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Craft Ecology: Traditional Ironworking in the Chotanagpur Plateau and The Impact of Industrial Mining and Environmental Change

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Abstract

This paper examines the impact of environmental change on traditional ironworking societies in the Chotanagpur Plateau, in Eastern India, particularly in Purulia (West Bengal) and Hazaribagh and Chatra (Jharkhand). Although these areas are now regarded as part of the Iron Belt due to the rich mineral resources, traditionally these regions were home to communities of indigenous iron smelters and blacksmiths such as the Asur, Lohra, Karmakar, and Karmali. These skills have now greatly declined due to a combination of factors, including past forest laws, deforestation, industrial mining activities, changing climatic patterns, and technological change. Using ethnographic fieldwork and documentation of oral histories amongst these four communities undertaken by the researchers, the paper explicates the impact of these environmental instabilities on the ecological sustainability of traditional ironworking, ritual practices, and the displacement of artisanal knowledge systems. This paper highlights the need for the timely measures of ecological sustainability for preserving heritage, such as community-centered recording and eco-craft projects, and their incorporation into education to ensure the sustainability of such declining knowledge systems as living cultural heritage.

Keywords: Traditional ironworking, Environmental change, Craft ecology, Cultural heritage, Iron smelting communities, Ethnoarchaeology.

Introduction

The Chotanagpur Plateau, encompassing areas in Jharkhand, Bihar, West Bengal, and Odisha,

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has a rich history of indigenous ironworking traditions. Iron smelting and blacksmithing have been passed down through generations of communities, such as the Asur, Lohra, Agaria, and Karmali, which rely on localized knowledge of finding iron ores, making charcoal, and building indigenous furnaces (Elwin, 1942; Sinha, 2015) to produce bloomery iron. Ethnoarchaeology and archaeological investigations have suggested that the area may have established an Iron Age culture in the second millennium BCE, characterized by the remains of bloomery furnaces, tuyères, slags, and archeometallurgical debris as well as the use of local materials (Chakrabarti, 1976; Tewari, 2003). Environmental stability in the form of rich, dense forests, a reliable water supply, and seasonal patterns related to agriculture and their ritual calendar facilitated continuity in past centuries (Tripathi, 2008). This mutual association between ecology and craft has been broken in the past few decades, caused by mass deforestation, poor rainfall patterns, aggressive mining, and the leasing of natural resources (Guha, 1983; Rangarajan, 1994; Belcher et al., 2015). Expansion of extractive and limited forest initiatives has caused their displacement and has obstructed access to natural resources (Poffenberger, 1999; Saxena & Sarin, 1999; UNESCO, 2013).

Environmental degradation also noticeably affected relevant aspects of traditional ironworking, and the impact the practice and transmission of traditional ironworking has not been fully examined. This paper aims to fulfil that gap by looking at the ecological, cultural, and occupational changes that have been adopted by these communities. It strives to record the impact of the loss of natural resources, capture communal views of ecological change, and examine how alterations in climatic conditions have resulted in the decline of the traditional method of iron smelting.

Ironworking Traditions, Craft Ecology and Environmental Change

Archaeologists and anthropologists have long been interested in learning the origins of ironworking in India. There are a few radiocarbon dates of some sites, like Mahisdal, Mangalkot, and Pandurajar Dhibi of Eastern India, that indicate dates as far back as the second millennium BCE (Chakrabarti, 1976; De & Chattopadhyay, 1989; Tewari, 2003). The ancient and traditional smelting communities, such as the Asur, Agaria, Lohra, Karmakar, and the Karmali, have a sense of continuity of their hereditary smelting occupation and have been living in Jharkhand and West Bengal for generations (Karmakar & Mondal, 2024a, 2024b). The developed use of the bloomery furnace, cowhide bellows, and local charcoal was seen along with rich cultural symbolism (Elwin, 1942; Sinha, 2015). These traditions were mostly abandoned, but there are still surviving ritual and oral traditions, which are remnants that reflect a rich metallurgical history.

The historical craft ecology presupposes the interdependence between the environment and the production of the craft. The pre-industrial ironworking depended on the cycle of seasons and access to heavy forests as a source of fuel (Tripathi, 2008; Neogi, 2017). The foundation of artisanal sustainability is based on the cyclical prosperity, community resource management, and environmental familiarity (Chirikure, 2007).

Large-scale deforestation, mining, and infrastructural development, and the forest laws have led to clear losses in terms of access to and availability of rights to forest resources with respect to the indigenous communities (Guha, 1983; Saxena and Sarin, 1999; Srinivasan, 2020). Scarcity of water and the irregular monsoons have also led to a further disturbance in the artisanal practice (UNESCO, 2013; Belcher et al., 2015). Political, economic, and environmental changes are not simple but are intertwined in the implementation and extension of policies and allocation of resources in markets (Rangarajan, 1994; Rant, 1994). These multiple forces have resulted in the gradual decline of hereditary occupations, loss of craft knowledge across generations, and continuous decline of the sustainable ironworking practices in Eastern India.

Area Covered

Archaeometallurgical debris was uncovered during fieldwork by the researcher in the regions of the Chotanagpur Plateau, including Purulia (West Bengal), Hazaribagh, and Chatra (Jharkhand), which belonged to the traditional ironworking communities such as the Agaria, Lohra, Asur, Karmakar, and Karmali. The sites are geographically located in the Ajodhya Hills in Purulia, Tandwa Forest Range in Chatra, and Hazaribagh plateau in Hazaribagh, on the Chotanagpur Plateau as indicated in Fig 1 and Fig 2.

Figure 1: Bird-eye view of the studied sites in the Hazaribagh district, Jharkhand

(Source: https://earth.google.com/)

Figure 2: Bird-eye view of the studied sites in the Purulia district, West Bengal
(Source: https://earth.google.com/)

Environmental Changes in the Chotanagpur Plateau

During the present researcher's field visit to Purulia (West Bengal) and Hazaribagh and Chatra

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(Jharkhand) in 2024, it was noted that there is rampant ecological deterioration, which has had a direct impact on traditional ironworking practices. Forest cover has reduced drastically since the 1990s, according to oral testimonies. Open-cast mining, the exportation of timber, and the construction of roads have led to the deforestation of the sal and dense forests. With the help of historical satellite images, the environmental deterioration can be clearly visible. In the case of the district of Hazaribagh and Chatra Forest region, where archaeometallurgical evidence of iron smelting had been recovered (Karmakar and Mondal, 2024c), the changes in the geography are quite noticeable from 1984 to 2020 in the satellite image. The area had been exploited for its rich mineral resources, especially for coal. It is also noted that the smelting took place near the forest and rural habitations. Thathangi (23°44'58" N, 85°00'28" E), located in the Tandwa forest range, is currently inhabited by the Tana Bhagats, who came to the Chatra district during the revolt and have continued to reside there since then. When the present researcher showed the iron slags scattered over the agricultural field, a community member said that he had no idea what they were and that perhaps previous occupants might have known.

At Ajodhya Hills of Purulia, iron slags have been found near the present habitations of Lohra Asurs, who have been living at 2200 ft for generations. They used to practise the art of smelting in the Saal forests of the Ajodhya hills, and called them "*Asurkuthi*" and "*Lohakuthi*." This was guided by a mythical belief rooted in the tale of Rahu and Jwala Mukhi, which forbade smelting under the sunlight but working under the shadows (Karmakar and Mondal, 2024a). At present, Lohakuthi has been destroyed for the purpose of agriculture.

It is clear from the archaeometallurgical evidence scattered over the places that the iron smelting took place in the past, as it is also an area rich in iron ores. Thereby, it is essentially important to document these iron smelting evidences, the productivity of iron ores, and the surviving memoirs in the descendants of the ancient iron smelters as living intangible heritage. Many of the rural habitations are still close to slag heaps. This trend is also reported in the case of the iron and steel archaeometallurgical landscape in the Telangana region, where villagers lived close to high-carbon wootz steel production sites with crucible and slag debris (Srinivasan et al 2011), and also in Tamil Nadu (Srinivasan and Ranganathan 2014, Srinivasan 2007)

Figure 3: Iron slags scattered under the Banyan tree in Ajodhya Hills, Baghmundi, West Bengal

Figure 4: Iron Slag at the Thathangi, Chatra

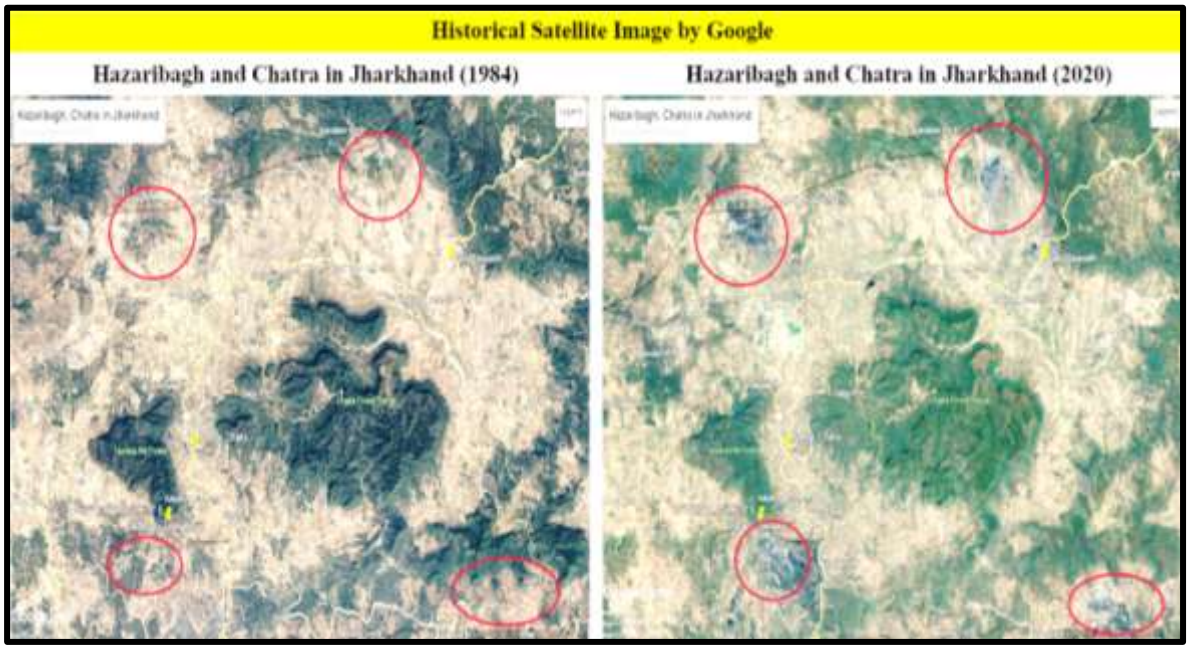

Figure 3: ***Google Historical Satellite Image of the studied region of the Hazaribagh and Chatra districts in Jharkhand***

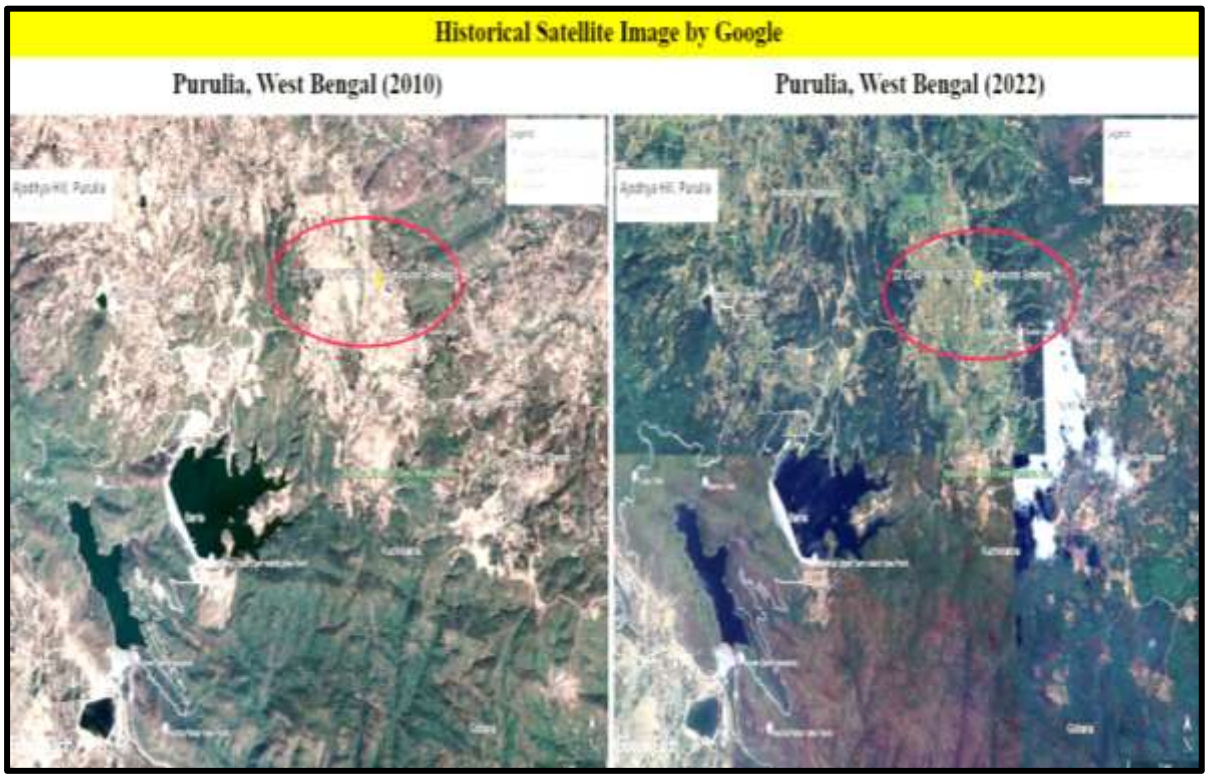

Figure 4: ***Google Historical Satellite Image of the Studied Region of the Purulia district in West Bengal***

Craft-Ecology Nexus

Traditional ironworking was practised in an ecologically sustainable way. The availability of charcoal-bearing hardwoods, supplies of labour after harvesting, and reliable water supplies were requirements to keep the smelting cycles alive. They were not marginal markets, but they were the key to economic production and spiritual life (Tripathi, 2008; Neogi, 2017).

Communities like the Asur and Agaria synchronized smelting activities with those of seasonal activities of harvesting and getting forest produce, a characteristic which historical ecologists refer to as artisanal systems that are governed by resources. These rhythms have been altered, however, by deforestation, mining, and changes in climatic patterns. This confirms the findings of UNESCO (2013), which have declared that climate change poses a threat to the intangible heritage since it destroys its material existence.

The craft-ecology model of the traditional ironworking in the Chotanagpur Plateau shows a profound interdependence between natural resources, technology, and cultural systems. In the past, the accessibility of raw materials was the basis of indigenous smelting. The Agaria and Asur communities procured the iron ore found in the exposed hill outcrops. The charcoal necessary to run the bloomery furnaces was found in the forests. This has changed in the post-1990s era, when mining leases, state regulations, and commercial exploitation have significantly limited access to forests, with the result of ore-based smelting being terminated entirely. As deforestation and lack of fuelwood have become widespread, scrap melting and blowers have replaced the artisans. Although these alternatives permit continuing with limited forging, they represent a radical departure from native furnace technology.

The rituals are now part of cultural fragmentation and degradation of craft image. The worship of Guram Thakur and the Vishwakarma Puja, which are discussed in the next section, involves ritualised practices done by the Lohra Asurs, Karmakar, and Karmalis and integrates metallurgy into belief systems and related social structures. These rituals still exist but have become more of a ceremonial nature in metallurgical work, where there has also been a certain degradation in technological skills. Knowledge transfer, which was formerly preserved by family-based apprenticeship and shared learning, has been reduced. The result is that metallurgical traditions have been lost greatly, and community craft memory is gradually fading.

Ritual and Identity in the Post-smelting World

Although the smelting has vanished, the worship of Vishwakarma Puja and Guram Thakur is still in practice, though it has changed. Such continuity of practice without its actual purpose is a relevant indication of the shift of functional ritual to ritual heritage (Sinha, 2015; Karmakar & Mondal, 2024b). Such practices have become sources of identity and not outlets of production.

Figure 5: Tilak on the bellows signifies the worship of it by the ironworkers

(The researcher took the Picture during the fieldwork at Purulia, West Bengal, in 2024)

To blacksmith communities such as the Karmakar and Karmali, the bellow is not just a tool, but rather, an object of ritualistic continuity and honour. The preservation of rituals by either gender through rituals like putting a tilak by women after the celebrations of Vishwakarma Puja, as done in Garia village, expresses the gendered maintenance of belief.

Figure 6: The Portrait of Lord Vishwakarma is worshipped every day before starting work

(The researcher took the Picture during the fieldwork at Purulia, West Bengal, in 2024)

There is a definite difference between that which has remained and that which has vanished in the ritual practices and technological processes, as evident in traditional ironworking communities of the Chotanagpur Plateau. These rituals that are traditionally intertwined in the ironworking process, despite the progressive decline of the functional and technological aspects of the craft.

It is significant to note that the indigenous iron smelters have their own deity for believing and having faith in the process of iron smelting, whereas on the other hand traditional blacksmiths worship Lord Vishwakarma, the divine architect and craftsman from Hindu mythology. A certain dichotomy was also observed amongst the traditional blacksmiths in Telangana, Tamil Nadu, and Karnataka (Juleff et al., 2011; Srinivasan 2020) whereby the worship of the goddess of steel or Mammayee seems to have been a more ancient practice although as pointed out in researches by Tathagata Neogi with Srinivasan, the emergence of a more dominant narrative of the Vishwakarma in Telangana is of more recent vintage.

The Lohra Asurs, the iron smelters, on the other hand, worship Guram Thakur, a folk deity. This used to be conducted at the start of the smelting process as a protective and success measure, and is still a significant symbolic activity in most households. Even though smelting is not done anymore, the rituals remain as a cultural landmark, which provides evidence of the continuation of rites. Equally, Vishwakarma Jayanti, the day of traditional worship of tools and bellows, is celebrated in the rural and urban workshops all over the state. Such continuity brings out the cultural relevance of artisan identity that exists even though these traditional modes of production are not being used.

Another ritual that still survives is of applying a tilak on a pair of bellows by women (*Kamarani*). It is still practiced in the rural blacksmith households today. These practices are sustained to demonstrate how ritual structures may continue even as there are significant

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changes in the technological routines. Conversely, this has been a major disruption to the functional aspects of ironworking. The process of smelting to produce iron blooms has ceased due to the unavailability of ore, fuel depletion, and the high amount of labour involved. The practice of coal-making, which was formerly the foundation of the bloomery furnace, has also lost its place due to ecological strain and pressure related to the accessibility of the forests. Consequently, such practices have visible markers of functional discontinuity.

All these tendencies depict the asymmetrical nature of change. Whereas symbolical and ritual implications of ironworking remain as symbols of heritage, the functional and technological implications of the practice are rapidly disappearing. This points to the vulnerability of intangible heritage with respect to ecological and economic change.

Impact on the Traditional Ironworking

Traditional smelting of iron is now extinct due to multiple factors. However, diminishing natural resources are one of them. There are also places such as the villages of Tanasi (23°24’25.1” N and 86°11’15.7” E), Ajodhya (23°12’49.2” N and 86°07’26.9” E) in Purulia, Jihu (24°09'36"N and 85°22'05" E) in Hazaribagh, and Thathangi (23°44’58” N, 85°00’28” E) in Chatra, where smelting furnaces have been left unattended and were destroyed by human activities and environmental deterioration. Now, rural blacksmiths no longer use iron blooms directly from the iron ores and have instead turned to industrial scrap (Karmakar & Mondal, 2024b).

The crisis of natural resources (twigs, water) has changed the method of iron production. There were times when cowhide-made foot-operated bellows, powered by the help of family (*Kamarani* or children), were used to keep the furnace at a hot temperature. But various blacksmiths have modified their bellows (to hand-geared) and introduced electric blowers to use less fuel. This has led to iron smelting being abandoned with a move towards blacksmithy, along with agriculture, carpentry, and migration to many to the urban centers. The migration of blacksmiths from rural to urban areas is also reported in Telangana, Tamil Nadu, and Karnataka as well (Juleff et al., 2011; Srinivasan, 2020).

As for the significance of rituals, a descendant of the Lohra Asur community in Purulia commented that although the rituals have become symbolic and dissociated from production, they still need to be saved as an emblem of their community heritage and identity.

Community Adaptation

Communities have adapted to practical means to deal with ecological pressure. The Karmakar and Karmali families of Begun Kodar and Garia are now focused on manufacturing small tools, such as knives, tongs, and sickles, that are destined for the local markets. A number of these households have hand-geared *Kamarsalas* (forges) to produce various iron implements. The Lohra Asur of Ajodhya have abandoned iron smelting altogether. The art of traditional iron smelting was practiced during the 1980s, and the areas had turned into agricultural fields. Their metallurgical past is now represented symbolically in their new life as simple farmers of the land, carpenters, and blacksmiths. They continue to practice the Guram Thakur Puja, by which protection is taken against hurt in the practice of the art of forging. This implies that the significance of rituals and beliefs has persisted despite the loss of technology. In the households of Karmalis, wives of Blacksmiths (*Kamarani*) continue to apply tilak to their bellows with ochre and kaolin before Vishwakarma Puja to seek protection during the smithing process.

Emotional stories of loss were also recorded in interviews: elderly people were worried about losing the memory of their smelting practices, which used to be a foundation of pride and their identity (Sinha, 2015; Elwin, 1942; Karmakar and Mondal, 2024a). Other community members indicated an interest in museum collaborations to retain implements, songs, or

techniques. Purulia District Museum has a unique display of traditional ironworking, which signifies a long history of the craft in the district as well as the region.

Figure 7: Model of Auger Manufacturing inside Kamarsala
(Source: Purulia District Science Museum)

Decline, loss of resources, adaptation, and displacement

The decline of traditional ironworking in the Chotanagpur Plateau is not only due to waning tools or outdated methods. Instead, it is evidence of a more profound breakdown of a historically viable craft ecology, a connected manner of access to natural resources, seasonal traditions, and cultural ceremonies. Among the field data of Purulia, Hazaribagh, and Chatra, we find that environmental degradation is going hand in hand with policy alienation. Market restructuring has been the bane of this mutually reinforcing style of life.

Some artisans have been able to adjust to new realities with the use of electric blowers and using machine scrap as forge material. The crisis of lack of raw materials in artisanal practices and of environmental degradation is more broadly seen in the context of intangible heritage in various parts of India (Srinivasan 2022; Srinivasan and Turner 2022). The rural-urban migration of skilled workers to the industrial workshops in cities is one of the changes that reflect the change of community-based production to market-based labour regimes (Karmakar and Mondal, 2024b). Although such a transition guarantees the continuity in livelihoods, it breaks the ecological and cultural foundations of the craft (Guha, 1983; Belcher et al., 2015; Srinivasan, 2020).

The access to the forest, which was previously negotiated by the community, is today run through the state regulations, mining activities, and conservation legislation. Erosion of indigenous technology occurs when such communities as the Asur are forced into labour-intensive mining or subsistence forms of agriculture for their livelihood. It is against this context that the policy on heritage needs to be rethought to look beyond monuments to such living knowledge systems as traditional metallurgy, systems that require ecological rights and cultural appreciation to survive.

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Craft Resilience and Cultural Sustainability

Revival of old traditional iron working in Chotanagpur requires multiple approaches. The first step is to document ethnographic records, the current techniques, and oral records. Secondly, cultural memory can be preserved with the help of community-based heritage projects, e.g. community museum, a festival, or a storytelling archive. Thirdly, the combination of sustainable forestry and craft revival may revive access to resources. Lastly, integration of metallurgy heritage into schools and career development programs on small-scale businesses would help to enable the younger generation to reclaim the ancient knowledge.

The art of traditional ironworking in the Chotanagpur Plateau (especially Purulia, Hazaribagh, and Chatra) has been affected because of environmental degradation, policy changes, and socioeconomic changes. Ironworking was a cultural system as well as a technical process, centred on the availability of resources, collective hard labour, and ritual preservation. Although the communities adapted and responded to the changes by utilizing urban workshops and other forms of modern forging techniques, it caused they lost their traditional knowledge, ritual context, and ecological connections. The cultural salience of traditional ironworking is reflected by the most well-known ritual of Vishwakarma Puja, which has now become very prevalent as a form of community identity. The study points to the fact that such knowledge systems of artisans are urgently in need of documentation and preservation as a form of living heritage. The traditional smelting sites are either being left as barren land or are already on the verge of destruction by agricultural activities. The policy and heritage approaches should not be limited to preservation methods, but should also actively engage stakeholders with community awareness with respect to the environment, culture, and technology.

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