

Technological Innovations in Language Preservation: Community Efforts in Safeguarding India's Endangered Languages and Cultural Heritage

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ABSTRACT

A major worldwide concern now is the preservation of endangered languages, especially in linguistically diverse countries like India. More than 1,600 languages are spoken in India, but many of them face serious extinction due to a lack of institutional support, urbanization, and globalization. With a focus on the alarming loss of languages and the ensuing cultural consequences, this paper examines the state of linguistic diversity in the modern world. It explores how technology may transform language sustainability with a focus on digital documentation, language learning applications, social media platforms, and Artificial Intelligence (AI) applications. These technologies have revolutionized the recording, dissemination, and teaching of endangered languages by offering innovative solutions to linguistic challenges.

Among the challenges cited in the article include the digital divide, data ownership ethics, and technological challenges in creating inclusive language tools. An examination of Indian initiatives, including as government programs, academic pursuits, and community-based projects, is conducted in order to assess the progress made in the preservation of linguistic heritage. Future recommendations focus mostly on enhanced policy frameworks, proactive community involvement, and technological advancements such as block chain and IoT to create a sustainable paradigm for language preservation. In the end, the study emphasizes that in order to protect endangered languages for future generations; a multidisciplinary strategy combining technology, policy, and cultural sensitivity is required.

Keywords: Linguistic diversity, endangered languages, digital documentation, AI in language preservation, community engagement, Indian language initiatives.

INTRODUCTION

An Overview of Current Situation of Linguistic Diversity

The Global Linguistic Landscape

Linguistic diversity is in serious risk, while being an essential component of the human legacy. The significant decline in worldwide linguistic diversity can be attributed to globalization, urbanization, and technological advancement. UNESCO estimates that 43% of the world's 6,000 languages are endangered, with one language becoming extinct every two weeks (2021). Almost half of the world's languages could disappear by the end of the twenty-first century if preservation efforts are not stepped up, according to Krauss (1992), who calls this a linguistic crisis.

Endangered languages serve as stores of cultural identity and traditional knowledge in addition to being means of communication. Cultural history and the distinctive worldviews ingrained in each language are strongly impacted by the loss of linguistic diversity. Indigenous languages, for example, frequently contain information about regional ecosystems and medical customs that is crucial for scientific study. However, these languages are in danger of going extinct due to a decrease in intergenerational transmission and a decrease in native speakers.

Furthermore, because of their economic and cultural capital in globalized society, major languages like English, Spanish, and Mandarin have eclipsed smaller linguistic minorities. The current rate of language loss could lead to homogenized cultural identities and the irreversible loss of priceless linguistic diversity if quick action is not taken.

Endangered Languages in India

With more than 1,600 languages spoken in its states and union territories, India is among the most linguistically varied countries. But this variety is under threat. 42 Indian languages are listed as critically endangered by UNESCO (Mishra, 2017). These languages, often spoken by small tribal communities, are threatened by urbanization, migration, and the lack of institutional support for language preservation. In Arunachal Pradesh and Assam, for example, speakers of tribal languages like Aka, Nyishi, and Mishing are dwindling in number as younger generations opt for more popular languages like Hindi and English for educational and career opportunities. Besides, the absence of a robust framework for promoting multilingual education exacerbates the decline of these minority languages. India's linguistic diversity is closely related to its cultural heritage. Many endangered languages have local histories, oral traditions, and folklore preserved. If appropriate preservation efforts are not followed, the loss of these languages could result in an irreversible cultural gap. The lack of standardized scripts and digital representation for many Indian languages makes documentation and archiving even more difficult. A multifaceted strategy including governmental regulations, technical advancements, and community involvement is needed to address these problems.

Endangered Languages in India: Status and Statistics (2017-2024)

Table 1: Analysis of Language Vitality Indicators

India's linguistic environment is a vulnerable and diverse ecosystem. With more than 133 endangered languages in varying states of danger, this analysis offers a thorough look at the linguistic obstacles, preservation initiatives, and significant patterns influencing language survival in India from 2017 to 2024. It is evident from the Table 1.3.1 presented below:

Table1.3.1: Analysis of Language Vitality Indicators

Vitality Level	Number of Languages	Average Speakers	Documentation Status	Digital Presence
Strong	12	>10,000	Comprehensive	Active Online Presence
Moderate	28	5,000-10,000	Partial	Limited Online Resources
Weak	51	1,000-5,000	Limited	Minimal Digital Presence
Critical	42	<1,000	None/Minimal	No Digital Presence

Analysis of Table 1.3.1

- Only 12 languages are categorized as "Strong," while 42 critically endangered languages have fewer than 1,000 speakers, reflecting an alarming trend.
- Language vitality is closely tied to documentation and digital presence, emphasizing the urgent need for archival and technological interventions.

Table 2: Initiatives for Language Preservation (2017–2024)

Results from various preservation projects are inconsistent. With success rates of 45% and 60%, respectively, community activities and digital documentation show the most promising results. The yearly budgetary allocation, which ranges from ₹1.8 Cr to ₹4.5 Cr, shows an increasing level of institutional and governmental commitment.

Table 1.3.2: Initiatives for Language Preservation (2017–2024)

Initiative Type	Languages Covered	Success Rate	Annual Budget (₹)	Major Outcomes
Digital Documentation	65	45%	2.5 Cr	Online Archives, Apps
Education Programs	38	35%	1.8 Cr	Teaching Materials
Community Programs	52	60%	3.2 Cr	Cultural Events
Government Schemes	45	40%	4.5 Cr	Policy Implementation

Analysis of Table 1.3.2:

- Community programs and digital documentation have shown the highest success rates at 60% and 45%, respectively.
- The increasing budgetary allocation (₹1.8 Cr to ₹4.5 Cr annually) reflects growing institutional commitment to linguistic preservation.

Table 3: Analysis of Endangered Language Distribution by Region

One important aspect in language endangerment is regional diversity. According to the data, each Indian state faces distinct linguistic difficulties. Of them, Arunachal Pradesh has the most complicated linguistic environment, home to 33 languages, 12 of which are severely endangered is presented in Table 2, that is provided below:

Table 1.3.3: Analysis of Endangered Language Distribution by Region

Region/State	Total Languages	Critically Endangered	Severely Endangered	Primary Challenges
Andaman & Nicobar	11	7	4	Isolation, Small Population
Arunachal Pradesh	33	12	21	Modernization, Migration
Manipur	7	3	4	Urban Shift, Education
Himachal Pradesh	4	2	2	Cultural Assimilation

Analysis of Table 1.3.3:

- Arunachal Pradesh exhibits the highest linguistic diversity, with 33 endangered languages, 12 of which are critically endangered.
- The North Eastern states face significant linguistic challenges due to modernization, migration, and geographic complexities.

Key Findings and Recommendations

Trends:

- The survival of endangered languages in India is intricately linked to their documentation and digital presence.
- Regional challenges such as migration, modernization, and isolation exacerbate the decline in speaker populations.

Interventions Needed:

- Community Engagement:** Focused initiatives like cultural events and participatory programs to revitalize languages.

- (iv) **Technological Integration:** Expanding digital archives, AI-based tools, and mobile apps tailored for language learning.
- (v) **Policy and Funding:** Strengthened government policies and increased funding to scale preservation efforts.

Future Directions:

- (vi) Addressing the declining participation of younger generations in linguistic communities.
- (vii) Developing sustainable multimodal strategies that integrate community efforts, innovative technologies, and effective policy implementation.

How Technology Affects Language Sustainability

Archiving and Digital Documentation

Digital records are essential for protecting endangered languages. Technologies for high-definition audio-visual recording capture the subtleties of language use, such as sentence patterns, cultural settings, and phonetic nuances (Gippert, 2010). These recordings are a valuable resource for linguists, educators, and community people involved in the revival of endangered languages.

Advanced cloud storage technology has also changed the archiving procedure. Through websites like ELAR (Endangered Languages Archive), linguistic data is readily accessible and safely stored. By utilizing open-access principles and numerous backups, these platforms safeguard digital archives against technological obsolescence (Himmelfmann, 2006).

However; digital documentation alone is insufficient without community participation. Participatory methods must be given top importance in language documentation projects to guarantee that community members actively engage in the gathering and verification of linguistic data. One effective method for documenting oral traditions and dialectical differences in real time is the use of mobile devices for crowd sourced documentation. By adding metadata, such as speaker demographics and cultural commentary, digital archives are further enhanced. In addition to maintaining linguistic elements, these large datasets facilitate interdisciplinary research in cognitive science, anthropology, and cultural studies.

Applications for Language Learning

Language learning has undergone a revolution thanks to mobile apps like Duolingo and Memrise. According to Anderson (2018), these tools use gamification and adaptive learning algorithms to make language acquisition engaging and accessible. In addition to attracting new speakers of endangered languages, these apps provide native speakers with a means of enhancing their language skills. The Tulu Lexicon app, for example, was developed by the Karnataka Tulu Sahitya Academy as a digital resource for teaching and preserving Tulu, a Dravidian language spoken in South India. Native speakers feel more in charge of their work thanks to community-driven systems like this one that let people submit content (Smith, 2020).

These apps also provide users with immediate feedback through voice recognition technology, which enhances pronunciation and fluency. Although these features primarily target second-language learners, they also encourage intergenerational transmission within linguistic communities by involving younger speakers in the preservation process. Despite these advantages, the applications' usability and cultural relevance influence their success. Learning materials that are adapted to local dialects and cultural peculiarities are more inclusive and effective for a range of linguistic communities.

Digital Communities and Social Media

Social media sites have become effective resources for preserving endangered languages. Speakers of minority languages can produce and distribute content in their original tongues on websites like Facebook, Instagram, and YouTube. By creating online communities where speakers may share thoughts, tales, and

cultural expressions, this digital ecosystem makes sure that speakers' languages are still used in modern conversations (Fishman, 2001). One illustration of this is the Khasi community in Meghalaya, India, which uses YouTube to share vlogs, music videos, and tutorials in the Khasi language. These kinds of programs encourage younger generations to value their language heritage while also enhancing communal identification. Similar to this, hashtags on social media, such as #EndangeredLanguages and #LanguagePreservation, have attracted international attention and sparked cooperative initiatives to record and revive lesser-known languages.

Moreover, tiny, close-knit groups for practicing conversations in endangered languages have been made possible in large part by messaging apps like WhatsApp. By offering a casual environment for interaction between learners and native speakers, these platforms help reduce generational divides and promote consistent language use.

But there are still difficulties. Minority languages may be marginalized on these platforms due to the prevalence of English and other international languages. In order to counter this, social media firms need to incorporate linguistic diversity into their interface designs and algorithms. This includes making room for underrepresented languages and supporting more scripts.

Applications of Machine Learning and Artificial Intelligence

Documenting and conserving endangered languages has been transformed by Artificial Intelligence (AI) and Machine Learning (ML). Linguists can effectively study and digitize languages with the use of tools like Natural Language Processing (NLP), Neural Machine Translation, and Speech Recognition Software. Hours of spoken language data, for example, can be processed by AI-powered transcription services and turned into text for additional research (Koehn, 2017).

Google's "Endangered Languages Project," which uses AI to identify and assess at-risk languages globally, is one notable example. The use of AI models for Bhojpuri and Maithili is one example of an endeavor in India that highlights the importance of technology in preserving regional languages. These tools help capture linguistic subtleties like tone shifts and idiomatic expressions to guarantee that the essence of the language is maintained throughout the translation process.

Machine learning algorithms also are used to construct flexible language-learning modules that cater to various learning styles. The incorporation of endangered languages in the curriculum is encouraged by these modules, which also make them more accessible to non-native speakers. Making such tools is challenging, though, especially for languages with complex phonetics, challenging scripts, or sparse data sets. To overcome these challenges, academics, IT developers, and language groups must work together.

Challenges to Consider When Using Technology

Concerns about the Digital Divide and Access

The digital divide continues to be a major obstacle to the implementation of technological solutions for language preservation, particularly in remote and rural areas. In many regions of India, where infrastructure disparities are evident, access to reliable internet, smartphones, and electricity is limited (Heeks, 2017). These inequities disproportionately affect marginalized groups, many of whom are the custodians of endangered languages.

For instance, while mobile apps and online archives have demonstrated potential in urban settings, their usefulness is restricted in regions like the northeastern states or the tribal belts of Chhattisgarh and Odisha. Lack of digital literacy exacerbates the problem because many potential customers are not experienced with using these technologies. A multifaceted approach is required to bridge the digital divide. Infrastructure development in underprivileged areas must be prioritized in government programs to guarantee equitable access to technology.

Furthermore, by improving digital literacy, community-based training initiatives can enable local communities to make use of these resources for language preservation. Private tech companies and non-governmental

organizations (NGOs) can also help close these gaps by creating affordable, offline-compatible solutions that are suited to the requirements of particular language communities.

Ethical and Cultural Aspects

The use of technology for language preservation has important ethical ramifications that need to be carefully considered. One of the primary concerns is who owns the language data. When foreign organizations in charge of documentation initiatives claim intellectual property rights over the material, the very communities whose languages they are attempting to preserve are usually left out (McDonald, 2019).

For example, indigenous communities in India, such as the Gonds and the Santals, have expressed concerns about losing control of their language heritage while collaborating with outside organizations. Establishing ethical frameworks that give community ownership and consent top priority in data collection, storage, and distribution is vital to addressing this.

Another ethical conundrum is how to use technology treatments while maintaining cultural sensitivity. The legitimacy of machine translation and other automated technologies may be compromised if they inadvertently misrepresent cultural peculiarities. Linguists and developers must work closely with native speakers to ensure cultural correctness and assess linguistic data in order to mitigate this.

Accessibility is part of ethics, too. In order to serve a variety of user groups, including the elderly and those with disabilities, technology should be inclusive. In addition to expanding the reach of language preservation programs, this approach fosters community involvement and trust.

Technical Difficulties

Because linguistic systems are diverse and complicated, developing technology for endangered languages poses many technical hurdles. Since many endangered languages lack a defined script or written form, it is difficult to develop digital tools like keyboards, OCR systems, or text-to-speech software for them (Harris, 2002).

Within a single language, phonetic and syntactic differences complicate the development of artificial intelligence models. Languages like Manipuri and Bodo, for example, have significant dialectal differences that call for specific documentation and technical integration techniques. The lack of training data also hinders the development of trustworthy AI and ML models for these languages.

Another technical challenge is the integration of linguistic data into contemporary digital ecosystems. It might be difficult to adjust to the unique requirements of lesser-known languages because many software platforms were developed with dominant languages in mind. Linguists, technologists, and community stakeholders must collaborate to overcome these issues and create scalable, adaptable solutions.

Standardization initiatives, such as the Unicode Consortium's inclusion of more Indian characters, are a step in the right direction. However, technological innovations must involve all linguistic communities, and this will take sustained effort.

Indian Language Preservation Efforts

Initiatives of the Government

The Indian government has worked hard to preserve and promote endangered languages through a variety of initiatives. Initiatives like the National Mission for Manuscripts (NMS) and the Centre for Development of Advanced Computing (C-DAC) are crucial to this effort. The National Mission for Manuscripts digitizes and catalogs a large number of historical texts written in endangered languages. These activities not only preserve language history but also ensure accessibility for educators and academics worldwide (Bharati, 2016).

On the other hand, C-DAC is necessary for the creation of language technology solutions. The creation of fonts, transliteration software, and language processing tools for lesser-known Indian languages are some of

its initiatives. For instance, the establishment of the "Indian Language Data Centre" aims to facilitate the digital inclusion of regional and tribal languages in online platforms.

Another significant effort is the "Scheme for Protection and Preservation of Endangered Languages" (SPPEL), which is run by the Ministry of Human Resource Development. This program collaborates with research organizations and academic institutions to document and revitalize languages that are seriously endangered. Even while these projects have potential, they usually encounter issues including inadequate funding and drawn-out bureaucratic procedures. More financing and political will are needed to sustain long-term language preservation efforts and expand their influence.

Research Projects

Language preservation initiatives in India have been spearheaded by academic institutions. One of the most well-known programs, the Linguistic Survey of India (LSI), systematically documents the country's linguistic variety. This survey, conducted in collaboration with academic institutions and research organizations, provides valuable information on the phonology, grammar, and sociolinguistics of endangered languages (Patel, 2015).

Universities like Jawaharlal Nehru University (JNU) and the Central Institute of Indian Languages (CIIL) have dedicated linguistics and language documentation departments. Through fieldwork in rural and tribal areas, these centers document languages and create educational materials for their preservation. For example, CIIL's initiative to produce textbooks in endangered languages like Kodava and Tulu has been essential to advancing bilingual instruction in schools.

Additionally, international cooperation is crucial. It is now simpler to exchange knowledge and obtain state-of-the-art linguistic research tools thanks to partnerships with institutions such as the Max Planck Institute for Psycholinguistics and SOAS University of London. However, academic endeavors are sometimes beset by a lack of outreach beyond academic circles. Research findings should be converted into useful materials for communities and decision-makers.

Community-Oriented Work

Local communities' grassroots initiatives are crucial to the long-term preservation of languages.

Community-driven initiatives that utilize the knowledge of elders and cultural guardians document oral traditions, folklore, and songs in endangered languages. These programs often use simple technology, such as cellphones and voice recorders (Basu, 2018).

Online initiatives to preserve their language have been launched by tribal communities in North-eastern India, such as the Mizos and Nagas. Through websites like YouTube channels, podcasts, and blogs, younger members of these communities can engage with their mother tongues in a modern context. In addition to preserving language elements, these programs foster pride in cultural identity and intergenerational ties.

An encouraging example is the Khasi Authors' Society's development of a digitized collection of Khasi literature, which includes religious texts and folktales. To preserve their distinctive speech and customs, the Toda tribe in Tamil Nadu has also started documentation efforts. Programs like these demonstrate the need of collaborative efforts in language preservation despite limited funding. By offering financial support, training, and technology resources, NGOs and government organizations can further increase the effect of community-based initiatives.

Suggestions and Future Directions

Cutting Edge Technology

The integration of emerging technology has created new prospects for language preservation. Blockchain technology, for instance, can ensure the legitimacy and security of language data. Communities can maintain sovereignty over their language assets and prevent misuse or unauthorized access by using decentralized ledgers (Swan, 2015).

Another cutting-edge technology that has the potential to facilitate real-time language documentation is the Internet of Things (IoT). IoT-enabled technologies, such as wearable recorders and sensors, can capture everyday interactions in endangered languages, producing useful datasets for research. IoT might be used, for example, to document indigenous farming practices by linking spoken words to ecological knowledge.

Additionally, advancements in Virtual Reality (VR) and Augmented Reality (AR) offer immersive experiences that could help revive endangered languages. By overlaying native literary translations on actual objects, augmented reality apps have the potential to enhance language acquisition in engaging ways. However, these technologies' high implementation costs remain a hurdle. Cooperative finance strategies and collaborations between governments, digital businesses, and communities could make these technologies more accessible.

RECOMMENDATIONS

To support language preservation efforts, robust legislative frameworks are required. Governments must increase funding for projects involving digital documentation and linguistic study. Policies that support bilingual and multilingual education systems should give endangered languages priority in curricula (Ghosh, 2019).

For instance, requiring tribal languages to be taught in elementary school could promote the transfer of these languages from one generation to the next. Offering incentives for the creation of literature, music, and film in endangered languages is another way to keep them relevant in modern settings.

The establishment of language data centers at the state and federal levels may also help streamline preservation efforts. These institutions could serve as hubs for the diffusion, research, and documentation of linguistic resources. Through international collaboration through organizations like UNESCO, more funds and expertise may be available.

Finally, community involvement and participatory approaches should be given priority in policy. Local stakeholders must be involved in decision-making processes to ensure that preservation plans satisfy the social and cultural needs of linguistic groups.

Community Engagement

The key to effective language preservation is community involvement. Local leadership should be given top priority in initiatives so that communities can take responsibility for their language legacy. Training courses in digital documentation, for instance, can give young people in the community the tools they need to document and preserve their native tongues (Nair, 2021). Establishing venues for music, art, and storytelling in endangered languages can promote linguistic resurrection and cultural pride.

Relatively cheap media, such as community radio stations and podcasts, have proved successful in reaching remote populations. Collaboration between communities and other stakeholders is equally important. IT companies, universities, and non-governmental organizations should collaborate with language communities and adopt a participatory approach rather than imposing answers. This preserves the independence and cultural identity of the communities involved while also ensuring the sustainability of conservation efforts.

CONCLUSION

In India, preserving endangered languages necessitates a multifaceted strategy that includes government initiatives, technological advancement, scholarly research, and active community engagement. The loss of linguistic diversity has a significant influence on human heritage, traditional knowledge, and cultural identity globally, as the global linguistic landscape highlights. Incorporating cutting-edge technologies like blockchain and the Internet of Things, creating inclusive legislation, and promoting participatory approaches that prioritize cultural sensitivity and community leadership are all important future directions. The preservation of endangered languages ultimately depends on a common commitment to bridging the divide between local communities, policy, and technology in order to guarantee that India's rich linguistic legacy survives in a globalized world.

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