa field experience; they almost always contain relatively small size tap slag (Lyaya 2009). In order to document sites, we used a Garmin GPS map 60CSx with a 3-4m precision to record location and elevation, but areas and distances between sites were measured by tap measures and a theodolite. The results for both ethnohistorical and archaeological survey in the two wards are presented in the following section.

Results

Fieldwork in the Itaka ward involved four villages, namely Itaka, Shihando, Insane, Malolo and Hangomba. It appears that Nyiha iron smelters were species-selective in wood for making charcoal. According to informants (e.g. Kunzitwe Mwashilingi), only a few species of trees were selected for charcoal-making. Locally named, these species included *Ilenje*, *Msani*, *Mng'anzo*, *Tobalo*, and *Mulama*. Amongst the reasons for the selection of such species mentioned were: (1) their ability to provide very long lasting fire, and (2) they produced very strong fire. Iron smelting in Unyiha was secluded from settlements, and smelters were not allowed to take showers or to return home before accomplishing the work. Women were allowed to bring food to the site, but they were not allowed to stay. Although the informants were not aware of the exact medicines put in furnaces, they were clear and confident that medicines were part and parcel of ironworking in Unyiha. These medicines were intended to protect the practise against people with bad intentions, and to act as a process catalyst.

The results from archaeological surveys in the Itaka ward are presented in Tables 1 to 3 (note SE refers to smelting, and RF refers to refining). We discovered six sites in Itaka village, 12 sites in Shihando village, one site in Hangomba village (attached to Table 1 after SHIRF12), six in Insane village, and two in Malolo village (attached to Table 3 after INSRF6). Of all sites, ten were smelting and 17 appear to be refining sites. Their spatial distribution in relation to each other is presented in Figure 2. Smelting sites were comprised of remains of still-standing furnaces with very blocky and rough slag, tuyeres with slag-coating and large piles of smelting debris. Refining sites were comprised of all tap slag, tuyeres, and possibly remains of *Ishitengwi* furnaces.

The fieldwork in Kapele ward yielded eight sites from Kapoka village, and three sites from Iyendwe village (Table 4 and 5). Of these, nine were smelting and two were characterised as refining sites (for their spatial distribution, see Figure 3). In particular, Kapoka sites were comprised of still standing smelting furnaces, but in terms of the defining features for both processes there is no difference when compared to Itaka sites. The height of smelting furnaces is between 2.8 and 3m, nine tuyere ports and one large slag outlet hole (Figure 4). Opposite the slag hole, and at the back of the furnace, there is always a peep hole at 1.4m above the ground. The base's internal diameter is about 1.6m, the middle internal diameter is about 1.26m, and the top internal diameter is about 0.88m. Our informant(s) in Kapele were not aware of the tree species that produced charcoal for smelting, and this remains an avenue for future research.

Discussion

While the overall objective of this project was to examine Nyiha ironworking, the specific objectives were: (1) to identify archaeological evidence for the refining process which was under-investigated in previous work, and (2) to map the spatial distribution of refining sites in relation to smelting sites. First, the presence mainly of tap slag at certain sites coupled with the absence of smelting-defining characteristics, such as large furnaces and blocky and rough slag, are strong indicators of the refining process. The absence of any still-standing furnace at smelting sites can be explained by the fact that *ishitengwi* were meant to serve only once, although there was the possibility of re-using the same area. Similar studies elsewhere have not discovered such secondary furnaces (e.g., Barndon 2004; Davison and Mosley 1988; Lyaya 2009), but you can find remains of their walls. Based on these findings, I strongly support Brock and Brock's (1965) proposal on the possibility of the practise of refining technology in Unyiha. Apparently, the results support the fact that iron smelting in this part of the region involved tall furnaces with 10 tuyere-holes, which were operated by natural draft. The question of what type of ore was utilized awaits chemical analyses confirmation, but low-iron content ores such as limonite or goethite were proposed in the 1960s (Brock and Brock 1965).

Second, the spatial distribution of refining and smelting sites probably indicates that both processes were secluded from settlements, and that the refining process was situated a few meters away from the smelting process. For instance, Itaka sites were 14 and 65m apart, and Kapele sites were respectively located in the range of 3.1m and 33.7m apart. This separation provides an avenue to examine the products of the two processes separately, and it indicates that these processes were technologically and functionally different (see Lyaya 2007; Mapunda 2010). The small number of refining sites can be justified because oral accounts claim that they were shared or repeatedly re-used by smelters. This practice is problematic for systematic chemical analyses of their respective products— their differences might be complicated.

Also, the results indicate that iron smelters in Unyiha were species-selective of the trees for charcoal production, and there is a need to name these species botanically for confirmation purposes. The selection of species supports previous studies including those of Chaplin (1961), Davison and Mosley (1988), Mapunda (2003), Barndon (2004), and Lyaya (2008). It can be argued that if smelters were species-selective, then the direct association of ironworking and total deforestation is possibly unrealistic, but I am aware of opposing views on this issue from Schmidt (1997) and Stromquist et al. (1999).

Conclusion

Based on the fieldwork results, it appears that traditional ironworking in Unyiha is more or less similar to traditional Fipa ironworking. The next step will be chemical and metallographic analyses of the metallurgical remains from Unyiha with the view of identifying possible types of iron ores that were used, and the microstructural patterns of refining slag relative to the microstructures of Fipa refinery slag. The main goal of these endeavours is to demonstrate that the refining process existed, and that it was significant for production of highly desirable quality iron tools.

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