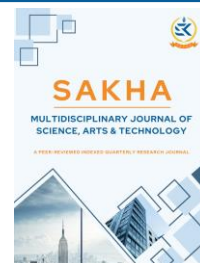




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Technology-Enabled Tribal Welfare in India: A Systematic Review of Policies, Practices, and Development Outcomes

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Abstract

The tribal communities in India aspect ongoing socio-economic relegation which manifests through their inability to access adequate education and healthcare services and economic opportunities and public infrastructure. Governments can use the solution which emerged from recent technological advances and digital inclusion projects to enhance welfare services while bridging development gaps. The review examines evidence from government programs and academic research and actual projects to assess the use of technology for tribal welfare purposes. The research on digital empowerment shows that ICT usage in educational settings will provide tribal students with learning resources while causing difficulties in building infrastructure and developing capacity (Ghodam & Madhusudan, 2025). Mobile-based community media platforms enable tribal communities to share their viewpoints while teaching them about their rights and entitlements according to (Moitra, Kumar & Seth, 2021). Research results demonstrate that tribal women and rural communities experience digital divides because they possess insufficient internet access and digital skills which stop them from participating in the digital economy (Arya & Pradeep Kumar, 2025; Natuvilakkandy & Kumar, 2018). The development of technological platforms which enable tribal language support and cultural preservation efforts demonstrates how digital technology can better serve diverse linguistic needs and cultural demands according to Singh and Kumar 2025 and Adi Vaani 2025. The digital entrepreneurship initiatives create online portals which enable tribal artisans to access wider markets while providing training programs that help them generate income and protect their cultural heritage according to Manoj

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and Aithal 2025 and Aadirang 2025. The existing positive developments face obstacles because organizations need to provide equal access while developing designs that respect cultural differences and achieve lasting impact. The review demonstrates that integrated policy frameworks which combine digital infrastructure with Indigenous knowledge-based design and specialized capacity development create pathways to effective welfare improvements. Together, these two actors make technology the most fundamental asset reaching the tribes and capable of fulfilling their wishes for welfare and empowerment.

Keywords: Technology-Enabled Development, Digital Divide, Rural Connectivity, Social Empowerment, Inclusive Governance.

Introduction

The socio-economic status of tribal communities in India ranks them among the most disadvantaged groups in the country. Tribal people face ongoing difficulties because they lack access to basic education and healthcare services and employment opportunities and vital public amenities. Tribal communities have faced geographic and economic difficulties which prevented them from receiving equal benefits from development programs since the beginning of their existence (Sathiyaraj et al., 2025). The socio-economic gap between tribal and non-tribal groups remains extensive despite the existence of constitutional protections and dedicated welfare programs. Digital platforms and technological innovation create fresh possibilities which can enhance welfare programs for tribal communities.

The Digital India initiative from the Government of India intends to create digital opportunities for all people while using ICT tools to improve access to various services (Anuradha et al., 2025; Ghodam & Madhusudan, 2025). The implementation of ICT enables remote tribal communities to gain access to educational resources and health services and financial assistance and government services through various digital platforms that offer information sharing and secure identity verification and mobile service applications and electronic government services (Ghodam & Madhusudan, 2025). Digital education tools enable tribal students to access educational materials which would be impossible to obtain because of their geographical situation (Ghodam & Madhusudan, 2025).

The digital divide which affects tribal populations continues to exist because of three main reasons which include insufficient infrastructure and limited internet access and the lack of digital literacy and existing socio-cultural barriers (Arya & Pradeep Kumar, 2025; Realities of Digital Inclusion among Tribal Women, 2025). Studies indicate that tribal women and youth in remote districts experience pronounced digital exclusion which limits their ability to access technology-based welfare services (Arya & Pradeep Kumar, 2025).

The diversity of languages together with cultural differences creates obstacles for digital service delivery which has led to recent technological developments that produce language tools such as Adi Vaani for tribal languages to promote better ICT access for all users (Singh & Kumar, 2025; Adi Vaani, 2025).

The existing research shows that researchers have not yet developed a complete synthesis of how technology-based methods impact tribal welfare across different sectors and community groups. The research shows that a systematic review is needed to examine all existing technology-based solutions that researchers developed to improve tribal welfare through their evaluation of research policies and operational methods and their assessment of technological results. The review is required to discover effective methods while showing existing deficiencies that should be studied to create policies for digital access which should be distributed equitably among all tribal communities in India.

Literature Gap

Multiple studies have researched tribal welfare development in India, yet scholarly work has mainly investigated four specific areas (Xaxa, 2014; Mohanty, 2011). Research studies assess constitutional protections together with welfare initiatives and livelihood programs which aim to enhance tribal health and welfare (Planning Commission, 2013). The studies examine technology as an element that provides assistance to welfare transformation which they consider to be a secondary component of their research. Recent studies demonstrate how Information and Communication Technology (ICT) achieves better educational results through its application in tribal educational systems and government operations (Ghodam & Madhusudan, 2025). Digital inclusion studies show both advantages and obstacles which affect tribal women and isolated communities (Arya & Pradeep Kumar, 2025; Natuvilakkandy & Kumar, 2018). which merely reveal particular findings at individual study sites. There is no comprehensive study which surveys technology-based welfare programs that operate across education, health care, government procedure, economic development and cultural heritage protection.

The existing research base contains only a single study which examines the relationship between technological adoption and Indigenous Knowledge Systems (IKS) and cultural contexts and community participation. The research gap exists because no comprehensive frameworks exist which link together digital infrastructure and policy execution and social

results. The research requires a systematic review which brings together current evidence and determines effective methods and assesses difficulties to find out how technology functions as a complete system for tribal development instead of an administrative tool.

Conceptual Framework

The authors of this review utilize the Technology-Enabled Tribal Welfare Framework which defines technology as a tool that connects welfare policies to socio-economic development results for tribal communities. The framework identifies government programs and digital governance methods and ICT infrastructure as essential components that allow services to reach remote and underserved tribal areas. The administration of welfare systems benefits from Digital India and e-governance platforms and Direct Benefit Transfer (DBT) systems and telemedicine and digital education and mobile-based livelihood applications because these programs create pathways to better access and transparency and operational efficiency (Ghodam & Madhusudan, 2025; van Dijk, 2020). The technological inputs function through processes of community participation and digital literacy development and local adaptation and Indigenous Knowledge System integration to achieve technological solutions that respect cultural diversity and promote social equity.

Through these mechanisms, technology provides improved access to health and education and financial and governance services. The system delivers benefits to users with quick and open procedures which allow tribal communities to share information with institutions. The results of these activities lead to long-term society-wide benefits which include socio-economic empowerment and reduced regional disparities and increased development participation and enhanced life quality. The framework identifies structural barriers which include poor connectivity and digital illiteracy and linguistic diversity and socio-cultural exclusion as factors that decrease technological intervention efficiency and create digital inequality which requires solution (Arya & Pradeep Kumar, 2025; Natuvilakkandy & Kumar, 2018).

The model demonstrates that technology cannot bring welfare benefits. Sustainable tribal development results from using digital infrastructure and policy support and capacity building and community-centered implementation. Technology serves as both a technical instrument and a socio-technical system which requires alignment with local requirements and indigenous contexts to deliver equal tribal welfare benefits.

Review of Literature

Since the 1990s, scholars and policymakers have increasingly debated the role of technology in tribal development which forms integral part of inclusive development and digital governance in India. Conceptually, the existing research shows that all the tribal communities are more empowered for inclusive welfare by more inclusive access to welfare program through technology intervention and eb po management including ICT, Mobile services. However, findings also show that structural disparities, infrastructural deficiencies, and socio-cultural impediments mitigate the effects of these programs. The thematic review below summarizes pertinent outcomes of the key researches on the GIS focused and mobile enabled tribal welfare.

Technology and Tribal Education

Educational technology is an important resource to tribal communities which leverage the transformational power of ICT integration to improve their educational outcomes in remote areas Digital classrooms and smart boards integrated with online courseware and mobile apps have enabled children of tribal areas to learn despite dearth of physical resources and the lack of teachers. Ghodam and Madhusudan (2025) contended that, ICT-based education improve access to quality instructional material including sharing of best practices, in turn increasing student involvement contributing towards reduction in education gaps between non-tribal and tribal students. Initiated through Digital India supported government programs, e-learning initiatives have also made possible many virtual classrooms and safe learning environments that will cater to students attending geographically remote schools. There are several challenges with even the most basic e-learning technologies lies in that it requires reliable broadband service and teachers equipped with digital literacy skills and there is no efficient technical support. Educational technologies face these limitations which hinder their efficient use. Education technology implementation is grounded on three fundamental elements, which include teacher research, self-directed online learning guides research, researcher searches online for guidance.

Technology and Tribal Health Services

The provision of health care in tribal localities is often hampered by accessibility (majority of them are remote locations) and by the lack of health workers and other institutional infrastructure. Tele-medicine and m- health services are found to be effective solutions in

overcoming these limitations. Together the tele-medicine and digital health consultation and remote diagnostics and virtual health awareness campaigns through mobile phones and other tools provide accessible health care services. Numerous researches point out that the tele-health are more capable of providing efficient health information and services through remote health risk assessment, Monitoring and better diagnoses. Digital health records offer access to better information, provide online booking systems and improve the clinical management and operational challenges. because of three main factors which include insufficient electricity and users' low technological expertise and their distrust of digital systems. The community awareness program needs to combine with technology solutions to achieve successful healthcare results.

E-Governance and Welfare Delivery

The government of India uses electronic governance as its primary system for implementing technology-based welfare programs. Digital platforms such as Aadhaar-based identification systems, Direct Benefit Transfer (DBT), and online service portals have established better transparent systems which enable efficient delivery of welfare services. The system establishes direct benefit distribution to tribal recipients because it effectively removes all unauthorized elements which would cause financial loss. The digitized governance systems according to policy analysis studies provide better document management and faster resolution of citizen complaints while creating better interaction methods between citizens and government officials. The research conducted by Van Dijk in 2020 proves that digital governance frameworks help decrease administrative inequality when people have proper access to digital technology. The tribal population faces three main obstacles which prevent them from using digital services because they lack understanding about the services and they experience challenges with documentation and they do not possess digital skills. The system of technology-based governance needs to establish both educational support systems and local assistance facilities.

Digital Inclusion, Livelihoods, and Economic Empowerment

The technology sector increasingly supports indigenous communities by enhancing their economic stability and their ability to sustain their traditional livelihoods. The three platforms which include mobile agricultural advisories and digital marketplaces with online skill development programs, provide tribal farmers and artisans access to wider markets which helps them to raise their productivity. The researchers Manoj and Aithal (2025) state that

digital entrepreneurship together with eco-tourism projects enables tribal producers to sell their products directly to buyers which helps them to earn more money without using middlemen services. The combination of skill development portals and digital financial inclusion tools which include mobile banking and digital payments, helps people to participate in economic activities. The interventions provide people with a continuous system which allows them to link into the rest of the economy as in the process they also preserve traditional crafts and knowledge systems. A large number of households are not able to get on board with activities requiring their full involvement due to lack of access to cell phones and banking literacy skills.

Digital Divide and Socio-Cultural Barriers

Several researches show how the digital divide still exists among tribal areas. Despite the availability of technology, there still exist a large gap between the advantages and disadvantages of using the same. Van Dijk (2020) defines digital inequality as a multidimensional concept which comprises 3 essential aspects which are access, skills and usage gap. The dimension of access, skills and usage do not support the tribal areas in utilizing the facility as they suffer from lack of internet connectivity and digital skills. This widened the male female differentiation. Arya and Pradeep Kumar (2025) states that the tribal women faced with minimum access to mobile technology, lack of digital skills and found difficulty in involving within the welfare and economic activities. Natuvilakkandy and Kumar (2018) demonstrate that the combination of social norms and insufficient training results in digital exclusion for tribal women who reside in Kerala. Digital platforms become more challenging to use because they lack localized and indigenous language interfaces which exist in multiple languages. The research shows that technology does not provide a solution for inclusion; digital programs need to create solutions which consider actual social traditions and build organizational capacity.

Integration of Indigenous Knowledge and Technology

Recent scholarship shows that Indigenous Knowledge Systems (IKS) need to be combined with contemporary technological solutions for optimal results. Technology functions as a supplementary tool which helps to document and preserve indigenous ecological knowledge and traditional practices and cultural heritage. The use of community-centered approaches that include local residents allows organizations to adopt technology in ways that respect local customs while maintaining long-term viability. The integration process creates dual benefits

because it improves community welfare while protecting cultural traditions which support tribal identity and self-governance.

Methodology of the Review Study

The current research uses systematic narrative review research methods to study how technology-based programs help Indian tribal groups achieve their development goals. The research design based on reviews is suitable because the study aims to combine existing knowledge with policy framework analysis and evaluation of how digital and technological programs impact tribal development rather than collecting new research findings. The research shows how various tribal groups develop their technology through its use and assessment across their various situations. The review conducts its analysis through qualitative and descriptive and analytical methods which use multiple secondary sources to detect patterns that repeat and trends that develop and links between themes and research gaps in education and healthcare and governance and financial inclusion and livelihood development. The method enables complete analysis of how technology creates multiple benefits through better access and fair treatment and increased empowerment for indigenous communities.

The review adopted the following inclusion and exclusion criteria to maintain the quality and have the utility of the review: The review included the studies on tribal and indigenous populations of India that explored the relationship of technology, digital governance or ICTs with welfare delivery or development outcomes. The researchers drew mainly on the peer-reviewed publications and government or policy documents published in the last ten years, though essential primordial studies were also included. They did not include the opinion pieces, gray literature, duplicated studies and those not linked with technology-enabled welfare.

The selection process did employ current research studies which showed policy relevant together with empirical evidence as the basis for inclusion screen. The peer reviewed corpus of research studies was systematically compiled, coded, and analyzed using thematic analysis for the purpose of accumulating evidence in order to make evidence based conclusions. The review included studies that focused on tribal or indigenous populations in India and examined the role of technology, digital governance, or ICT in welfare delivery and

development outcomes. The review process prioritized peer-reviewed publications and official policy documents which had been published during the last ten years while also allowing foundational studies to be included when needed. The analysis excluded opinion pieces and non-academic sources together with duplicated materials and studies which did not pertain to technology-enabled welfare.

The researchers conducted a detailed study of the chosen publications to gather information about the research purposes and the study methods together with the main results and their potential consequences. The researchers used thematic analysis to organize and synthesize the collected data. The studies were organized into six main categories which included technology in education and digital health services and e-governance and service delivery and livelihood enhancement and digital inclusion and barriers to adoption.

Thematic categorization created a system which permitted researchers to compare studies while they examined how technological solutions benefited tribal communities and faced various obstacles and produced results. The review depends on secondary data because it needs both existing studies and their different research methods to analyze its findings but the reviewers included trustworthy sources from various fields to achieve complete and fair assessment. The systematic narrative review approach shows how technology affects tribal welfare because it combines different technological aspects through its integrated evaluation which leads to evidence-based policy recommendations.

Findings

The findings of the literature review highlight that relying on technology aided approaches has become indispensable for tribal welfare programs not only in India, but also globally to administer and evaluate its various interventions. Use of digital platforms and Information and Communication Technology has proven its efficiency in reducing spatial limitations, increasing access to services and enhancing administrative efficiency across plethora of sectors. Empirically, to achieve an effective intervention using this approach it's imperative to ensure an adequate formal infrastructure combined with digital capabilities and people friendly approaches. Advantages and disadvantages of interventions through technology is directly linked to the existing technological infrastructure through digitalization of class rooms, online study content and receiving instructions remotely, survey found that these activities are helping the remote tribal schools to overcome the problem of paucity of teachers &

infrastructure shortcomings, as they improve the learning skills in students and improve their performance. (Ghodam & Madhusudan, 2025).

The mentioned success stories are facing challenges in continued success as irregular internet connectivity and lack of sufficient training to teachers or digital technology skills of learners. The empirical results of the research world suggest that educational technology helps in better access of education by students in case of school-led teachers' training activities.

ICT use in education can help open doors to educational resources for tribal students as resources come to tribal schools that are turning to digital classrooms, online learning platforms and other remote educational support systems; researchers reveal ICT programs can address the issues of problem faced by remote tribal schools that lack sufficient teachers and infrastructure hence benefit the learners when well plans for such implementation is ensured as the follow-up studies revealed higher student achievement and retention in the schools (Ghodam & Madhusudan, 2025) However the sustainability of such program is hindered by poor internet connectivity and inadequate training of teachers and digital skills of learners while the study findings disclose the technology can support inclusive access to education.

E-governance mechanisms create a second important area which shows their effects. The implementation of digital identity systems Direct Benefit Transfer (DBT) and online welfare portals has improved both transparency and accountability for service delivery. The platforms enable direct benefit transfers to eligible beneficiaries which results in decreased bureaucratic delays and reduced instances of leakage. The evidence shows that these systems help improve targeting accuracy while they enable tribal populations to access essential certificates and pensions and scholarships and subsidies more easily. Digital illiteracy and documentation problems stop most beneficiaries from using these services independently which creates a need for intermediary support structures. Van Dijk 2020 states that digital skills access creates social inequality because it allows existing social inequalities to reproduce themselves through technological advancement. Technology has also brought benefits to tribal communities through improved living standards and increased economic opportunities.

Tribal farmers and artisans now have better access to job opportunities and market facilities because of mobile agricultural services and digital marketplaces and vocational training websites. The programs create business opportunities for people while they establish revenue streams that enable people to access digital banking services and payment systems (Manoj &

Aithal, 2025). The developments establish support for indigenous knowledge systems and traditional crafts through their promotion of self-sufficiency and environmentally sustainable practices. The situation exists because women and underrepresented communities face barriers to participation from unequal smartphone access and financial literacy deficiencies and restricted educational opportunities.

The existing research demonstrates that the digital divide continues to exist as the most important obstacle which prevents people from accessing technology-based welfare solutions. Tribal communities, particularly women, experience limited access to digital devices, internet connectivity, and technical skills, thereby constraining their engagement with digital services (Arya & Pradeep Kumar, 2025; Natuvilakkandy & Kumar, 2018). The standardized digital platform is less usable for the users since their language and cultural needs are different. These existing barriers indicate that digital inclusion should be more focused on all the three areas such as social, economic and culture issues instead of only focusing on the infrastructure.

The findings of the studies suggested that technology acts as a powerful agent which enables tribes to fulfill their welfare aspirations by facilitating the access to services and enhances the efficiency of operation and brings visible transparency of service delivery processes. The effectiveness of this system however depends on the infrastructure available along with the extent of literacy and gender equity and community participation. The findings established that when technology is synergized with the system of indigenous knowledge and people's own governance and training efforts issues like sustainability can be addressed successfully. It is the understanding of the people that technology is an important tool which facilitates the process of equal and just treatment of tribes.

Conclusion

This review examined the role of technology-enabled interventions in advancing tribal welfare in India by synthesizing evidence from policies, scholarly studies, and sector-specific initiatives across education, healthcare, governance, and livelihoods. The research shows that digital technologies and Information and Communication Technology (ICT) platforms function as essential tools which help tribal communities solve their persistent development problems. The technology improvements have helped people who belong to tribal and non-tribal groups because they make services more reachable and they create better administrative systems

which handle welfare distribution. The use of digital education tools and telemedicine services and e-governance portals and Direct Benefit Transfer (DBT) systems and mobile-based livelihood applications demonstrates how remote areas can use technology to overcome their geographical and infrastructural limitations (Ghodam & Madhusudan, 2025; Manoj & Aithal, 2025). The review demonstrates that technological interventions will not automatically achieve the goal of developing inclusive societies. The digital services face accessibility challenges because people lack internet access and digital skills and they experience economic hardship and gender inequalities and they speak different languages. The digital divide remains particularly pronounced among tribal women and marginalized households, thereby limiting the transformative potential of technology (Arya & Pradeep Kumar, 2025; Natuvilakkandy & Kumar, 2018). The digital resource access inequality which exists between different social groups leads to greater social divisions unless policy makers create systems which support equitable resource distribution (van Dijk 2020).

The study therefore concludes that technology should not be viewed as a standalone solution but as a socio-technical enabler that must be embedded within community-centered, culturally responsive, and participatory development frameworks. tribal welfare needs both digital infrastructure and continuous funding for capacity development and digital education and creation of region-specific content and language accessibility and implementation of Indigenous Knowledge Systems. The approach enables technological innovation to support existing traditional methods while enhancing the resilience of the community.

The application of technology into welfare programs in India indicates a promising opportunity to promote social justice and local empowerment; and at the same time, to contribute to sustainable development in tribal areas. The program can be successful only if its objective contributes towards bridging the digital divide and designing technology solutions to suit local circumstances. Exploring the digital and technological framework is vital to tailor the innovations for the end user with appropriate research and policy with participatory approach in evaluating the long term impacts. Thus, the all-encompassing and inclusive approach can lead the technological aid for the development of tribal welfare from mere services to empowerment.

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