

The Industry and Iron Trade on Barito Watershed in 17th-19th Century AD

Hartatik Hartatik^{1,*}, Eko Herwanto², Bambang S.W. Atmojo³

^{1,2,3} Balai Arkeologi Provinsi Kalimantan Selatan (Regional Agency for Archaeological Research in South Kalimantan Province)

* Corresponding author: tatitibalar@gmail.com

ABSTRACT

Iron is important tool in human life since the abandonment of stone tools until now. This article aims to explain the iron industry sites on Barito watershed and iron trade in Kalimantan before the 20th century. The research's method used is qualitative with inductive reasoning. Primary data were obtained from archeological research about iron on Barito watershed in 2017 until 2019. This research also uses ethnohistory approach. Archaeological research on Barito watershed found at least 19 iron smelting sites with the findings of slag, tuyere, furnace, iron ore residue, and ingot. The results of carbon radio dating analysis show that iron industry on Barito watershed was in the 17th century until the early 19th century. Ethnohistory study it is known that the upstream of Barito as a producer of iron blades which are marketed to various regions in southeast Kalimantan through the Barito River.

Keywords: Barito watershed, iron industry, trade.

1. INTRODUCTION

Iron is the most dominant type of metal as a tool. Iron has been processed and used by humans for thousands of years, but the use of iron on a large scale has occurred since the discovery of "blast furnace" in the United States in the early 17th century CE (Kurunov, 2010). Iron is obtained from rocks containing iron (Fe) and then melted and forged to be tools. Iron ore smelting skills are owned by people living near iron sources, such as Angkor and Cambodia iron which is mined by the Kui people on the border with Laos. Burmese and Siamese iron is mined from the mountains near the Burma and Siam border, then processed in blacksmith villages (Reid, 2011). In Kedah, Malaysia, smelting furnaces and tuyere fragments as evidence of iron ore smelting were found at the Lembah Bujang and Kampung Gading sites dated to 535 BCE-1500 CE ((Muztaza, Saidin, Azwin, & Rosli, 2012; Naizatul Akma Mohd & Saidin, 2018). Smelting furnaces associated with lateritic ore deposits were also found at the Ban Kao Din Tai site, (Bangkok), Thailand, dated to the 14th-15th centuries CE (Pryce & Natapintu, 2010). Iron smelting in Xinjiang, China occurred much earlier, namely in the 9th century BCE (Mei, et al., 2015), while in Bukit Khasi, India occurred in 353 BCE – 128 CE (Prokop & Suliga, 2013).

Metal sites in Indonesia were found in Banten with archaeological evidence in the form of kowi, remains of bellows, negative prints and former burning holes (Mundardjito, 1977; Haryono, 2008). The iron-making site was found in Lake Matano, Luwu, South Sulawesi with the oldest date being 1000 – 1250 AD, while exploitation reached its peak in the 15th century to the 19th century CE (Bulbeck & Prasetyo, 2000). Luwu iron has a characteristic in the form of prestige iron which contains nickel, so that it is rust resistant (Do, 2013).

Archaeological research in 2017 until 2019 found the smelting sites along Teweh River and Montalat River, both are tributaries of the Barito River in Central Kalimantan. Local people, the majority are Dayak Tawoyan, call the location of iron smelting as *buren*. The community recognizes the existence of the *buren* by the spread of slag which concentrated on hilly land. Slag is a mineral residue or waste in the process of making iron (Killick, 2014). Fragments of ore, air pipes (tuyere), and clay smelting furnaces were also found (Figure 1). Iron from upstream Barito is known as Montalat iron, because it comes from ore around the Montalat River (Hartatik, et al., 2019; Hartatik & Sofian, 2018).

1.1. Methods

The purpose of this study is explain the existence of iron smelting site in the Barito watershed as evidence the producer of iron blades were traded in the Southeast Kalimantan before 20th century. Primary data on iron smelting sites were obtained from research by the Regional Agency for Archaeological Research in South Kalimantan Province in 2017 and 2019 using survey and excavation methods. This study also uses ethnoarcheological and ethnohistorical approach. Ethnoarcheological approach to explaining and interpreting artifactual findings at the Buren site and iron ore smelting technology by performing ethnographic analogies on the behavior of today's society (David & Kramer, 2001; Renfrew & Bahn, 2012).

The ethnohistorical approach is used to explain the sequence of historical events based on historical data according to the research objectives (Ember & Ember, 2006). This approach uses historical documents as material for critical analysis and synthesis (Martin, 2009), especially with regard to the history of trade and shipping in the Barito watershed before the 20th century.

2. IRON ORE SMELTING SITES IN THE BARITO RIVER BASIN

Archaeological research in 2017-2019 found 19 iron smelting sites located in the Teweh sub-watershed and the Montalat sub-watershed, both of which are tributaries of the Barito River in the North Barito Regency, Central Kalimantan (Figure 2). The artifactual findings at the 19 sites are almost the same, namely iron slag, iron ore, clay air pipes (tuyere), and smelting furnaces (Table 1). All the artifact were buried in dry leaves and thick weeds. The artifacts were seen after the site was cleaned of leaves and weeds, then excavations were carried out to reveal the artifacts, especially the smelting furnace. The condition of the smelting furnaces were mostly destroyed.



Figure 1. Smelting furnace, tuyere and iron ore at Buren Benangin Site (Hartatik & Sofiyani, 2020)

Table 1. List of Iron Smelting Sites in the Teweh and Montalat sub-watersheds (Hartatik, et al., 2019)

No.	Name of <i>Buren</i>	Location		Artifact
		Village-District	Sub-DAS - River	
1	Gunung Saing Imang	Hajak - Teweh Baru	Teweh-Jungan	Laterite ore
2	Lesung Empit	Hajak - Teweh Baru	Teweh-Jungan	Slags, laterite
3	Buren Tukuq 1	Hajak - Teweh Baru	Teweh-Tukuq	Ore fragments
4	Buren Tukuq 2	Hajak - Teweh Baru	Teweh-Tukuq	Ore fragments
5	Buren Tukuq 3	Hajak - Teweh Baru	Teweh-Tukuq	slags
6	Japus	Kandui - Gunung Timang	Montalat-Japus	Slags, ore fragments
7	Jaga Ramis/ Layung Bura	Kandui - Gunung Timang	Montalat-Layung Bura	Furnaces, slags, ingot, ore fragments
8	Buren Muara Lesung	Payang Ara - Gunung Timang	Montalat-Montalat	slags, ingot
9	Buren Maninyau	Jaman - Gunung Timang	Montalat- Montalat	Slags, ingot, tuyere, ore fragments
10	Buren Temelalo	Pelari - Gunung Timang	Montalat-Temelalo	Furnaces, slags, ingot, ore fragments
11	Buren Akoi	Pelari - Gunung Timang	Montalat- Montalat	Ore fragments
12	Buren Mejahing	Pelari - Gunung Timang	Montalat- Jaman Kecil	Slags, ore fragments, tuyere, charcoal
13	Buren Benangin	Pelari - Gunung Timang	Montalat-Benangin	Furnaces, slags, ingot, ore fragments
14	Buren Santo	Pelari - Gunung Timang	Montalat-Montalat	Slags, ore fragments
15	Buren Mejahing 2	Pelari - Gunung Timang	Montalat- Jaman Kecil	Slags, ore fragments
16	Buren Bemilum	Pelari - Gunung Timang	Montalat-Montalat	Ore fragments
17	Buren Odir	Sengkorang- Gunung Timang	Montalat- Tiontang	Furnace, slags
18	Buren Pimping	Sengkorang - Gunung Timang	Montalat-Montalat	slags, ore fragments
19	Buren Kelaat	Tongka - Gunung Timang	Montalat-Kelaat	ore fragments

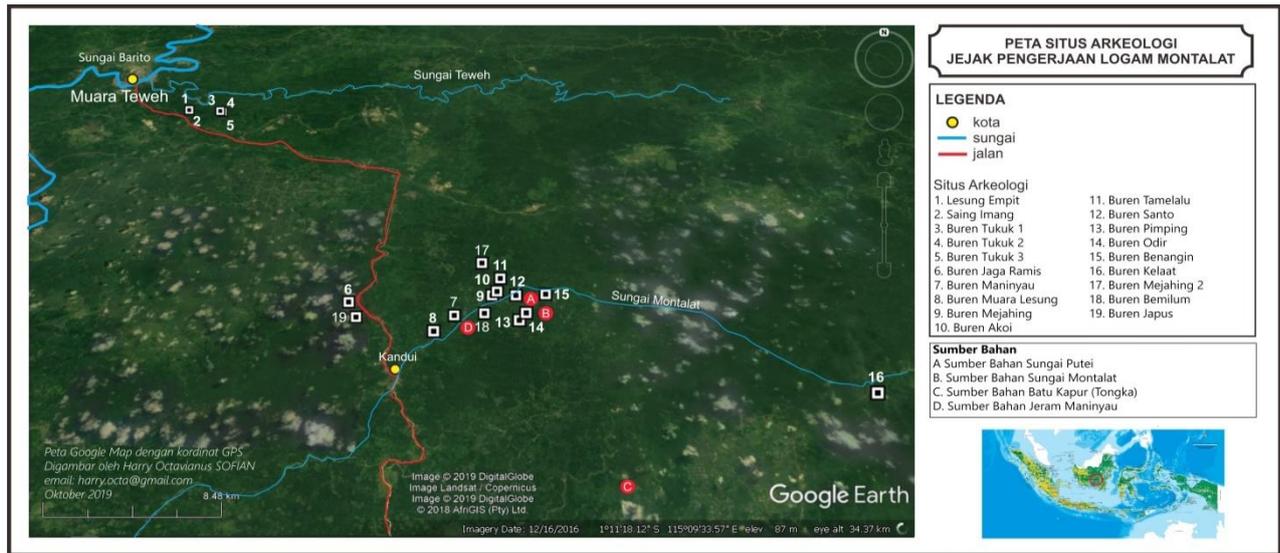


Figure 2. Map of the distribution of iron smelting sites (*buren*) in the Barito watershed (Hartatik, et al., 2019).

Excavation results at Buren Benangin, Buren Temelalo, and Buren Jaga Ramis found two furnaces at each sites. The condition of furnaces are incomplete, because the process of taking the smelting products (raw iron) by destroying one of the walls of the furnace. The furnace is roughly round on the outside but the inside is rectangular in shape with compaction or flatness. Of all the furnaces found (7 furnaces at four sites), the condition of the top of the furnace was destroyed. It is estimated that the top is shaped like a furnace which is conical at the top with a height of about 1 meter (Hartatik, et al., 2019; Hartatik & Sofian, 2020).

The dating analysis from 5 sites, namely Benangin, Mejahing, Jaga, Temelalo, and Tukuq were in 1530 – 1820, indicating that the peak of the iron industry in the upper Barito River took place in the 16th century until the early 19th century. The end of the iron industry at the early of 19th century is in accordance with ethnohistorical data from the collective memory of the community. The activity of iron smelting in the Montalat watershed has been abandoned since four generations ago, or about 150 years ago. Ethnohistorical study known that the iron smelting industry in the upper Barito watershed stopped at the end of 19th century due to the entry of iron from China with lower price than local iron (Hartatik, et al., 2018; Reid, 2011).

2.1. Rivers and Sources of Iron Ore

Laterite reserves in the southeastern of Kalimantan are highest compared to other places in Indonesia (Ishlah, 2009). Laterite ore is blackish red because of the presence of hematite and siderite elements (clay ore). The iron element in laterite rocks is quite low so that for the iron smelting process, quite a lot of laterite material is needed. Laterite types are very common in

Africa and Southeast Asia in the form of eluvial and alluvial deposits (Do, 2013).

The existence of iron ore in the Montalat River was mentioned by Schwaner in his expedition along the Barito River in 1847. He stated that iron ore used in the upper Barito taken from the banks of the river. The ore is taken from lignite formations containing taresferosiderite clay, which was cut by the Barito River. The iron ore can be seen when the water of the Barito River recedes, so that people take more of the stones in the dry season when the river water recedes (Schwaner, 1853).

Information about the source of material in the river was also disclosed by residents living on the banks of the Montalat River, they said that at low tide, iron stones appeared in the middle of the river. If the water discharge is high, the stones cannot be retrieved even by diving, because it is a location for heavy cascades. People around Jaman Village call Riam Maninyau which is in the middle of the Montalat River. Research in 2019 in June when the dry season so that the Montalat river water was receding, Riam Maninyau looked like a charred river with the type of laterite hamatite rock that contains a lot of iron (Hartatik, et al., 2019).

The tributaries of the Montalat River also provide sources of iron ore, that are Semayap River, Putei River, Benangin River where Buren Benangin is located, and the Jaman River where the Mejahing Buren is located, Layung Bura River with Buren Jaga Ramis located. In tributary of the Teweh River, there are Buren Lesung Empit near from the Jungan River, and the Buren Tukuq near the Tukuq River. Not all ore material is taken from nearby rivers, such as the Buren Lesung Empit which is closer to the Jungan River (about 50 meters), but iron

ore material is brought from Mount Saing Imang which is about 300 meters away (Hartatik, et al., 2017). Likewise, the Buren Maninyau ore, located 200 meters from the bank of the Montalat River, which was taken from Riam Maninyau on the charred river of the Montalat River is about 500 meters upstream (Hartatik, et al., 2019).

The experimental of iron ore smelting with a replica of the furnace from Buren Benangin with local iron ore has succeeded in proving that the iron ore from Montalat River and its tributaries contains high iron (around 50%) (Hartatik, et al., 2020). It's higher than the average Fe content of laterite as much as 30.26% (Usman, 2015). That experiment is one of the basic approaches to explain the smelting artifacts such as iron slag, raw iron, tuyere and smelting furnaces.

The map of site distribution in the Barito watershed shows that all sites are located in forest near the river. That location related with the availability of material sources. Materials in the form of iron ore, wood or charcoal as fuel, and clay as materials for furnace and air pipes are widely available around the sites.

2.2. The Iron of Buren Production

The spread of *buren* sites in the Barito watershed indicate that amount of iron production in upstream of Barito were large enough. Each site has a hilly mound of iron slag, averaging in a radius of about 2 meters, and a height of 0.5 – 1 meter. In one site, there are one mound of slags or more, such as in Buren Benangin and Buren Jaga there are two mounds of slags. The excavation at Buren Benangin found 245 fragments (12.46 kg) of slags (Hartatik, et al., 2018). That slags found from four excavation box as TP 1 until TP 4. The outside of TP 1 – TP 4 there are still mounds and the spread of iron slag up to the slopes of the site which the spread about 10 x 10 meters. The amount of slag that still stored in the site is probably about 10 times of the excavation results. Suppose the slags which stored in the site were considered to be 10 x the excavation result, so the amount of slags in the buren site were 10 x 12.46 kg = 120, 460 kg of slags.

The result of iron smelting experimental in 2019, comparison of slag and raw iron from Buren Benangin shows the ratio of raw iron separated from slag is 50.9% (Hartatik, et.al, 2019). This means that the raw iron obtained as much 50.9%, while the others becomes slag as much 40.1%. If the iron slag at the Buren Benangin site is 120,460 kg (40.1% of the total iron ore material), then the raw iron that has been produced from smelting as much $50.9/40.1 \times 120.460 \text{ kg} = 152.9 \text{ kg}$ of raw iron.

The raw iron is forged to remove other elements than iron so that obtained the solid and strong iron. The

analogy of the experiment of making keris blades, for 1 keris blade it takes 3 kg of raw iron (Suryono & Wiyoko, 2016), so from Buren Benangin raw iron will produce iron blades or weapons blades as much as 152.9 kg: $3 = 50.96$ or 51 blades. A total of 51 iron weapon were too much to use alone. The production results are not only used to meet their own needs but also become traded commodities. The record of iron trade in interior of Kalimantan before the colonial period has not been found due absence of writing traditions in the region. The iron trade during the colonial period was recorded in Schwaner's travel journal in a geological survey along the Barito River in 1847 and Carl Bock along the Sungai Negara (a tributary of the Barito River) in 1879 (Bock, 1988; Schwaner, 1853).

3. IRON TRADING IN BARITO WATERSHED

The peak of iron industry in the Barito watershed took place later than Luwu. In Meyer's notes quoted by A. Reid, it is stated that some areas which haven't ore sources, they forced to buy raw iron from China, such as blacksmiths in Visaya and Luzon, Philippines. Not far from Visaya and Luzon, namely in Cebu, the remains of iron ore smelting were found, but because iron from China was of better quality and cheaper, they preferred to buy iron from China rather than smelting the ore self. Many small-scale iron industries then stopped producing, except in the remote hills in the interior such as in central Kalimantan and Sulawesi which still lasted until the 19th century (Reid, 2011). The hills in the interior of central Kalimantan are most likely the upstream area of Barito. Buren sites in the upper Barito watershed are in the highlands which are part of the Meratus and Muller Mountains.

The existence of iron industry in upper Barito watershed was reported in Schwaner expedition in 1843-1847, that along Montalat River there were about 10 iron smelters (Reid, 2011; Schwaner, 1853). Information about trade in the upper Barito River comes from the records of explorers such as Carl Bock and Schwaner. The iron industry in Barito upstream is not only sufficed the needs of local communities, but is also traded throughout the southeastern of Kalimantan. Barito upstream is a producer of iron blades (raw iron) which traded throughout southeastern Kalimantan. The weapons industry in the Nagara, on the banks of the Nagara River (a tributary of the Barito River in South Kalimantan) obtains its raw iron from Barito upstream which in colonial times was called Dusun Hulu (Bock, 1988; Hendriks, 1842).

In the mid-19th century, iron blades were one of the main commodities from the Barito upstream Barito which traded throughout southeastern Kalimantan. Other commodities from Barito Barito are rattan,

agarwood, beeswax, and honey. Iron blades were traded from villages along the Barito River, to be exchanged for daily necessities, such as salt, cloth, kebaya, sarongs, tobacco, and cotton. Schwaner notes that the exchange rate of 1 bushel of salt is equal to 4 iron blades or f 1.60 (1.60 Guilders), so 1 bar of iron is valued at f 0.4. (Schwaner, 1853).

In the mid-19th century, the river trade network in South Kalimantan to the upper Barito was almost entirely controlled by the Dutch colonial government. In 1881 the Dutch brought in steam ships under the management of Koninklijk Paketvaart Maatschappij (KPM) which sailed the Banjarmasin – Purukcahu route (upstream of the Barito River) every two weeks. The existence of KPM as a shipping network is also a direct controller of commodity-producing areas (Susilowati, 2004). This is also supported by one of the goals of the establishment of the KPM to achieve political benefits for the Dutch colonial government and economic benefits for Dutch entrepreneurs (Sulistiyono, 2003).

According to Schwaner's notes and story telling, the sharpness of Montalat's iron weapons is known better and more durable than iron from Kalimantan outer (Schwaner, 1853). However, iron from Barito upstream has low exchange rate, so the iron industry in Barito upstream is in a weak position. Maybe because as a small industry in the interior, there is without good management system, or there is without intervention from government to increase the exchange rate of iron blades in trade. That are contradiction with the Montalat iron quality which onsidered high value. Weak industrial organization and management became one of the factors that accelerated the end of the iron industry in Barito upstream.

Besides the upstream of Barito, in West Kalimantan there was also the Karimata iron which the production of axes and machetes. In 1631 and 1637 the Dutch bought thousands of axes and machetes from Karimata to trade in the local market of the archipelago. Even in the 1800s merchant ships from Makassar also sailed to Sukadana (the closest port to Karimata Island) to buy axes and machetes (Reid, 2011).

The record of Carl Bock's journey across the Nagara River in 1879 stated that Nagara is a very busy city with a population of about 300,000 inhabitants. The residents work as pottery makers, boats and iron tools such as swords (machetes). Nagara's goods are sold in the market in Banjarmasin and its surroundings via the Nagara River and then into the Barito River, downstream to Muarabahan and Banjarmasin. The iron material was imported from the Dusun District (Bock, 1988). If it is related to Schwaner's notes, the Dusun District which is inhabited by Dayak Dusun (Dusun people) which consists of several small tribes, as Dusun

Witu, Dusun, Bayan Kayan, Karawatan, Malang, Karamau, and Tawoyan.

The results of radiocarbon analysis show that the activity of smelting iron ore in the upper Barito is on average between the 17th and d. 19. This is accordance with historical records which show that the peak of the iron industry and trade at that time. From ethnohistorical data, it is known that until the early 20th century or four generations ago, the activity of smelting iron ore in the Montalat watershed still ongoing. After that, peoples prefer to buy finished goods in the form of machetes, sabers, and knives from Nagara blacksmiths brought by local traders (Hartatik, et al., 2018).

Until now there are still hundreds of blacksmiths in Nagara who are still actively making iron tools. Nagara blacksmiths no longer use raw iron or blades, but scrap iron from car and metal plates (Hartatik, 2007; Hendrawan, 2015). In the past, the distribution of Nagara iron tools produced was carried by traders to all corners of southeastern Kalimantan via the Nagara River and the Barito River. But, since the existence of the land route, traders prefer the land route and only a small number still use the river. In the past, scrap metal was supplied by iron traders from Banjarmasin via the Barito River - Sungai Negara route, but now they use trucks (by road) which faster. If travel take the Barito river - Nagara river by boat, the distance from Banjarmasin to Nagara is about 15 hours, while the road is only about 5 hours. Likewise, ships from Banjarmasin-Muara Teweh navigating the Barito River take about 2 days 2 nights (48 hours), while the road takes about 12 hours. This condition makes people, especially traders, prefer land routes to rivers, so that ship transportation from Banjarmasin upstream (Muara Teweh-Purukcahu) and Banjarmasin - Nagara becomes quiet. Before 1990 year, the ships (water buses) heading Banjarmasin - Muara Teweh that docked at the Banjarmasin's pier was five ships per day, but now there is only one ship in five days or once a week (Zahidi, 2019).

4. CONCLUSION

The iron industry and trade in the upper Barito River is influenced by the existence of the Teweh and Montalat Rivers and their tributaries as material sources and as transportation routes. The existence of iron industry sites in upstream of Barito is related to the condition of the natural environment in upstream of Barito which provides iron ore.

The iron produced from Barito upstream which marketed to southeastern Kalimantan. That's mentioned in the travel notes of Schwaner (1847) and Carl Bock (1879) who sailed the Barito River and Nagara River.

Trade in the region has become increasingly bustling since the arrival of steamers and merchant ships which sailed from the mouth of the Barito River (Banjarmasin) to the upstream of Barito. Various foreign commodities, including iron from China, are traded upstream to Barito. The price offered by Chinese iron is cheaper. On the other hand, the quality of iron produced upstream of Barito is of the same quality as European iron, but iron from Barito upstream has low price. The low price wasn't accordance with the energy and time t has been spent on the production process. Finally, the craftsmen one by one stopped making raw iron.

The raw iron industry by smelting in the upper Barito has stopped, but the iron tool industry by smithing on the banks of the Nagara River be continues until now. The Nagara blacksmiths brought scrap iron from Java through the port in Banjarmasin. Before there was a road, the distribution of raw iron and iron tools was carried out via the Barito River and its tributaries. However, since the existence of adequate land roads, river routes being abandoned. The role of Barito River in trade is fading along with the bustle of land roads that are faster and more efficient.

AUTHORS' CONTRIBUTIONS

All authors contributed to the writing of this article. Hartatik as the main contributor, while Eko Herwanto and Bambang S.W. Atmojo as member contributor. This manuscript has been read and approved by all authors. The order of authors listed in the manuscript has been approved by all authors. All authors confirm that there is no conflict of interest associated with this publication and no financial support that could affect the results.

ACKNOWLEDGMENTS

Thank you to all resource persons and the Montalat research team, North Barito Regency, Central Kalimantan Province for 2017-2019. Thank you to the Head of the Archaeological Center of South Kalimantan Province who has funded the research on Montalat in 2017-2019.

REFERENCES

- [1] Bock, C. (1988). *The Head Hunters of Borneo*. Singapura: Graham Brash (Pte) Ltd.
- [2] Bulbeck, F. D., & Prasetyo, B. (2000). Two Millennia of Socio-cultural Development in Luwu, South Sulawesi, Indonesia. *World Archaeology*, 32(1), 121–137. <https://doi.org/10.1080/004382400409925>
- [3] David, Nicholas & Kramer, C. (2001). "Settlement: System and Patterns." In

- Ethnoarchaeology in Action* (pp. 226–227). Cambridge: Cambridge University Press.
- [4] Do, M. (2013). *Iron-Nickel Alloy Smelting Production in Luwu, South Sulawesi during The Pre-Islamic Period. Dissertation*. UCL Institute of Archaeology, London.
 - [5] Hartatik, Harry Octavianus Sofian, Nugroho Nur Susanto, Sunarningsih, R. B. S. (2017). "Jejak Pengerjaan Logam Montalat di Kabupaten Barito Utara Kalimantan Tengah" *Laporan Penelitian Arkeologi*. Banjarbaru.
 - [6] Hartatik, Harry Octavianus Sofian, Nugroho Nur Susanto, Sunarningsih, R. B. S. (2018). *Laporan Penelitian Arkeologi Pengerjaan Alat Logam Kuno di DAS Montalat Kabupaten Barito Utara Kalimantan Tengah: Pendekatan Etnoarkeologi dan Arkeologi Publik*. Banjarbaru.
 - [7] Hartatik; Sofian, H.O; Sunarningsih; Susanto, N.N; Dhaneswara, G. V., & Sulistiyo, R. . (2019). *Laporan Penelitian Teknik Pengerjaan Alat Logam Kuno dan Pemanfaatan Situsny di DAS Montalat, Kabupaten Barito Utara, Kalimantan Tengah: Studi Eksperimental dan Arkeologi Publik*. Banjarbaru.
 - [8] Hartatik; Sofian, H. . (2020). New Evidence of Iron Smelting Sites on the Montalat Watershed (Central Kalimantan, Indonesia): Comparison with the Iron Smelting Sites at Sungai Batu (Kedah, Malaysia). In N. H. Tan (Ed.), *Advancing Southeast Asian Archaeology 2019* (pp. 371–380). Retrieved from <https://www.spafajournal.org/index.php/spafapub/issue/view/136>
 - [9] Hartatik. (2007). Teknologi Pembuatan Alat Logam Nagara Kabupaten Hulu Sungai Selatan, Kalimantan Selatan. In Herry Porda Nugroho (Ed.), *Perkembangan Teknologi dan Ekonomi dalam Perspektif Arkeologi* (pp. 42–61). Banjarbaru.
 - [10] Hartatik, & Sofian, H. O. (2018). Jejak Pengerjaan Logam Kuna di Hulu DAS Barito Kalimantan Tengah : Kajian Arkeometalurgi. *Purbawidya*, 7(21), 119–136.
 - [11] Hartatik, Sofian, H. O., Sunarningsih, Susanto, N. ., & Sulistiyo, R. . (2020). The sustainability of the iron industry based on local wisdom in the Barito watershed watershed. *ICSTSI 2020 IOP Conf. Series: Materials Science and Engineering* 980, 012046, 1–11. <https://doi.org/10.1088/1757-899X/980/1/012046>
 - [12] Hendrawan, A. (2015). Pengaruh Proses Sepuh Terhadap Kekerasan Mata Kapak Hasil Pandai Besi di Kabupaten Hulu Sungai Selatan Kalimantan Selatan. *Jurnal Poros Teknik*, 7(1), 47–53.

- [13] Ishlah, T. (2009). Potensi Bijih Besi Indonesia Dalam Kerangka Pengembangan Klaster Industri Baja. *Buletin Sumber Daya Geologi*, 4(2), 12–21.
- [14] Killick, D. (2014). From Ores to Metals. In C. P. T. (eds.). B.W. Roberts (Ed.), *Archaeometallurgy in Global Perspective: Methods and Syntheses*. Roberts, Benjamin W. Thornton, Christopher P. ed. (pp. 11–45). <https://doi.org/10.1007/978-1-4614-9017-3>
- [15] Kurunov, I. F. (2010). Blast-furnace smelting in China, Japan, North America, Western Europe, and Russia. *Metallurgist*, 54(1–2), 114–126. <https://doi.org/10.1007/s11015-010-9265-6>
- [16] Mei, J., Wang, P., Chen, K., Wang, L., Wang, Y., & Liu, Y. (2015). Archaeometallurgical studies in China: Some recent developments and challenging issues. *Journal of Archaeological Science*, 56, 221–232. <https://doi.org/10.1016/j.jas.2015.02.026>
- [17] Mundardjito. (1977). “Wadah Pelebur Logam dari Ekskavasi Banten 1976 Sumbangan Data Bagi Sejarah Teknologi.” *MISI*, 7(2), 57–58.
- [18] Muztaza, N. M., Saidin, M. M., Azwin, I. N., & Rosli, S. (2012). 3D GPR Mapping for Excavation Plan in Jeniang , Kedah , Malaysia. *International Journal of Environmental Science and Development*, 3(6), 574–578. <https://doi.org/10.7763/IJESD.2012.V3.288>
- [19] Naizatul Akma Mohd, & Saidin, M. (2018). Budaya Material Industri Besi Di Kompleks Sungai Batu, Lembah Bujang, Kedah (Material Culture Of Iron Industry In Sungai Batu Complex, Bujang Valley, Kedah). *Jurnal Arkeologi Malaysia*, 31(2).
- [20] Prokop, P., & Suliga, I. (2013). Two thousand years of iron smelting in the Khasi Hills , Meghalaya , North East India. *Research Communication*, 104(6), 761–768.
- [21] Pryce, T. O., & Natapintu, S. (2010). Smelting Iron from Laterite: Technical Possibility or Ethnographic Aberration? *Asian Perspectives*, 48(2), 249–264.
- [22] Reid, A. (2011). *Asia Tenggara dalam Kurun Niaga 1450-1680 Jilid 1(Southeast Asia in the Age of Commerce 1450-1680). Volume 1. translated by Mochtar Pabotinggi*. (M. P. (translator), Ed.). Jakarta: Yayasan Pustaka Obor Indonesia.
- [23] Renfrew, C., & Bahn, P. (2012). *Archaeology, Theories, Methods, and Practice* . London: Thames & Hudson. London: Thames & Hudson.
- [24] Schwaner, D. C. A. L. . (1853). *Borneo Beschwing van Het Stroomgesied van den Barito*. Amsterdam: P.N. van Kampen.
- [25] Sulistiyono, S. T. (2003). *The Java Sea Network: Patterns in the Development of Interregional Shipping and Trade in the Process of National Economic Integration in Indonesia*. Universitas Leiden.
- [26] Suryono, S. J., & Wiyoko, A. (2016). *Peleburan Tradisional Pasir Besi Bengawan Sala Desa Tawang Sari Dan Pasir Besi Luwu Sulawesi Selatan Untuk Bahan Baku Besi Keris Dan Pamor Keris. Penelitian Hibah Bersaing*. Surakarta.
- [27] Susilowati, E. (2004). *Pasang Surut Pelayaran Perahu di Pelabuhan Banjarmasin, 1880-1990*. Universitas Indonesia, Jakarta.
- [28] Timbul Haryono. (2008). Kebudayaan Logam Masa Prasejarah Asia Tenggara dan Kaitannya dengan Indonesia. In Gunadi Kasnowihardjo; Sumijati Atmosudiro (Ed.), *Prasejarah Indonesia dalam Lintasan Asia Tenggara-Pasifik* (pp. 134–142). Yogyakarta.
- [29] Usman, D. N. (2015). Ketersediaan Potensi Endapan Bijih Besi Indonesia Dalam Mendukung Industri Besi Dan Baja Nasional. *Jurnal Teknik Pertambangan*, 1–20.
- [30] Zahidi. (2019). <https://kumparan.com/banjarhits/km-pancar-mas-ii-bus-air-terakhir-sungai-barito-yang-masih-tersisa>. 25 Agustus 2019 1.