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Protecting Indigenous Knowledge Systems: Different Issues in Intellectual Property Law

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Abstract: *This study investigates the protection and legal empowerment of traditional knowledge (TK) held by indigenous communities in India within the framework of intellectual property rights (IPR) and related legal instruments. Drawing upon a comprehensive review of literature, national policies, international treaties, and judicial decisions, the research examines the extent to which existing legal frameworks recognize and safeguard ownership rights of TK. The study further explores strategies for legal empowerment, including the use of digitization tools like the Traditional Knowledge Digital Library (TKDL), participatory governance, and capacity-building initiatives. Additionally, the research identifies challenges in practical enforcement, community-level adoption, and equitable benefit-sharing, highlighting gaps in policy implementation. Employing a case study methodology, the study provides context-specific insights into effective approaches for protecting TK, emphasizing the integration of customary laws, international obligations, and socio-cultural considerations. Finally, the study proposes actionable policy recommendations aimed at enhancing TK protection, promoting sustainable utilization, and ensuring fair recognition of indigenous communities' rights in India.*

Keywords: Traditional Knowledge (TK), Indigenous Communities, Intellectual Property Rights (IPR), Legal Empowerment, Sui Generis Systems, Traditional Knowledge Digital Library (TKDL), Policy Recommendations, India, Benefit-Sharing, Legal Frameworks

I. INTRODUCTION

The protection of Indigenous Knowledge Systems (IKS) has emerged as one of the most complex and contested domains in contemporary intellectual property law. Unlike conventional intellectual property (IP) rights, which are based on principles of individual authorship, novelty, and limited duration, indigenous knowledge is often collective, intergenerational, and dynamic in nature. It encompasses practices, innovations, and cultural expressions that are deeply rooted in the spiritual, ecological, and social fabric of indigenous communities (Posey &Dutfield, 1996). However, when subjected to modern IP frameworks such as patents, copyrights, and trademarks, indigenous knowledge does not easily fit within their rigid parameters, leading to concerns of inadequate recognition, misappropriation, and biopiracy (Dutfield, 2017).

One of the pressing issues is the misappropriation of traditional knowledge (TK) by commercial entities without proper acknowledgment or benefit-sharing. For instance, cases involving the patenting of the neem tree and turmeric in India illustrate how knowledge that has been used for centuries by local communities was claimed as a novel invention under Western patent systems (Gupta, 2004). Such cases highlight the limitations of IP law in acknowledging prior art and customary ownership, while also exposing indigenous communities to the risk of economic exploitation. International frameworks such as the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) and the Nagoya Protocol on Access and Benefit-Sharing have attempted to address these concerns, yet challenges remain in their domestic implementation and enforcement (Taubman, 2011; Bodeker, Ong, Grundy, Burford, &Shein, 2005).

Another critical challenge arises from the clash between indigenous worldviews and Western legal systems. While indigenous knowledge is regarded as a living heritage that evolves with the community and environment, intellectual property law treats knowledge as a static commodity that must be fixed in a tangible form and attributed to a particular

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author (Shankar &Swamy, 2013). This mismatch often leads to the exclusion of indigenous perspectives in the global IP regime, thereby weakening the protection of their cultural and ecological contributions. Scholars argue for the development of sui generis legal frameworks that can accommodate the unique characteristics of TK while respecting the self-determination and customary laws of indigenous peoples (Cottier&Panizzon, 2004; Brown, 2005).

The rise of digital technologies adds yet another dimension to the debate. Digital archives and databases such as the Traditional Knowledge Digital Library (TKDL) in India have been developed to prevent biopiracy by documenting indigenous practices and making them accessible to patent examiners worldwide (Anuradha, 2014). However, such initiatives also raise ethical and cultural concerns regarding consent, ownership, and control of the documented knowledge. Without proper safeguards, digital repositories risk reproducing the very inequities they seek to resolve by shifting control away from indigenous communities to state or global institutions (Ballardini, Tuominen, & Girardi, 2024).

In this context, protecting indigenous knowledge systems through intellectual property law requires a multifaceted approach. It involves strengthening existing legal frameworks, fostering international cooperation, recognizing customary practices, and ensuring equitable benefit-sharing mechanisms. Moreover, it necessitates meaningful participation of indigenous communities in policymaking and the creation of legal instruments that reflect plural legal traditions (Gonzalez, 2025). Only through such inclusive and adaptive approaches can the gaps between indigenous knowledge systems and intellectual property law be bridged in ways that ensure justice, sustainability, and respect for cultural diversity.

1.1. The Emergence of the Study

The emergence of this arises from the growing tension between the communal, intergenerational, and evolving nature of traditional knowledge and the rigid, individualistic frameworks of modern intellectual property regimes. As cases of biopiracy and misappropriation—such as those involving neem, turmeric, and basmati rice—have highlighted, existing legal systems often fail to adequately recognize indigenous ownership and ensure equitable benefit-sharing (Gupta, 2004; Dutfield, 2017). Moreover, international instruments like TRIPS and the Nagoya Protocol, while significant, have left considerable gaps in addressing the cultural, ethical, and human rights dimensions of indigenous knowledge protection (Taubman, 2011). This gap underscores the urgent need for critical research that explores how intellectual property law can evolve through **sui generis mechanisms, community participation, and plural legal frameworks** to safeguard indigenous heritage while promoting fairness and sustainability in global knowledge governance.

1.2. The Statement of the Problem

The central problem addressed in this study lies in the inadequacy of existing intellectual property law frameworks to effectively protect indigenous knowledge systems, which are inherently collective, dynamic, and culturally embedded. Conventional IPR mechanisms, such as patents, trademarks, and copyrights, are designed to safeguard individual, novel, and time-bound creations, making them ill-suited for traditional knowledge that evolves across generations and belongs to communities rather than individuals (Dutfield, 2017; WIPO, 2020). This mismatch has resulted in widespread instances of misappropriation, biopiracy, and inequitable exploitation of indigenous resources, where commercial entities gain profits without acknowledgment or fair compensation to the rightful custodians. Despite initiatives such as the Traditional Knowledge Digital Library (TKDL) in India and global treaties like the Nagoya Protocol, significant gaps persist in ensuring recognition of ownership rights, equitable benefit-sharing, and meaningful community participation. Thus, the problem lies in reconciling indigenous epistemologies with modern legal structures, while addressing judicial challenges and policy limitations that hinder the protection of traditional knowledge within national and international frameworks.

1.3. The Significance of the Study

The significance of this study lies in its potential to bridge the critical gap between conventional intellectual property law and the unique characteristics of traditional knowledge (TK), which is deeply rooted in the cultural, spiritual, and ecological heritage of indigenous communities. As globalization and commercialization intensify, instances of

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misappropriation and biopiracy have highlighted the urgent need for legal mechanisms that not only recognize the collective ownership of TK but also ensure equitable benefit-sharing and community participation in decision-making. By evaluating existing legal frameworks, analyzing empowerment strategies, and proposing policy reforms, this study contributes valuable insights to policymakers, legal scholars, and indigenous advocates seeking to strengthen the protection of TK within both national and international contexts. Furthermore, it promotes a more inclusive and culturally sensitive approach to intellectual property governance, ensuring that indigenous knowledge systems are preserved, respected, and leveraged for sustainable development while safeguarding the rights and dignity of the communities that sustain them.

1.4. The Research Questions

RQ1: To what extent do existing legal frameworks recognize and protect ownership rights of traditional knowledge (TK)?

RQ2: What strategies can be analyzed for the legal empowerment of traditional knowledge (TK) of indigenous communities?

RQ3: What policy recommendations can be proposed to enhance traditional knowledge (TK) protection within national legal frameworks?

1.5. The Objectives of the Study

O_1: To find out the extent to which existing legal frameworks recognize and protect ownership rights of TK.

O_2: To analyze the strategies for legal empowerment of TK of indigenous communities.

O_3: To propose policy recommendations aimed at enhancing TK protection within national legal frameworks.

II. THE REVIEW OF RELATED LITERATURE

The reviewed literature collectively underscores the multifaceted challenges and emerging strategies in protecting traditional knowledge (TK) and indigenous intellectual property within both national and international frameworks. Studies by Oguamanam (2025) and Perron-Welch (2025) highlight the role of information systems, digitization, and the WIPO Genetic Resources Treaty in facilitating record-keeping, patent compliance, and equitable benefit-sharing for indigenous communities. Gonzalez (2025) and Alves (2024) emphasize the tension between collective, intergenerational TK and conventional IP regimes, advocating for sui generis frameworks and digital documentation systems like the TKDL. Research by Elpina (2024) and Baxi (2024) demonstrates the legal and administrative hurdles in implementing IP protections in corporate and educational settings, while Upreti (2024) and Penteado & Chakrabarty (2024) focus on embedding sustainability, human rights, and community empowerment into IP regimes. Reports by WIPO (2025), Dutfield (2024), and Boteju (2024) further stress the need for harmonizing international obligations with local legal systems to prevent misappropriation and ensure participatory governance. Ballardini et al. (2024) and Zhang et al. (2024) extend this discussion to digital and resource-intensive contexts, showing that effective IP protection must balance innovation incentives, cultural integrity, and socio-economic equity. Overall, these studies converge on the critical need for legal reform, policy integration, and proactive community engagement to safeguard TK while promoting sustainable and equitable utilization of indigenous knowledge.

2.1. The Research Gap

The review of related literature reveals significant research gaps regarding the recognition, protection, and empowerment of traditional knowledge (TK) in India. While existing studies address theoretical challenges of conventional IP regimes and the benefits of sui generis systems, there is limited empirical evidence on the practical effectiveness of national legal frameworks in safeguarding TK ownership rights. Similarly, although digitization, participatory approaches, and information systems are highlighted as empowerment strategies, their real-world impact at the community level, including accessibility and capacity-building, remains underexplored. Furthermore, despite emphasis on policy integration and international harmonization, there is a lack of context-specific, actionable recommendations addressing India's socio-legal realities, inter-agency coordination, and equitable benefit-sharing.

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Collectively, these gaps underscore the need for empirical assessment, practical evaluation of legal mechanisms, and development of tailored policy frameworks to ensure the effective recognition, protection, and sustainable use of TK in India.

III. THE METHODOLOGY OF THE STUDY

The methodology of the study adopts a **case study approach** to provide an in-depth and contextualized understanding of the protection and legal empowerment of traditional knowledge (TK) in India. This qualitative method allows for a detailed examination of specific instances where indigenous communities' TK has interacted with national legal frameworks, including patents, sui generis systems, and the Traditional Knowledge Digital Library (TKDL). The case study approach facilitates the collection of rich, contextual data from multiple sources such as legal documents, policy reports, judicial decisions, and interviews with stakeholders including indigenous knowledge holders, legal experts, and policymakers. By focusing on real-world examples, this methodology enables the analysis of both the effectiveness of existing legal frameworks and the practical challenges faced in implementing TK protection strategies, while also highlighting best practices and potential policy interventions tailored to India's socio-legal context.

IV. THE ANALYSIS AND INTERPRETATION

O_1: To find out the extent to which existing legal frameworks recognize and protect ownership rights of TK.

India has developed a **patchwork of legal and institutional measures** that aim to prevent misappropriation of traditional knowledge and to secure benefit-sharing — but these measures stop short of recognizing TK as proprietary rights in the same way conventional IP treats inventions. The two statutory pillars are the **Patents Act, 1970** (which governs patentability and sets novelty/inventive-step tests) and the **Biological Diversity Act, 2002** (which creates the National Biodiversity Authority and a regime for access and benefit-sharing). The Patents Act remains designed for individual, novel inventions and therefore is structurally ill-suited to communal, orally transmitted TK; by contrast the Biological Diversity Act expressly seeks to regulate access to biological resources and associated traditional knowledge and to ensure fair and equitable benefit-sharing, but it does not convert TK into an exclusive property title for communities in the patent sense.

A practical instrument that has materially improved India's ability to **defend TK at patent offices worldwide** is the **Traditional Knowledge Digital Library (TKDL)**. Compiled by CSIR in standardized formats usable by patent examiners, the TKDL provides prior-art evidence in English and patent-searchable formats and has led to numerous patent applications being withdrawn, set aside, or amended. The TKDL is therefore best understood as a *defensive* mechanism: it helps prevent erroneous patents by documenting prior art, but it does not itself create a proprietary right for knowledge holders. CSIR reports and WIPO descriptions show the TKDL's concrete impact (hundreds of patent applications affected), illustrating how documentation can translate traditional uses into evidence that the global patent system can act upon.

Landmark case examples illustrate both the **vulnerabilities of TK** under conventional IP rules and the **practical gains** India has achieved by combining law, documentation and activism. The **turmeric case** (US patent on turmeric's wound-healing use) was revoked after India (CSIR) produced traditional literature showing prior art, demonstrating that documented TK can defeat a patent claim founded on novelty. Likewise, **neem-related patents** granted abroad were successfully opposed and revoked after evidence established longstanding traditional uses; European Patent Office proceedings and oppositions (and subsequent revocations) became important precedents in the anti-biopiracy movement. The **Basmati/RiceTec** dispute likewise shows how claims to traditional crop varieties can be challenged through coordinated governmental and civil-society interventions and USPTO re-examinations. These cases underscore that, in practice, TK can be protected against wrongful patents — but only through costly, evidence-heavy oppositions and international advocacy rather than by an automatic domestic property right.

Despite these successes, important **gaps and limitations** remain. First, India lacks a single, comprehensive *sui generis* proprietary regime that confers perpetual, community-held ownership rights tailored to TK's collective character. The Biological Diversity Act provides ABS procedures and empowers the National Biodiversity Authority to oppose foreign patents arising from Indian resources, but it does not vest communities with patent-style exclusive rights or

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solve the evidentiary problems posed by orally transmitted knowledge. Second, enforcement across borders remains difficult: even where TK is documented (e.g., in TKDL), patent offices in other jurisdictions can still grant patents before oppositions succeed, requiring lengthy challenges. Third, many communities still do not have systematic documentation of their TK, so they cannot easily demonstrate prior art or assert benefit-sharing claims under administrative regimes. Academic analyses and policy reviews have repeatedly identified these implementation and recognition gaps.

Taken together, the **extent of recognition and protection** in India can be characterised as **partial and defensive**:

Recognition: India recognizes the value of TK in policy and law (Biodiversity Act, national policies) and has institutional mechanisms (NBA, SBBs, TKDL). *Protection*: Protection is mainly preventive (preventing wrongful patents via TKDL, NBA interventions and oppositions) and regulatory (ABS rules), rather than proprietary (granting community-held exclusive IP titles). Where protection is successful, it typically results from **documentary proof + administrative/judicial action**, not from a legal regime that inherently recognises communal ownership as a patent/copyright analogue.

India has built effective tools for *deterrence* and *remedy* — TKDL, NBA's powers, judicial and administrative challenges — and has won high-profile fights against biopiracy (turmeric, neem, basmati). However, the country still faces a fundamental legal mismatch: mainstream IPR law (Patents Act) is not designed for communal TK, and existing measures are often reactive and resource-intensive. To move from partial protection to meaningful recognition, India (and similar states) will likely need a combination of (a) stronger, well-designed **sui generis** protections that reflect customary rights; (b) wider, community-led documentation and consent protocols; (c) enhanced international cooperation to prevent cross-border misappropriation; and (d) capacity building so communities can engage effectively with TK documentation, ABS processes, and patent oppositions. The empirical record and case law show what is possible with current tools, but they also make clear the limits of a system that defends rather than formally recognizes communal ownership

O_2: To analyze the strategies for legal empowerment of TK of indigenous communities.

India has developed a multi-pronged strategy to legally empower holders of traditional knowledge. These strategies operate at **four mutually reinforcing levels**: (A) defensive documentation to block wrongful patents, (B) statutory access-and-benefit-sharing (ABS) and local documentation (PBRs) to regulate use and return benefits, (C) positive/market-facing instruments (GIs, collective marks, sui generis proposals) to secure economic value, and (D) capacity-building, participatory digitisation and international cooperation to strengthen communities' agency. Each element has produced tangible results but also faces practical limits; below I explain each strategy, give concrete India-specific data or case examples, and note strengths and weaknesses.

Defensive documentation — the Traditional Knowledge Digital Library (TKDL)

India's TKDL is the best-known example of a defensive documentation strategy: it translates and codifies thousands of traditional medicinal formulations into patent-searchable formats for patent examiners worldwide. TKDL has demonstrably reduced biopiracy risks: CSIR and WIPO reporting shows hundreds of patent applications have been set aside, withdrawn or amended after TKDL prior-art submissions (CSIR/TKDL data and WIPO coverage). For example, the high-profile **turmeric** and **neem** episodes demonstrate the practical utility of documentation and oppositions — the US turmeric patent was revoked after CSIR produced prior-art evidence, and neem patents granted in Europe were successfully opposed and revoked on similar grounds. These actions illustrate that good documentary evidence can defeat erroneous patents more quickly and cheaply than drawn-out litigation. However, TKDL is *defensive* — it prevents others from patenting TK but does not itself confer ownership, control, or benefit-sharing entitlements on communities.

Statutory ABS regimes and local documentation — Biological Diversity Act, NBA, and People's Biodiversity Registers (PBRs)

The **Biological Diversity Act, 2002** created a three-tier institutional architecture (National Biodiversity Authority (NBA), State Boards, and local Biodiversity Management Committees (BMCs)) and mandates prior informed consent and benefit-sharing for commercial access to biological resources and associated TK. A central empowerment tool

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under this statute is the **People's Biodiversity Register (PBR)** — a locally maintained repository of flora, fauna, practices and knowledge that can serve as evidence in ABS claims and patent oppositions. Official reporting indicates very large scale PBR efforts: government releases have reported hundreds of thousands of PBRs compiled (press releases indicate over 267,000 PBRs prepared as of 2023), reflecting broad grassroots documentation activity that strengthens communities' legal standing. The NBA also has statutory powers to advise on, and sometimes challenge, foreign patents relying on Indian resources. The ABS regime institutionalizes benefit-sharing and gives communities a statutory pathway to be consulted and compensated — although implementation gaps (awareness, enforcement, and resource constraints at the BMC level) remain significant.

Positive protection — Geographical Indications (GIs), collective marks, and sui generis models

India has used **Geographical Indications** to capture market value tied to place-based TK and traditional production know-how — the Darjeeling tea GI is a clear example: registration and active policing of the GI have helped protect the product's premium identity and revenue for local producers. GIs are a form of **positive** legal protection (they enable exclusivity over a name/brand linked to traditional practices), complementing defensive tools like TKDL. Beyond GIs, scholars and advocates push for **sui generis** legal regimes tailored to TK's communal nature (permanent or long-term communal rights, customary law recognition, and collective benefit-sharing). While India has robust policy debates and pilot initiatives (TKDL, ABS rules, PBRs), it still lacks a fully developed national sui generis property title that grants communities enforceable, perpetual ownership over TK — a gap many commentators identify as crucial to move beyond defensive protection.

Litigation, oppositions and international diplomacy

A functional strategy has been to combine domestic documentation with targeted litigation/opposition and diplomatic engagement. India's coordinated responses to **RiceTec's Basmati claims** (resulting in withdrawal/amendments of many claims) and the coordinated oppositions to neem and turmeric patents show how documentation + legal challenge + international advocacy can produce concrete results. These cases illustrate a multi-actor strategy: government agencies (CSIR, Ministry of Commerce), civil society, and academic experts pooling evidence to mount effective opposition before foreign patent offices. The downside is cost and time: oppositions and re-examinations are resource-intensive, and not every community can sustain such campaigns without institutional support.

Digital, participatory and technological empowerment (PBRs + ICTs + emerging tech)

Digitisation and ICT tools — including community-managed databases, TKDL-style resources and proposed new technologies (blockchain for provenance, community controlled digital archives) — are increasingly promoted to give communities agency over how knowledge is documented and shared. Recent scholarship and policy briefs stress that cultural heritage institutions (libraries, archives, museums) and patent offices must partner with indigenous communities in ICT4D initiatives so that digitisation supports IPLC goals rather than expropriation. The WIPO GRATK (2024) treaty (requiring disclosure of origin in patent applications) also dovetails with digital strategies because searchable registries and provenance systems facilitate compliance and enforcement at the patent office level. However, digital initiatives raise ethical questions (consent, control, data sovereignty) — hence participatory design and community governance of digital systems are essential.

International instruments and disclosure regimes — WIPO Treaty and multilateral leverage

The adoption of the **WIPO Treaty on Intellectual Property, Genetic Resources and Associated Traditional Knowledge (May 24, 2024)** represents a significant international empowerment mechanism: it establishes mandatory disclosure obligations in patent filings about the origin of genetic resources and associated TK, which should assist countries like India in tracing misappropriation and enforcing ABS obligations. This multilateral tool amplifies national efforts (TKDL, NBA) by improving transparency in global patenting systems, but its ultimate effectiveness depends on national implementation (translating disclosure into refusals, sanctions, or benefit-sharing outcomes) and international cooperation. The treaty thus strengthens the legal architecture available to communities but is not a panacea; national capacity and political will remain decisive.

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Strengths, limits and practical lessons from the Indian experience

India's combined strategy has clear strengths: (a) **TKDL** shows that well-structured documentation can prevent biopiracy cost-effectively (CSIR reports dozens/hundreds of affected patent filings), (b) **statutory ABS** creates legal channels for benefit-sharing and community consultation (Biological Diversity Act + NBA), and (c) **market instruments** (GIs) can deliver tangible economic value to traditional producers (Darjeeling tea). Case law demonstrates success when documentation + institutional action are mobilized (turmeric, neem, basmati). However, persistent limitations include: uneven PBR implementation at the grassroots, the absence of a comprehensive sui generis title conferring community ownership in the patent/copyright sense, the resource-intensity of opposition/litigation, cross-border enforcement difficulties, and the ethical complexities of digitisation. For many communities the barriers — technical, financial and institutional — remain high.

Policy implications and next steps for empowerment

To strengthen legal empowerment, the Indian model suggests a combined agenda: (i) expand and resource PBRs and BMCs so communities generate usable prior-art and ABS claims (government reporting shows large PBR rolls but quality/verification varies), (ii) scale community-governed digitisation projects with strong consent/data-sovereignty rules, (iii) operationalize the WIPO treaty domestically (make disclosure rules meaningful by linking non-disclosure to refusal/penalties), (iv) pilot sui generis rights that recognize collective and perpetual custodianship, and (v) fund legal-technical assistance so communities can mount oppositions or negotiate ABS agreements without prohibitive costs. These steps follow directly from India's successes (TKDL, GI registrations, NBA interventions) and address observed weaknesses (implementation, resourcing, cross-border enforcement).

India's strategy for legally empowering TK holders mixes **defensive documentation (TKDL), statutory ABS and PBRs, positive market protections (GIs), litigation/opposition tactics, participatory digitisation, and now strengthened international disclosure obligations (WIPO 2024 Treaty)**. The approach has produced high-impact wins (turmeric, neem, basmati adjustments; hundreds of patent applications addressed via TKDL) and offers a practical template for empowerment — yet it remains **partial**: defensive measures do not create community property titles, enforcement is costly, and grassroots capacity and ethical oversight of digitisation must be substantially strengthened for empowerment to be meaningful and sustainable.

O_3: To propose policy recommendations aimed at enhancing TK protection within national legal frameworks.

Adopt a well-designed sui generis regime that recognises collective and customary rights.

Conventional IP instruments (patents, copyright) are ill-suited to communal, intergenerational TK. A national **sui generis** law should explicitly recognise collective custodianship, permit long-term or perpetual rights where culturally appropriate, allow communities to register claims on customary terms, and provide tailored enforcement remedies (including injunctive relief and equitable compensation). The sui generis design should be participatory (co-drafted with IPLCs) and flexible enough to accommodate customary norms and different cultural practices rather than imposing Western ownership models. This is a foundational reform: without a tailored property/rights architecture, communities will continue to rely principally on defensive measures.

Strengthen and resource Access & Benefit-Sharing (ABS) mechanisms and make them community-centric.

ABS under statutes like India's Biological Diversity Act is a crucial statutory route to secure benefits for communities, but implementation gaps limit impact. Governments should (a) simplify ABS procedural pathways for local communities, (b) mandate direct, traceable benefit flows (monetary and non-monetary) to claimant communities, (c) require clear prior informed consent (PIC) protocols in local languages, and (d) establish transparent monitoring and grievance mechanisms. Resourcing State Biodiversity Boards and Biodiversity Management Committees (BMCs) and building their technical capacity will make ABS operational at the grassroots. Strengthened ABS turns legal recognition into tangible outcomes for knowledge holders.

Operationalise disclosure and origin-traceability obligations domestically in line with the WIPO 2024 Treaty.

The WIPO Treaty (May 2024) establishing mandatory patent disclosure about origin of genetic resources and associated TK creates an international leverage point. States should incorporate robust **patent disclosure requirements**

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into national patent law—requiring applicants to disclose source, PIC evidence, and benefit-sharing arrangements—and link non-disclosure to concrete sanctions (rejections, invalidations, fines). Domestic implementation will convert treaty disclosure into a usable enforcement tool that helps patent offices identify potential misappropriation early.

Scale defensive documentation while ensuring community control, consent and data sovereignty. Defensive databases such as India's TKDL have demonstrably reduced wrongful patenting by making prior art accessible to patent examiners; WIPO and EPO reporting credit TKDL with measurably fewer patent applications on Indian medicinal systems. Governments should continue to invest in defensive documentation (TKDL-type resources) **but redesign governance so IPLCs retain control over what is documented, how it is accessed, and how consent is recorded**. Data-sovereignty protocols, tiered access controls, and community benefit clauses must be embedded so digitisation empowers rather than displaces communities.

Massify and standardise People's Biodiversity Registers (PBRs) and build legal-technical support for their evidentiary use.

PBRs are critical local records that can establish prior art and evidence of customary use. The state should (a) fund systematic, quality-controlled PBR compilation across regions, (b) adopt minimum documentation standards so PBR entries are admissible in administrative oppositions and court proceedings, and (c) create legal-technical support cells (at NBA/SBB level) to help communities use PBRs effectively in ABS negotiations and patent oppositions. High-quality, standardised PBRs make grassroots knowledge legible to legal systems without erasing customary ownership.

Provide legal aid, rapid opposition funds and institutional support for patent oppositions and enforcement.

Successful defenses against biopiracy (e.g., turmeric, neem, basmati disputes) have required coordinated evidence, expert submissions and often expensive oppositions. Governments should establish legal aid funds and rapid-response units within relevant ministries or the NBA to support communities and civil society in bringing oppositions, re-examinations or litigation, and to subsidise expert prior-art searches. Reducing the cost-barrier democratizes access to enforcement and turns defensive documentation into actionable protection.

Recognise and integrate customary laws and community protocols into formal decision-making. Policy must enable formal recognition of community protocols (customary rules governing access, use and transmission of TK) by courts and administrative bodies. This can be done by (a) permitting submission of community protocols and customary law evidence in ABS and patent proceedings, (b) training registrars and judges to treat such materials as credible sources, and (c) creating statutory presumptions in favour of community custodianship where credible customary evidence exists. Such steps align statutory enforcement with social realities and promote culturally appropriate remedies.

Expand market-facing protections (GIs, collective trademarks) linked to TK and local livelihoods.

Geographical Indications (e.g., Darjeeling tea) and collective marks translate traditional production knowledge into market value and community income. Policy should incentivize GI registration for place-based TK products, support policing of GIs abroad, and provide training on quality standards and collective governance so communities capture downstream economic benefits rather than intermediaries. Linking market rights with ABS provisions further ensures commercialization benefits flow back to custodians.

Address digital sequence information (DSI) and evolving technological challenges in benefit-sharing frameworks.

Global negotiations (COPs and CBD workstreams) show DSI is a contested gap: digitised genetic data can be used without physically accessing resources. National policy should (a) monitor developments in DSI governance (CBD/COP outcomes), (b) adopt interim measures linking digital uses to ABS regimes where practicable, and (c) invest in provenance technologies (secure registries, blockchain pilots) that can help trace benefit-sharing obligations in digital environments. This prevents a new front of misappropriation in the bio-digital era.

Invest in judicial and administrative capacity-building and specialist IP benches/units. Judges, patent examiners and administrative officers need specialized training on TK, customary norms, ABS procedures and the evidentiary use of PBRs/TKDL. Creating specialist benches or tribunals (or dedicated IP-TK units within courts or the NBA) speeds resolution and builds jurisprudence sensitive to communal rights. Capacity-building reduces inconsistent rulings and creates predictable legal standards that communities and industry can rely upon.

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Foster international cooperation and mutual assistance for cross-border enforcement. Because misappropriation commonly occurs across jurisdictions, bilateral and multilateral cooperation (information-sharing, mutual legal assistance, harmonised disclosure rules) is essential. States should negotiate expedited channels with major patent offices to act on TK-related oppositions, share TKDL/ prior-art data, and coordinate ABS enforcement. The WIPO Treaty provides a diplomatic lever; domestic implementation plus cross-office protocols will turn treaty norms into practical deterrents.

Ensure participatory governance and benefit-sharing in digitisation and research partnerships. Any digitisation, research or commercialization initiative involving TK must be preceded by transparent PIC, community governance over data, and negotiated ABS terms. Funding for community capacity (data literacy, IP literacy, negotiating skills) and clear ethical standards for researchers and institutions will help avoid extractive partnerships and ensure IPLCs retain agency. Policy instruments (research licensing, ethical review boards, mandatory community consent clauses) should safeguard community interests in all public-private research collaborations.

These recommendations are mutually reinforcing: defensive documentation (TKDL) is most effective when paired with robust PBRs and funded opposition capacity; disclosure obligations are valuable only if patent offices and courts treat non-disclosure as meaningful; and sui generis recognition will deliver the greatest long-term security only if embedded within functioning ABS, market protections and international cooperation. Policymakers should prioritise **quick wins** (scale PBRs, fund opposition units, operationalise disclosure requirements) while engaging IPLCs in designing longer-term reforms (sui generis law and DSI governance). The combination of immediate operational measures plus structural, participatory legal reform offers the pragmatic pathway from defensive deterrence to substantive legal empowerment of traditional knowledge holders.

V. CONCLUSION

In conclusion, the study highlights that while India and many other jurisdictions have made significant strides in safeguarding traditional knowledge (TK) through mechanisms such as the Traditional Knowledge Digital Library (TKDL), People's Biodiversity Registers (PBRs), and Access and Benefit-Sharing (ABS) frameworks, the protection of TK remains fragmented and vulnerable to misappropriation, weak enforcement, and limited community participation. The findings underscore the need for a comprehensive approach that goes beyond defensive mechanisms to embrace proactive legal empowerment, recognition of customary rights, and participatory governance involving indigenous and local communities. Strengthening policy through a sui generis system, operationalizing international obligations such as disclosure of origin, scaling grassroots registers, and supporting communities with legal aid and market-oriented protections like geographical indications can provide a sustainable and equitable framework for TK governance. Ultimately, ensuring fairness and justice in the protection of indigenous knowledge requires balancing national legal reforms with international cooperation, while embedding cultural respect and community agency at the heart of intellectual property law and policy.

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