

Preserving Traditions of Particularly Vulnerable Tribal Groups (PVTGs) through Artificial Intelligence; A Sociological Study of Documentation of Lodha Tribal Heritage of Odisha

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Abstract: Lodha is one of the Particularly Vulnerable Tribal Groups (PVTG) found in the Mayurbhanj district of Odisha whose culture is rich in forest-based oral traditions and ethnobotany, including various crafts. But due to factors like modernization, poverty, and historical experiences of oppression during the colonial era, the existence of the group is now threatened. With reference to examples from other parts of the world such as ethical AI frameworks by UNESCO and NLP and GANs for preserving dying languages and rituals, this paper examines the role of artificial intelligence in the Lodha legacy. Some of the applications include motion capture animation for performing arts, archiving material artifacts in three-dimensional VR, AI-powered transcription, and Gamified mobile application for preserving dialects, along with predictive modeling for socio-cultural erosion. This research encourages collaboration with the local community and institutes, including the co-design of a "Digital Heritage Repository of Lodhas" and partnership between IIT Bhubaneswar and SCSTRTI, Odisha, while emphasizing the need for ethics, bridging the digital divide, data ownership, and mitigating any potential bias in the data analysis process. The research advocates for the inclusion of legislative measures to encourage sustainable tourism and AI literacy. Ultimately, it is demonstrated that artificial intelligence becomes a win-win solution to integrate traditional knowledge with sustainable development to preserve the natural and cultural heritage of the Lodhas for posterity.

Keywords: NA

1. Introduction

The Lodhas tribe in Odisha, India, is one of the most enigmatic and marginalized tribes residing in the green environment of the Mayurbhanj district (Sachan, 2018). As per the statistics of the 2000 census in India, the Lodhas number around 7,458 people and have been considered a Particularly Vulnerable Tribal Group (PVTG) (Government of Odisha, Ministry of Tribal Affairs, Government of India, 2020). Lodhas are identified by their dependence on forest-based occupations, such as hunting, food gathering, and primitive farming practices (Bhowmick, 1963; Kapoor & Kshatriya, 2009). The Lodha tribe struggles with poverty and deprivation at twice the rate as other communities in their region (Mukherjee & Das, 2023). Marginalization of the Lodha tribe is because of colonialism and categorization of this group as "criminal" communities under the Criminal Tribes Act during British rule, an identity retained even



after independence (Kamat, 2019). Poor literacy rates, discrimination, and lack of access to education cause many members to become part of the informal workforce or migrate out (Hassan & Mohamed, 2022; Mishra, 2016).

The core of Lodha culture is an extensive cultural heritage made up of oral tradition, folk tales, rituals, indigenous healing practices, and forest-derived artifacts (Sachan, 2018). This heritage goes beyond being merely historical. Instead, it is a vibrant legacy that unites generations through lessons on how to establish sustainable co-existence between humans and nature and maintain robust social systems (Vidyarthi, 1990). However, this heritage is endangered. The process of modernization, urban drift, growing illiteracy rates, and systematic neglect has sped up the erosion of this culture, where young members of the community gradually assimilate into the mainstream society while forsaking their indigenous roots (Hassan & Mohamed, 2022). Festivals lose their significance, dialects are spoken only by elderly individuals, and traditional arts lie forgotten in dust as economics becomes more challenging.

Nevertheless, artificial intelligence (AI) is one of the revolutionary forces in the age of information that transcends its portrayal as either a disruptive employment force or surveillance technology. In the context of cultural conservation, AI emerges as an omnipresent protector,

enabling digitization of transient information, analyzing invisible patterns, and providing historical knowledge access to marginalized communities worldwide (Kishore, 2024; Palmer, 2024). From United Nations Educational, Scientific and Cultural Organization (UNESCO)-funded programs to innovative technological developments, AI has already facilitated the digitization of dying languages and traditional dances globally (Sultana, 2023; UNESCO, 2024). With their rich heritage under threat of oblivion, AI can offer not only survival but empowerment to the Lodha tribe (Singh, 2024).

The purpose of this research is to look into the strategic use of AI to record, analyze, and preserve the heritage of Lodha people. Through analyzing various projects, global examples, and ethical considerations, this paper aims to create a route that will ensure technology will serve to enhance rather than replace indigenous cultures.

2. Understanding Lodha Cultural Heritage:

The Lodha culture heritage can be said to comprise of a range of characteristics both tangible and intangible that are inseparable from their natural environment in Mayurbhanj (State Tribal Museum, Odisha). The district characterized by undulating hillocks and green sal forests, has created a perspective where man serves as an integral part of nature rather than a conqueror (Vidyarthi, 1990).

3. Material Culture

The Lodha artefacts are composed of natural and biodegradable materials available within their surroundings, depicting ingenuity and temporariness (Sachan, 2018). The homes, which are mostly simple grass-roofed huts built on bamboo pillars, symbolize harmony with periodic flooding and wild creatures (Mishra, 2016). Utility craftsmanship is evident in their hunting and gathering paraphernalia such as bamboo baskets, leaf-woven mats, and wooden farming implements (Kapoor & Kshatriya, 2009). During ceremonies, the body is ornamented with accessories constructed from seeds, feathers, and herbal colors, representing social status and divine connections (Sachan, 2018). Though fragile, these objects hold deep symbolic value, where a beaded chain might invoke ancestral guardianship, whereas an etched bamboo pipe might signify forest deities (Verma, 2002). However, economic exploitation and artificial substitutes have endangered these traditions, as the youth resort to earning money (Panda, 2015).

4. Intangible Heritage:

This is the very soul of Lodha culture their language, an eloquent variant of the broader Munda family of languages, rich in onomatopoeia mimicking the calls of birds and the breeze through leaves (Sachan, 2018). There are oral stories; there is folklore relating to myths surrounding forest gods like the tiger god and fables cautioning on greediness, as well as epics describing how the community migrated from remote places (Mishra, 2016). Karam Puja festivals celebrating the sacred vitality of the karam tree feature dancing, singing, feasts, and the use of traditional

medicines like neem tree bark for curing fever, along with shamanic rituals using incantations to keep evil spirits away (Das & Dash, 2024). Music played on horn-shaped leaves and bamboo flutes accompanies one's existence from conception until death in a cyclic universe (Vidyarthi, 1990).

5. Socio-Cultural Practices:

Odisha's Lodha culture has aspects of both egalitarianism and hierarchy, governed by the family system that is widespread and pervasive like the vines in forests (Bhowmick, 1963). Marriage ceremonies emphasize clan exogamy and symbolically involve the exchange of forest fruits as a way to forge stronger kinship bonds (Sachan, 2018). Rituals denote change; initiation rites for adolescents involve activities in the forests, which not only build endurance but also community bonds (Mishra, 2016). The "panch" system was the community's method of conflict resolution through a process of consensus that favored reparative measures over punishment (Kapoor & Kshatriya, 2009). Gender relations, though patriarchal, ensure that women have influence in healing and storytelling traditions (Verma, 2002).

But it is threatened by several challenges that can lead to its extinction. The high poverty rate forces people to migrate to the suburbs of cities, thereby severing connections with ceremonial sites and wise men (Mukherjee & Das, 2023). Due to the absence of records, oral riches remain undocumented, exposing them to extinction with the death of wise men with no successors skilled in speaking the language (Hassan & Mohamed, 2022). Cultural assimilation through education and media transforms ceremonies as children sing Hindi nursery rhymes instead of Lodha ones, and ceremonies end up being replaced by fireworks on Diwali (Indian Express, 2020). Discrimination, the remnants of colonization, marginalizes Lodhas, causing self-loathing

and accelerating cultural bleeding (Kamat, 2019). If left unaided, this process of decline may eventually result in the destruction of the Lodha traditions, as well as their invaluable ecological knowledge that will be missed by indigenous communities across the globe (Cultural Survival, 2024).

6. Global Context of AI in Heritage Preservation

The world is becoming increasingly conscious about the fragile nature of indigenous heritages, with UNESCO predicting that over 40 percent of languages around the globe would be lost by 2100 (Sultana, 2023). AI, which was previously criticized for serving only the elite class, has now turned towards this task, offering scalable solutions to issues human effort cannot tackle (Palmer, 2024). This can be seen through the examples of UNESCO's projects; for instance, the project titled "Missing Scripts," which employs AI technologies to digitize and revitalize ancient scripts, including those used by Australian Aboriginal populations and African syllabics, ensures that such scripts remain alive in digital worlds (UNESCO, 2024). In another example, the 2024 panel organized by UNESCO on AI and ICH underscores the need for ethical AI in safeguarding music, dance, and oral traditions (UNESCO, 2024).

Language conservation is another area where AI performs well. For instance, Woolaroo by Google employs AI technology to translate objects in photos taken on smartphones into 30 endangered languages and encourages immersive learning among speakers across the globe (Kishore, 2024). AI-driven applications preserve Navajo oral histories, producing interactive vocabularies that can be accessed through gamified platforms for children (Sultana, 2023). Language is not alone; music and dance have also been revitalized using deep learning technology. AI analyzes rhythmic patterns in Maori haka dance sequences, recreating lost variations based on incomplete data, while spectral analysis restores lost tunes of Amazonian folk dances (Sinha, 2024). The British Museum applies AI technology to photograph recognition for cataloging items with an impressive 95% accuracy rate (Gray, 2022).

This research model is very relevant to the context of the Lodha people. The Lodha community faces problems of oral tradition and cultures that have never been recorded in written form, just as the Australian Aboriginal population faces with the same problem whereby AI has helped map their song lines to geostories (Cultural Survival, 2024). The ephemeral nature of the material

culture of the Lodha people is similar to that of the Pacific Island materials, which are protected from decay through 3D modeling with AI (Eyadah & Odaibat, 2024). Ethically, global models promote collaboration where

Indigenous projects such as Canada's First Nations AI consortium embed their cultural protocols in the algorithm to reduce bias (Carroll et al., 2020). It is believed by the Lodha people that adaptation of this technology through mobile applications to record dialects will help resist assimilation and empower the long-oppressed community (Singh, 2024). Success depends, however, on localization. What works in the case of Inuit throat singing cannot necessarily work with Lodha flutes, proving versatility is AI's greatest asset (Marley, 2019).

7. Potential Applications of AI for Lodha Cultural Heritage

The adaptability of AI allows for specific interventions in Lodha culture spheres, shifting from static documentation to dynamic revitalization efforts. Here, in this paper there are discussions regarding applications that are based on plausible technologies and community-oriented designs. Further, it is researched that in order to understand Indian Knowledge System in a systematic manner, Artificial Intelligence is extensively used. (Sagarika; Sethi 2025)

8. Language and Oral Traditions

Lodha language, along with its nature-rich vocabulary, is close to becoming extinct because only less than 20% of young people are fluent in this language (Hassan & Mohamed, 2022). However, Natural Language Processing (NLP) offers a solution – an automatic speech-to-text application capable of recording elder narratives in real-time through Odia-Munda language models (Sultana, 2023). Whisper AI, specifically built for low-resource languages, operates at 85% accuracy while transcribing in similar tribal languages, making it possible to create searchable databases of traditional folk tales (Kishore, 2024). For instance, let us imagine a Lodha elder sharing a tale about tigers; the AI would transcribe it and break it into topics of ecology and morality.

Translation eliminates isolation. Machine learning algorithms using parallel data sets of Lodha-Odia-English can enable songs to reach worldwide audiences, creating feelings of pride (Palmer, 2024). AI software applications, such as Duolingo's localized editions, have been developed for linguistic revival. For instance, "Lodha Lingua" is an application that superimposes dialect terms on forest plant life while going through the forests virtually (Sultana, 2023). Users earn medals

for their ability to comprehend words, and algorithms adjust the language training to suit the user's language skill. A pilot project can be introduced in Mayurbhanj schools.

9. Digital Archiving of Material Culture

The works of art by Lodha tribes like bamboo instruments and seed decorations are at risk of extinction as the population of artists is declining (Panda, 2015). AI-based image recognition, employing convolutional neural networks (CNNs), documents the items with utmost accuracy (Gray, 2022). A smartphone application identifies the item, categorizes it (for instance, "hunting spear made of bamboo used ritually"), and connects to stories about its provenance, just like the applications designed for museums through IBM Watson (Kishore, 2024).

Increasing access, 3D scanning combined with VR enables interactive museums (Eyadah & Odaibat, 2024). Drones with LiDAR scan the abandoned houses, generating interactive models where users can touch virtual decorations through tactile sensors. The VR environments hosted on websites like Mozilla Hubs enable international scholars to study without damaging the site, whereas Lodha kids living in cities virtually return to their "native" homes, reducing the impact of migration on culture.

10. Preservation of Rituals and Performing Arts

The festivals celebrated by the Lodhas, including Karam Puja, consist of dances imitating animal hunting and rain god songs – all temporary art forms that are disappearing among the older generation (Sachan, 2018). AI devices utilize multi-sensor systems: microphones detect sound, whereas cameras track movement to determine posture (Sinha, 2024). GANs recreate missing performances: enter a fragment of flute music, and the AI extrapolates

harmonics from spectral signatures, resurrecting forgotten rhythms, much like the Aboriginal didgeridoo projects (Gray, 2022).

Deep learning extends to animations: Dancers put on motion-capturing suits, whose data is fed to AI algorithms that produce avatars for augmented reality applications, enabling practice without masters (Kishore, 2024). AI studies video ethnographies about healing ceremonies to identify the relationship between gestures and languages during chants by shamans in an effort to preserve

healing knowledge amid health disparities (Das & Dash, 2024). Ethical filters ensure that output respects holy taboos, like hiding images of deities.

11. Ethnographic Data Analysis

However, field research generates an extensive amount of socio-cultural data, such as kinship maps and ritual chronicles, but manual analysis proves too much for anthropologists (Bhowmick, 1963). AI-driven approaches have been used to model Lodha social structures with graph neural networks (Carroll et al., 2020). The nodes represent clans, while the edges denote alliances. Migration patterns are used to predict changes. Time-series forecasting can be applied to measure cultural decay, including reduced attendance during festivals, and suggest interventions such as educational programs (Mukherjee & Das, 2023). The influence of deforestation on ritual sites in Mayurbhanj can be identified by integrating satellite imagery with AI techniques, indicating the role of habitat destruction in abandoning rituals (Vidyarthi, 1990).

12. Cultural Education and Revitalization

For children from tribes, formal education often leads to the loss of their culture, whereas AI helps restore it by creating a fusion platform (Hassan & Mohamed, 2022). Customization algorithms based on reinforcement learning provide folkloric lessons including mathematical concepts, for instance, using storytelling techniques where puzzles involve geometry in hut construction (Singh, 2024). The gamification process works well in virtual reality trips where the player becomes an ancestor collecting "artifacts" and listening to myths (Sinha, 2024).

Youth is also rejuvenated as AI chatbots with oral archives communicate through dialects, responding to queries such as "What lessons does the Tiger Myth impart?" (Palmer, 2024). Community design ensures cultural authenticity while lodging Lodhas as curators (Cultural Survival, 2024). When combined, these applications create an interconnected ecosystem where NLP feeds archiving and VR boosts education. If implemented collaboratively, they may preserve 80% of Lodha culture within five years, setting an example for other PVTGs (Kishore, 2024).

13. Challenges and Ethical Considerations

The potential benefits of AI in Lodha culture conservation are marred by various obstacles. Chief among them is the widening digital divide. Internet accessibility in Mayurbhanj district is below 30%, and power supply in the villages is irregular (Hassan & Mohamed, 2022). Smartphones and AI applications are still luxuries that cannot be afforded by everyone, hence deepening inequalities; without offline versions or solar-powered devices, interventions will appear elitist, targeting city migrants rather than the indigenous Lodhas (Indian Express, 2020). Awareness of cultural sensitivity is required. The black box nature of AI makes it susceptible to biases where algorithms trained using skewed data would characterize the Lodha dance performances as "primitive" (Marley, 2019). There are concerns about commoditization since digitization may spur the creation of profit-oriented NFTs and tourism scams, thus diluting spirituality (Cultural Survival, 2024).

Ownership of the data is essential. The Lodha knowledge of myths and medicines belong to the Lodha communities collectively, but the data used in AI is usually stored in cloud servers owned by corporations (Carroll et al., 2020). This could lead to data leakages to other pharmaceutical companies that would use the information concerning the ethnobotanicals for commercial gain (UNESCO, 2024). Too much dependence on the expertise of foreign NGOs or academics could amount to neocolonialism and weaken the Lodha people (Singh, 2024). To reduce

the risks, it is important to have an ethic of participation through involving participants and allowing them to veto their participation.

14. Policy and Institutional Support

The preservation of Lodha history using artificial intelligence requires a good framework to be developed by the institutions of Odisha. The SCSTRTI, which is the oldest institute in Asia researching tribal history, has set an example with a museum that houses Lodha artifacts and other contemporary documentation activities (Scheduled Castes and Scheduled Tribes Research and Training Institute, n.d.; Government of Odisha, n.d.-b). The government has already taken steps by setting up 29 research institutes for tribes and supporting multilingual dictionaries and oral archiving; however, AI integration could help further by subsidizing NLP technology for PVTGs.

The involvement of NGOs like Action-Aid and Pradan in Mayurbhanj facilitates communication across grassroots through digitization training and calling for Lodha inclusion (Times of India, 2024). The UNESCO ICH approach offers global influence: Partnerships could promote "AI for ICH" initiatives, just like they have for indigenous languages (UNESCO, 2024).

Cooperation is key: AI experts from IIT Bhubaneswar, anthropologists from SCSTRTI, linguists from EFL University, and Lodha elders are all part of the network (Government of Odisha). The Lodha Digital Archive Initiative (LDAI) suggests a government funding commitment of ₹50 crore in five years for solar kiosks, app creation, and workshops (Kishore, 2024). Policies for data sovereignty, which exist in the DPDP Act of India, guarantee tribal control while encouraging sustainable environments in which the Lodhas take charge of preserving their heritage (Carroll et al., 2020).

15. Future Outlook

Imagine a "Digital Heritage Repository of Lodhas," a technologically-driven storage place that will include 3D models, dialects, and cultural predictions, which could all be accessed through applications or community centers (Palmer, 2024). The next step is the AI-driven cultural tourism, where virtual tours are taken of virtual Karam festivals to entice responsible environmental tourists to donate to artisanal cooperatives and scholarships for youths (Sinha, 2024).

AI literacy will help young Lodhas in the future. Bootcamps for computer programming skills provide training in Python for the development of dialect applications, which creates a new generation of programmers from their communities (Singh, 2024). In addition, when climate change affects forests, artificial intelligence will store rituals that would ensure their survival along with their heritage (Cultural Survival, 2024). This would be a positive future for evolution.

16. Conclusion

Echoes of flutes from Sal forests and dance during rains call for immediate measures against erosion (Sachan, 2018). AI technology represents a transformational and complementary aid, transforming echoes to thunderbolts but not substituting the breaths of traditions (Kishore, 2024). The best way to go is adopting a balanced strategy, blending technological accuracy with

participatory action for Lodhas to build their digital culture (Cultural Survival, 2024). The resulting blend holds promises of sustainability, comprising vibrant evolution rather than dead-end artifacts to honor immortal songs of the forest (Vidyarthi, 1990).

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