Indian Journal of History of Science (2026) 61:296–305
https://doi.org/10.1007/s43539-026-00227-1

PROJECT REPORT

Metal technologies in Assam: Archaeological and historical perspectives

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Received: 2 May 2026 / Accepted: 25 June 2026 / Published online: 17 July 2026
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Abstract
Metal and metallic objects have played a crucial role in the material culture of societies across time and space. In Assam, metals have long served as essential materials for the production of a wide range of artistic, utilitarian and domestic objects. These artefacts have been crafted from materials such as iron, bronze, brass, copper, gold, and silver, reflecting both technological skill and cultural expression. Among these, iron holds particular archaeological and cultural significance due to its extensive use in construction, ritual practices and everyday life. Historical sources, especially the Tai Ahom chronicles known as the *Buranjis*, refer to highly skilled artisans proficient in working with multiple metals, indicating a well-developed metallurgical tradition in pre-colonial Assam. This project aims to document and analyse metal artefacts of historical importance currently preserved in museums, academic institutions, government departments and private collections. It further seeks to examine the significance of metal in pre-colonial Assam through a critical study of historical texts. Particular emphasis is placed on pyro-technology as reflected in the *Buranjis*, highlighting indigenous knowledge systems and technological practices. Adopting a multidisciplinary approach that integrates textual analysis and material culture studies, the research endeavours to reconstruct metallurgical practices, tools and the socio-political roles of metals in the region.

Keywords Iron smelting · Traditional metallurgy · Blacksmithing · Brahmaputra valley · Historical metallurgy · Material culture

1 Introduction

Metals and metal objects have long constituted a fundamental component of human culture and civilisation across diverse societies and historical periods. In Assam, situated in the northeastern region of India, metals have historically served as an important raw material for the production of a wide variety of artefacts, ranging from artistic creations to everyday utilitarian objects. The region has yielded numerous metal objects crafted from bell metal, brass, iron, copper, gold, silver and their various alloys, reflecting their extensive use in different cultural settings. Many such aesthetically significant and utilitarian objects are often recovered as accidental archaeological discoveries from different parts of Assam. These finds not only possess considerable historical value but also point to a long-standing and sophisticated tradition of metallurgical knowledge and technological practice in the region. The earliest known evidence of metal smelting in northeast India, particularly iron smelting, has been reported from the Khasi Hills of Meghalaya, dated to 2040 ± 80 years BP (353 BCE – CE 128) (Prokop & Suliga, 2013). The Khasi community is historically known for their exceptional metallurgical skills, using locally available iron ores to smelt and produce a wide range of agricultural tools and ornaments (Stoner, 1975). Similarly, many ancient tribal communities in North Eastern India forged tools and weapons using traditional technology, using both local and imported iron (Thakur, 2017, p. 210; Thakur & Rigam, 2023).

For example, Nagas are notable for their blacksmithing (Jamir et al., 2018). They make various hunting and agricultural tools, such as spears, knives, and axes, and many of these have ceremonial significance. Archaeometallurgical investigations in Wui village, Nagaland, also reveal evidence of iron smelting and smithing, pointing to

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a complex technological and social tradition of metallurgy in the area (Tzudir et al., 2019). Recent archaeological investigations at Chungliyimti in Nagaland have unearthed iron implements associated with kaolin ware, paddle-and-cord-marked pottery, and cord-marked pottery. The site dates back to CE 1080 ± 98 (Aier & Jamir, 2009; Pokharia et al., 2013, p. 1352).

Moreover, Yule (1842) wrote about the traditional iron industry of the Khasi-Jaintia hills and mentioned key mining areas such as Mylliem, Nongkrem, Laityngkot, near Mairang, and Cherrapunji. In the villages surrounding the mines, iron ore was often not melted. It was frequently transported for several miles to the villages where smelting furnaces were situated, and it was sold in baskets that held three maunds of ore. The workshops used to manufacture arrowheads, spears, and other implements were completely different from the huts used for the initial smelting (Thakur, 2014, p. 446). Consequently, the traditional iron industry played a significant role in the pre-colonial and early colonial economies of the Khasi-Jaintia highlands. Despite its importance to the economic development of the entire hill region, the industry was bound to have a significant impact on the ecology and forest resources of the Khasi-Jaintia hills. The industry's ability to produce goods depends on the availability and supply of raw materials and other resources (Wahlang, 2022, pp. 8–9).

Research on traditional ironworking in Manipur, India, and the Bagan region of Myanmar suggests the presence of an indigenous iron-smelting tradition dating to about 1600 ± 80 years BP, based on OSL and TL dating (Sheikh, 2013, pp. 121–125). Studies further highlight similarities in smelting techniques and practices between the two regions, indicating long-standing cultural interactions (Sheikh, 2013, 2016). Evidence of iron smelting has been found from excavations at multiple sites in the Kakching area of Manipur. Layers of smelting detritus, including ash, charcoal, slag, and fragments of potential tuyeres, were discovered at numerous locations, together with parts of mud-brick walls that may have been the collapsed remains of furnaces (Sapana et al., 2019). The Pangal community of Manipur is skilled in blacksmithing and particularly produces a variety of iron weaponry. J. Shakespear (1910) recorded the origins of iron smelting and the production of iron implements and weapons in Manipur. Shakespear (1912) also elaborated on the traditional metalworking practices of the Chin-Kuki-Mizo communities. Historically, the artisans of Kakching practised large-scale iron smelting using traditional methods, and iron swords have remained an important cultural element in the region. They also gained recognition for their proficiency in smelting iron and were known to have paid the royals of Manipur an annual tribute of iron (Singh & Singh, 2024; Singh and Singh 2025).

Beyond these notable studies in Meghalaya, Manipur and Nagaland, research on archaeometallurgy in other parts of northeast India remains limited. Consequently, the origins and early development of metallurgy in the region are still not clearly understood, largely due to the scarcity of systematic scientific investigations, gaps in historical documentation, and the lack of securely dated archaeological contexts. Furthermore, in northeast India, the cultural sequence from prehistoric to historical periods does not exhibit clearly defined Copper or Chalcolithic phases, or a distinct Bronze Age (Hazarika, 2017). The picture becomes somewhat clearer in the historical period, as several archaeological sites have yielded metal artefacts and religious icons belonging to different faiths, indicating the use of a wide range of metals in the production of objects.

2 Metals in historical and archaeological contexts in Assam

Although archaeometallurgical studies in Assam remain relatively limited, a number of significant works have contributed to its historiography. From a historiographical perspective, the works of Banarji (1911), Gait (1897), Handique (1959), Baruah (1989; 1995), Baishya (1989, 2009), Chaliha (1998), Dasgupta (1998), Chattopadhyay and Sengupta (2010), Kakoty (2012), Sarma (2008), Thakur (2017), and Saikia (2022) are particularly noteworthy in examining metallurgy and metalworking communities in Assam.

The earliest historical evidence of metal use is the copper bell inscription of Sri Kumara from Narakasura Hill in Guwahati, dated to the fifth century CE. At the same site, two bronze images of Vishnu with consorted form and two bronze sculptures of Surya point towards a long history of the use of metal technology (Das, 2007). Historical data suggest that in the seventh century CE, King Harshavardhan of Kannauj, in northern India, received a *kangshapatra*, a bell-shaped metal object, from King Kumar Bhaskarvarman of Kamarupa, ancient Assam (Baishya, 1989; Baruah and Roy Choudhury, 1999). Interestingly, the pre-Ahom inscriptions dated between the fifth and thirteenth centuries CE, written in mixed prose and verse, mention artisans engaged in metalwork, such as *takṣakāra* (engraver), *svarṇakāra* (goldsmith), *rupyakāra* (silversmith), *tāmrakāra* (coppersmith), and *karmakāra* (ironsmith).

One of the most significant archaeological discoveries in Assam is the metal hoard of thirty-seven objects from Narakasura Hill at Kahilipara, Guwahati. The assemblage includes a *mukhaliṅga*, two bronze bells, a conch, miniature shells, and twenty-two sculptures of various deities, mostly in bronze, except for a small basalt image of Manasa; four of the bronzes were cast on round plates. These artefacts are tentatively dated to the 8th–ninth centuries CE (Choudhury,

2004; Chutia, 1988, pp. 48–56) and are now preserved at the Assam State Museum. The sculptures and icons from this hoard are of exceptional artistic and cultural value (Misra & Hazarika, 2026). Recently, a hoard of metal artefacts, including a substantial number of iron swords, was unearthed at the Gojapara Kali Mandir in the Goalpara district of Assam (Misra et al., 2022–23).

Iron is a chemical element and a widely used metal throughout human history and in modern technology. Apart from using metals to make sculptures, write inscriptions, mint coins, and cast insignia, iron was also used as a binding material in the construction of stone structures. Many temples were built in dry masonry between the eighth and twelfth centuries CE, using stone blocks (Das, 2007; Sanathana & Hazarika, 2019; Sanathana and Hazarika, 2024), with iron clamps used to bind the stone blocks and architectural members. Most of the stone blocks have cavities or sockets for inserting the metal for binding. There are many sites with evidence of mason, wedge, and chisel marks, suggesting the use of iron or other metal tools for cutting and shaping the granitic-gneissic stones available in the Brahmaputra valley and its vicinity. These stones were locally mined from granitic-gneissic outcrops such as the Chapaidong hills near eastern Guwahati (Hazarika et al., 2022) and the Rajaduar areas in north Guwahati (Sanathana & Hazarika, 2019).

Archaeological excavations at a few historical sites of the Doiyang-Dhansiri valley in Assam have yielded materials and antiquities of stone, wood and metal sculptures, inscriptions, inscribed stone pieces, terracotta, clay seals, metallic pots and implements such as bronze-coated iron objects, plummets, manuscripts and other objects suggesting widespread use of metals (Dutta, 2012). Excavations in the Barpathar area of Golaghat produced several miniature copper sculptures engraved in Kamarupi script depicting King Digalekh Barma and Maharajadhiraja Jibora (Chaliha, 1998, pp. 6–7). Among other architectural elements and temple remains, the famous site of Ambari in Guwahati yielded some stone and iron cannon balls (Dutta, 2006, pp. 3–5), a few iron nails (Sharma, 2006, p. 43), and an iron piece (5 × 2.2 cm) (Kouli, 2006, pp. 122, 134). The artists may have chiselled the stone sculptures with these metal artefacts (Hazarika et al., 2022).

Several inscriptions attest to the use of silver in the region in the ninth century. The copper land grant plate of Vanamalavarman suggests that the king had on several occasions gifted gold, silver, elephants, and land to the deserving. This indicates that, despite having no known source of silver, the metal was known or used in Kamarupa during the ninth century CE (Neog, 1981). In the copper inscription of Harjara Barman, it is mentioned that at the time of royal accession, the king takes a bath with water brought from different holy places, which is stored in a silver pot.

3 Metallurgical practices in Assam

In the extraction of metals from their ores, a complex metallurgical process is involved, which includes selecting and mining the source rock or ore, transporting it to the smelting site, smelting in a furnace, collecting the metal from the furnace, and finally producing the objects in the manufacturing workshop. Throughout the process, the most common archaeological evidence would be slags, by-products of metalworking processes such as smelting. Slags are impurities in the ore that are removed by heating in a furnace at high temperatures and flow out of the furnace in liquid form during the smelting process. Iron slags have been recorded in many areas of the Brahmaputra valley, including Dhekial, Bosapathar, and Doiyang, in Golaghat district, Assam (Dutta, 2012). In our survey during 2021–23, we have been able to locate iron slags in Nazira in Sivsagar, Dhekial in Golaghat, Murtipham in Ulukunchi in West Karbi Anglong, Kamarpur in Mayong in Kamrup, Kamarkuchi near Sonapur in Kamrup, Bargaon in Garbhanga in Assam-Meghalaya border and Harinkata, Dakaidol and Luptachar in Goalpara district of Assam, suggesting widespread production of iron across the state. The Ahoms of the Medieval period extracted iron from iron nodules in the Dihing River bed and limonite iron ore in the Tiru Hills of present-day Nagaland (Saikia & Goswami, 2021).

There are occasional references to several iron production centres in the historical writings. Chaliha (1998) notes the naturally obtainable iron mixed clay (*loa-māṭī*) and iron (*lo*) in the Doiyang-Dhansiri valley in Golaghat district and the existence of the process of smelting of iron at Bossapathar, Doiyang, Dhekial, Kamargaon, Kamarbandha, Hamdoi and at some other places, supporting the hypothesis of the growth of native production and trade of iron since the early days. Dutta (2012) also suggests that the iron slags in the Rahdhala Pukhuri (tank) near Dhekial are direct evidence of iron extraction and smelting in the bygone days.

In Medieval Assam, *kamar* was the local name for an ironsmith (Handique, 1959, pp. 20–27). Barua (1995, pp. 447–453) mentioned that the people engaged in iron extraction were called *lo-saliya*, who formed a unit of five *paiks* under an expert. In the winter months, these units used to dig the dunes and mine the iron-rich clay ores. Rajaguru (1988) further describes ironworking under the Ahom administration, noting that iron workers were divided into groups. Every unit or division consists of one *Ojah* (head) and four *Palis* (assistants). Such a unit could produce about one maund (an Indian unit of weight equivalent to 37 kg) and 12 seers a day, working for the entire day and night. Moreover, various *khels* under the *paik* system, including *sonowal, moriya, sonari, sonsowa, and kamar,* which were related to metalworking, were institutionalised. The villages inhabited by these *khels* eventually developed into significant hubs for

manufacturing, trade, and commerce. It may be noted here that some ten to twelve thousand *sonowals* (who collected gold, '*xon'* in Assamese) were engaged in gold washing from the sands of the Brahmaputra River (Das, 2020; Handique, 1959, pp. 6–7). One of the notable Vaishnavite biographical works, *'Kotha-Gurucharita*' of the 16th–17th centuries, distinctly mentions the existence and mining of iron ore during the Koch rule. Hamilton (1963) stated that iron hoes valued at Rs. 600 were exported from Assam to the surrounding areas in medieval times.

In the mid-18th century, during the reign of Ahom king Rajeswar Singha, Roha, in the middle of Assam became a very popular trade centre. Small *haats* or markets were established where cowry shells and silver coins were used as a medium of business transaction. French diplomat and traveller Jean-Baptiste Chevalier (1729–1789) noted that during the Ahom reign, Guwahati was a hub for merchants from different parts of the North Eastern region, and that it served as a warehouse. All the merchandise was carried to Sonapur and to a place named Pandua, where people exchanged items through copper (C. Dutta Baruah and J. Deloche, 2008).

The north eastern part of India was situated along the south-western section of the historic Silk Road, which connected ancient Kamarupa with Southwest China and the rest of India. The region served as the route linking China, Tibet, and Burma (Myanmar) with the rest of India. Silk, pearls, cowries, musks, vermillion, cotton textiles, China ware, lead, copper, silver, and other commodities were among the goods traded. British naval officer, explorer and writer Charles Alexander Bruce (1793–1871) claims that silver used in Assam was imported from China (Saikia, 2020a, 2020b). Ganguli (1984, p. 7) reports from the Ahom chronicles that active trade and commerce flourished between the Nagas and the Assamese, primarily through barter. The Nagas exchanged salt, cotton, medicinal herbs, ivory, beeswax, mats and daos for rice, cloth and beads from Assam. Majumdar (1924, p. 42) documents that in the 1920s the Naga hills exported indigenous products such as cotton, rubber, tea, sugarcane and cardamom to the plains, while importing beads, glass bangles, zinc or brass items, boar tusks, ivory and glass, mainly from Kolkata, Mumbai and Myanmar.

Ethnographically, several communities in Assam are presently engaged in metal craft. These are mostly ironsmiths and bell or brass metal workers. The *kahars* (or *kanhars*) use traditional technology to produce items made of brass, an alloy of copper and zinc in the ratio 70:30, and bells, an alloy of copper and tin in the ratio 78:22. The *kamars* are engaged in iron works. The elderly generations of these communities possess extensive knowledge of indigenous technological skills passed down through oral traditions from their forefathers. An ethnographic study among these communities has provided insights into our understanding of metal technology or metallurgy in this region (Misra & Hazarika, 2025).

4 Metals and material cultures of Assam

Metals form a large segment of the material culture in Assam (Figs. 1, 2, 3, 4, 5, 6). All types of metals, including copper and its alloys, bronze, silver, gold, iron, and cast metals, are included as metal goods. Through typological classification, material assessment and stylistic evaluation, one can explore how metal objects reflect societal structures, craft specialisation and regional identities. Metal wares ranging from ritual vessels to utilitarian tools (Figs. 1, 4, 5) offer insights into everyday life and ceremonial practices, while ornaments reveal aesthetic preferences, social status, and the symbolic meanings embedded in adornment traditions. Weapons, including swords, spears, and protective gear, illuminate advancements in metallurgy, warfare strategies, and political power dynamics.

4.1 Agricultural Tools

Assam is a land of various agricultural practices, producing a wide variety of crops. The primary agricultural products of Assam include rice, sugarcane, tea, various vegetables, and jute. For these agricultural practices, a variety of tools and implements are required. *Da* is an important all-purpose tool and a general term used to identify and categorise a wide range of iron-made choppers (Colquhoum, 1885; Shakespeare, 1914). Different kinds of iron choppers, or *Da*, were gathered as tribute from small ethnic groups and kingdoms, or as war loot/booty during conflicts, while some were forged by the Ahoms. The ahoms utilised a variety of *Da*, including *nakoi-da, mit-da, nara-da, kopi-da, mechi-da, khangara-da, bolikota-da, shikara-da*, and others. For example, *shikara-da* was gathered from one of the northeastern ethnic group Mishing (Miri), as a tribute and as war loot. In later times, this kind of da was employed by the Ahoms (Gogoi, 2017; Nath, 2024, pp. 66–69) in war and on the battlefield. Barpujari (1994), Gogoi (2006), Baishya (2009), and Gogoi (2017) recognised and categorised *shikara-da* among other varieties of Ahom choppers. The use of forged iron choppers was mentioned in the *Assam Buranji* (Bhuyan, 1945) and the *Satsari Assam Buranji* (Bhuyan, 1960). At the District Museum in Mangaldoi, one piece of *shikara-da* is showcased. This *Da* is composed of a curved iron blade and a hilt with a wooden grip and a ferrule.

4.2 Jewellery and ornaments

Jewellery and ornaments are indispensable elements of the day-to-day life of the people of Assam (Fig. 2) since bygone



Fig. 1 Collections of metal objects documented in different museums and Satra institutions



Fig. 2 Metal objects and jewelleries being used by the Bodo and other ethnic communities in Assam

days. Among the ornaments, gold and silver are the most common in traditional Assamese jewellery-making in the present-day context (Misra & Hazarika, 2025). Even during the medieval period, gold and silver were mostly preferred by artisans, along with the use of various precious gems, stones, beads, and pearls (Baishya, 2009; Barua, 1995). However, in the later centuries of the medieval period, brass was also used alongside gold and silver to make ornaments



Fig. 3 Metal objects displayed at the Assam State Museum

(Chaliha, 1998). The Ahom rulers also patronised the artisans. Various Ahom *Buranjis* contain information regarding these jewellery makers. Ahom king Rudra Simha invited goldsmiths from Banaras to teach local craftsmen to make gold and silver jewellery (Bhuyan, 2010).

Gold plating, one of the important methods of goldsmithing, was used by the people of Assam in the early days on everyday items. Objects like *Bhogjora*, *Dogdogi*, *Moirajora*, *Maihang*, *Dhowakhowa*, *Chilim*, *Xorai*, *Xofura*, *Bota*, *Bati*, *Kahi*, *Choriya*, *Tema*, *Temi*, *Gosa*, and the hilt of swords were among the items utilised by Assamese people in their day-to-day lives, where gold-workers frequently plated them (Handique, 1959, p. 9; Sharma, 1950). The silversmiths and goldsmiths use several metal die moulds for making pendants. In this process, smiths place sheets of gold and silver on the die, then gently hammer it to create the desired impression on the sheets. Jewellery is created by soldering the imprinted pieces onto a gold or silver substrate. Hindu gods and goddesses were also carved into brass moulds by Assamese jewellers and used as stamps to produce motifs resembling repousse on pendants.

4.3 Weaponry and defensive tools

Several important iron-made arms and weapons (Fig. 6) manufactured in ancient Assam included spears, cannons, swords, daggers, knives, axes, adzes, spades, and hoes. These are found in archaeological context as well as recorded in historical literature (Baishya, 2009; Chaliha, 1998). During warfare in the medieval period, Ahom rulers and soldiers used a variety of swords, daggers, and daos, such as hengdang, mesi-da, mit-da, etc. (Gogoi, 2006). These were mostly locally made. According to historical evidence, the Ahoms have used firearms since the reign of

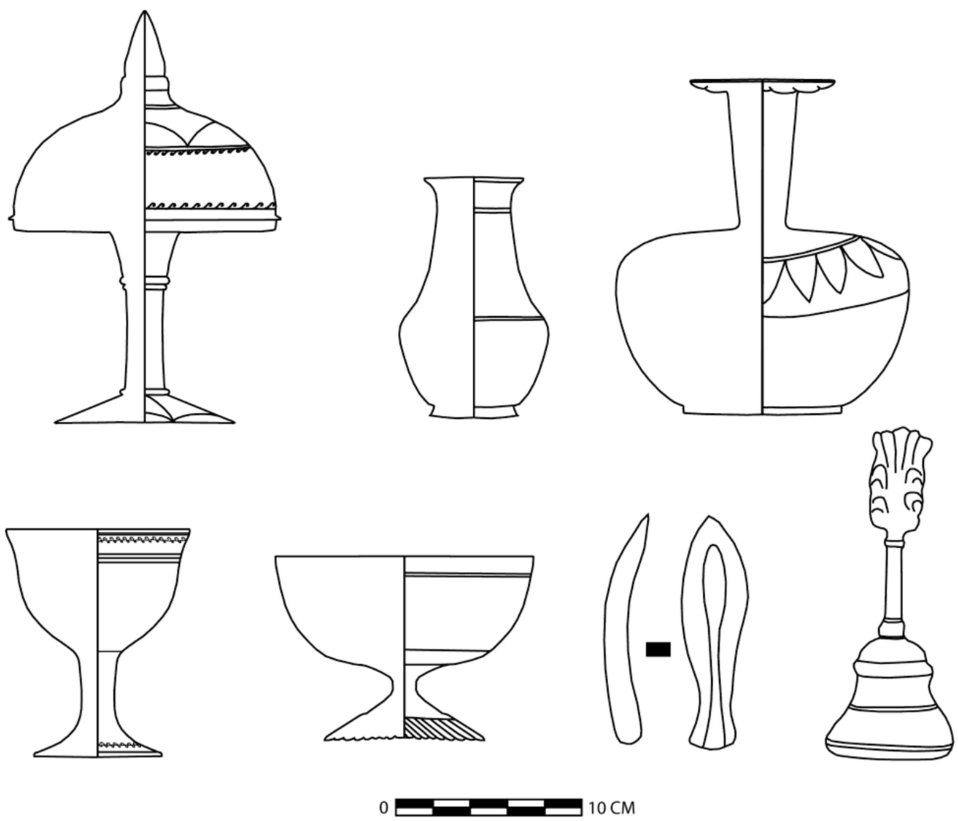


Fig. 4 Line drawings of different metal objects such as *Xorai*, *Ghoti*, *Koloh*, *Ban Bati, Kosa* and *Tilinga*

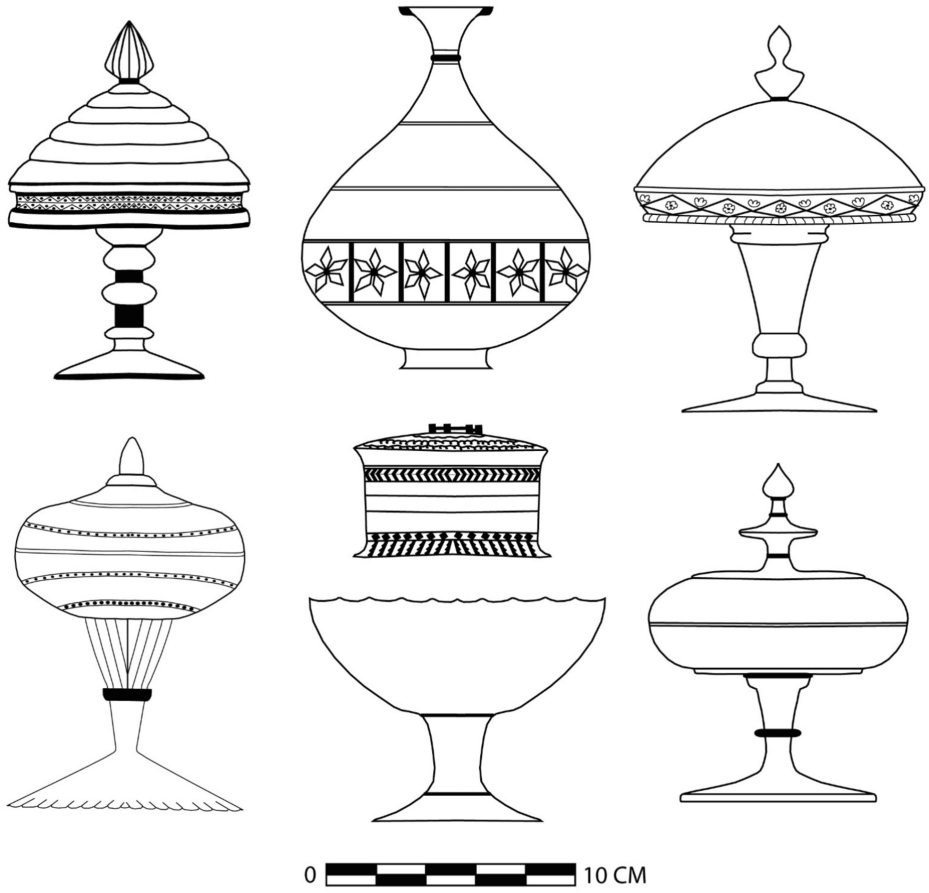


Fig. 5 Line drawings of various types of bell and brass metal household objects such as *Xorai, Lota, Xorai-Bota, Xofura,* small jewellery box, *Hatikhuliya Bati* and *Tema Bota*

Ahom king Su-hung-mung (r. 1497–1539) (Gogoi, 2006, pp. 98–99). The Ahom ruler's use of various types of firearms was observed during the conflict with Hussain Khan in 1533–1534 CE (Gait, 1926; Hussain, 2006). The Ahom army's arsenal in medieval Assam included matchlocks, gunpowder and cannons (Hazarika & Sharma, 2016, p. 88).

In the medieval history of Assam, metal-made cannon played a vital role in warfare (Chauley, et al., 2016). Cannons are locally known as *bortope* or *hiloi*. The use of cannons on the battlefield caused heavy casualties among the enemy. During the Ahom reign, extensive use of forge-welded iron cannons is evident from the cannons found in the region (Chattopadhyay & Sengupta, 2010). The Ahom rulers commissioned the *kahars* or *kanhars* (bell-metal workers) to manufacture the *bartope* (cannon) and *barhiloi* (cannon balls) (Tamuli, 2009). Various types of guns were used during the Ahom period, including *khorahiloi, hatnoli-yahiloi, ramsongihiloi,* and *muthiyahiloi*.

According to J.N. Sarkar (1994), not everyone had access to gunnery and cannonry during the Ahom era. The musketeers (a musketeer was a soldier who carried a long cannon or musket loaded with a muzzle) were from two groups known as *konwar* and *nara khel* (Gogoi, 1985). The edged weapons of the Ahom period were of three different kinds. These included locally made edged weapons (such as *hengdung* and *jathi*), edged weapons collected as battle booty (such as talwar), and edged weapons obtained as tribute (such as *nakoi-da* and *shikara-da*) (Gogoi, 2017; Nath, 2024). There are a large number of iron tool*s* displayed at the Assam State Museum in Guwahati, the District Museums in Tezpur and Mangaldoi, and the Tai-Ahom Museum in Sivasagar. These *talwars* consist of an iron blade and a hilt. In addition to its curved, single-edged blade and upswept tip, it also has a grip, crossguard, s-shaped knuckle guard, langet, and two globular quillons.

Blacksmiths are typically found throughout the state of Assam, producing basic farming tools like hoes, sickles, and ploughshares, as well as everyday tools like axes, dao, and a variety of knives. In the past, local blacksmithing also produced *hiloi* or matchlocks, small cannon or *tope*, and

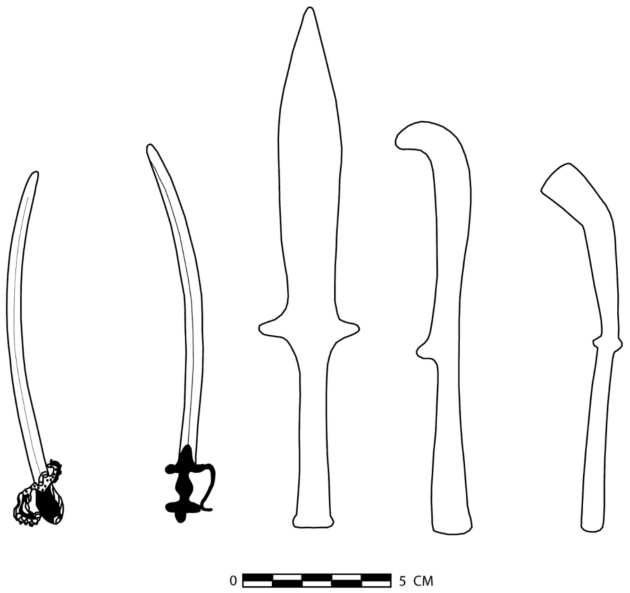


Fig. 6 Line drawings of select weaponry and defensive tools from Assam such as *Tarowal* (sword), *Bolikota Da* (sacrificial chopper or machete) or *Dakhar* and different types of *Da* or *Dao*

bortope or large cannon. The Mughal Chronicler Shihabuddin Talish, who travelled with Mir Jumla II in his 1662 expedition to Assam, recorded that the people of Assam cast excellent matchlocks and artillery and showed great skill in this craft, demonstrating that the Assamese blacksmiths had mastered the art of casting matchlock and artillery pieces by the middle of the 17th century CE (Nathan, 2009). Additionally, inscription on a cannon hints at the production of larger, higher-quality cannons since the second half of the 17th century CE. A huge amount of military weaponry, including 675 large cannons, 1343 Jambur (a type of cannon that resembles camel swivels), 120 *Ramchangis* (a light field piece), and 6750 matchlocks, were taken by Mir Jumla during the occupation of Garhgaon, the capital of the Ahom (Govt. of Assam Report, 2025).

Apart from the native sources, the Persian chronicle on the history of the Mughals in Assam is called *Tarikh-e-Assam* or *Fathiya-i-Ibriyya* (victory with a lesson). This chronicle, written by Shihabuddin Talish, provides an excellent account of the Mughal invasion of Assam under the reign of Aurangzeb. Nawab Mir Jumla was the administrator of Bengal and the ruler of Assam and Cooch Bihar. Additionally, *Tarikh-e-Assam* provides us with comprehensive details on the military strategies and equipment used by the Ahom. It mentions that the Ahoms' principal weapons were swords, guns, and arrows (Nathan, 2009).

4.4 Art and craft objects

There are numerous metal icons on display at the Assam State Museum, gathered from various archaeological excavations and sites throughout this area. The majority of these metal icons and images are bronze and are mostly created using the hollow and solid casting methods. The crafting of metal icons of Gods and Goddesses and other art objects has prevailed in Assam since ancient times. The crafting of metal icons using the lost-wax technique was well known in India and several Southeast Asian countries. Through Magadh and countries such as Tibet, Bhutan, and Nepal, the lost-wax technique entered Kamarupa during the pre-Ahom period. Some of those pre-Ahom metal icons of Gods and Goddesses are now kept in the Assam State Museum and have been studied in detail by the present authors (Misra & Hazarika, 2026). In the medieval *Buranjis*, there is a mention that during the attack by Mirjumla, he looted the silver Nandi and a golden Panchanan Shiva icon from an ancient Shiva temple in the Dergaon area of Assam (Chaliha, 1998). A variety of icons of Krishna Venugopala, Gadura, Radha-Krishna, Vishnu, etc., made of different types of metal, were sculpted using the brass-casting method.

5 Discussion and conclusion

In Assam, metal has been integral to crafting a diverse range of artistic creations and household items throughout its history. These items are crafted from a wide array of metals, including bronze, brass, iron, copper, gold, silver, and their alloys. Many of these artefacts carry historical significance, offering valuable insights into the region's rich heritage of ancient metallurgy. Iron holds particular importance in Assam, being extensively utilised not only for the creation of sculptures, inscriptions, coins, and insignia but also as a binding material in the construction of stone structures. Iron artefacts have been widely discovered at archaeological sites, in religious contexts, and in traditional customs, underscoring their significance in rituals, ceremonies, and daily life.

Additionally, it is worth noting that the bronze and brass icons of Assam illuminate a vibrant chapter in the region's early medieval artistic and religious history (Misra & Hazarika, 2026). The hoards from Odalbakra and Hahara, along with scattered finds from the Brahmaputra valley, testify to a well-developed metallurgical tradition and to Assam's participation in the wider eastern Indian sculptural network shaped by the Pala-Sena artistic idiom. While sharing iconographic and technical affinities with Bengal, Bihar and Odisha, these sculptures also reveal a distinct regional sensibility associated with the Kamarupa School of Art. Their forms, proportions and ornamentation reflect both

theological continuity and local adaptation, indicating that Assam was not a peripheral recipient of artistic influence but an active centre of bronze casting and devotional art production. These portable metal icons further underscore the dynamic religious landscape of ancient Assam, where Buddhist, Brahmanical and indigenous practices coexisted and interacted. Their ritual mobility, suitability for household worship, and presence across temples, monasteries and sacred sites highlight diverse devotional contexts that required both permanence and portability in sacred imagery. Together with stone sculptures and architectural remains, these bronzes demonstrate how artistic production, trade networks and religious exchange were deeply intertwined across eastern India. Ultimately, the sculptures stand not only as artefacts of faith but also as enduring markers of cultural connectivity, technological skill, and the creative vitality of the Brahmaputra valley during the 10th–eleventh centuries CE.

Interestingly, the ethnographic study of metalworking communities in Assam underscores their crucial role in preserving and transmitting traditional metallurgical knowledge. Communities such as the bell metal workers of Sarthebari, brass artisans of Hajo, goldsmiths of Rantholi, and blacksmiths across various districts not only produced functional tools and ritual objects but also shaped the region's cultural identity (Misra & Hazarika, 2025). Their craft practices, often supported by royal patronage, fostered intricate techniques, stylistic innovations, and specialised knowledge that have persisted across generations, linking past and present through tangible artefacts and local place names.

Acknowledgements We would like to express our sincere gratitude to the Indian National Science Academy (INSA), New Delhi, for its generous financial assistance for conducting this research.

Declarations

Conflict of interest The authors have no conflicts of interest to declare.

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