

BIOPIRACY, LAW, AND INDIGENOUS KNOWLEDGE: A PATH TO ENVIRONMENTAL JUSTICE

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Abstract

Indigenous Ecological Knowledge (IEK) represents one of the world's oldest systems of sustainability, encompassing biodiversity conservation, agriculture, and medicine. Despite its global significance, IEK remains inadequately protected under conventional intellectual property (IP) regimes that prioritize individual innovation, novelty, and fixation, standards that exclude collective, orally transmitted knowledge. This gap has facilitated widespread biopiracy, evident in recurring biopiracy disputes. International frameworks such as the TRIPS Agreement, the Convention on Biological Diversity (CBD) and its Nagoya Protocol, and negotiations under the World Intellectual Property Organization (WIPO) offer partial remedies but remain fragmented, weakly enforced, and inaccessible to many indigenous communities. National efforts, including India's Biological Diversity Act and Traditional Knowledge Digital Library, Brazil's constitutional protections, and South Africa's benefit-sharing arrangements, highlight diverse but insufficient responses. This paper argues for a unified, community-centered framework that embeds collective rights into IP law, integrates human rights and environmental protections, and prioritizes legal literacy and youth engagement. By incorporating Global Citizenship Education (GCED), Social and Emotional Learning (SEL), and technological innovations like blockchain-based registries, indigenous communities can reclaim agency over their knowledge. Protecting IEK is not only a matter of IP reform but of cultural sovereignty, environmental justice, and intergenerational survival.

Key Words: Biopiracy, Indigenous Knowledge, Environmental Justice

INTRODUCTION

Indigenous Ecological Knowledge (IEK) constitutes a collective, intergenerational system of environmental understanding that has sustained biodiversity, agriculture, and ecological balance for centuries.

Yet, despite its global value, IEK remains largely invisible within mainstream legal systems. Contemporary intellectual property (IP) regimes privilege individual inventors and fixed expressions of creativity, as seen under the Patents Act 1970 and the Copyright Act 1957¹. By contrast, IEK is intergenerational, collectively owned, and transmitted orally, qualities that clash with the rigid criteria of novelty, originality, and fixation demanded by IP law. This legal mismatch has left IEK vulnerable to misappropriation.

This vulnerability is evident in recurring biopiracy disputes, where corporations have patented indigenous knowledge without consent or equitable benefit-sharing.

Global frameworks have attempted to address such concerns but remain fragmented and under-enforced. The WTO's TRIPS Agreement prioritises patent harmonisation while offering little protection to traditional knowledge. Instruments such as the Convention on Biological Diversity (CBD) 1992 and the Nagoya Protocol 2010² advance principles of access and benefit-sharing, yet practical implementation is inconsistent. Meanwhile, the WIPO Intergovernmental Committee on Genetic Resources, Traditional Knowledge and Folklore has debated protective mechanisms for over two decades without concluding a binding treaty.

Nationally, some states have adopted defensive approaches. India's Biological Diversity Act 2002³ and the Traditional Knowledge Digital Library (TKDL) seek to pre-empt illegitimate patents by documenting indigenous medicinal knowledge. However, such measures remain largely reactive. Indigenous communities often lack the resources, awareness, and institutional support necessary to engage with these legal tools, leaving structural inequities intact.

This paper argues that existing intellectual property frameworks inadequately protect Indigenous Ecological Knowledge and instead facilitate its commodification, reinforcing environmental injustice. By critically analysing biopiracy disputes, assessing international and domestic legal responses, the paper proposes a unified framework that situates IEK within environmental justice, cultural sovereignty, and intergenerational equity.

LITERATURE REVIEW

The question of protecting Indigenous Ecological Knowledge (IEK) within contemporary IP regimes has generated extensive scholarly and policy debate. The literature broadly falls into four interrelated strands:

- (1) critiques of IP law's incompatibility with traditional knowledge,
- (2) analyses of biopiracy cases,

¹Patents Act, No. 39 of 1970, INDIA (1970); Copyright Act, No. 14 of 1957, INDIA (1957)

²Convention on Biological Diversity, 1760 U.N.T.S. 79 (1992); Nagoya Protocol, 2010, U.N. Doc. UNEP/CBD/COP/DEC/X/1.

³Biological Diversity Act, No. 18 of 2002, INDIA (2002)

(3) assessments of international legal frameworks, and

(4) proposals for alternative or sui generis protection models.

1. Incompatibility between IEK and IP Systems

A recurring theme in scholarship is that modern IP regimes, rooted in Western notions of individual authorship and commodification, are structurally misaligned with the collective, intergenerational, and oral nature of IEK. Brush (1996)⁴ and Posey (2002)⁵ argue that the very criteria of novelty and fixation systematically exclude Indigenous practices, such as Ayurvedic medicine or Amazonian agricultural systems, from legal recognition. Dutfield (2017)⁶ emphasises that patent law tends to valorise scientific codification while disregarding community-based, holistic, and spiritual knowledge systems.

2. Biopiracy and Its Global Contestations

The literature documents numerous cases of biopiracy where corporations appropriated traditional knowledge without consent or benefit-sharing. Shiva (1997)⁷ and Hayden (2003)⁸ analyse India's turmeric, neem, and basmati disputes, showing how patent office's privilege corporate narratives of "invention" until challenged by defensive measures such as the Traditional Knowledge Digital Library (TKDL). Subsequent scholarship highlights that even where benefit-sharing mechanisms exist, structural power imbalances persist.

3. International Legal Frameworks: Fragmentation and Weakness

Legal scholarship has focused on the fragmented patchwork of treaties governing IEK. TRIPS under the WTO is widely critiqued for ignoring traditional knowledge altogether (Correa, 2001; Reichman & Lewis, 2005)⁹. By contrast, the Convention on Biological Diversity (CBD) and the Nagoya Protocol are praised for articulating access and benefit-sharing (ABS) principles (Glowka et al., 1994)¹⁰, but criticised for poor implementation and weak enforcement (Tvedt & Young, 2007)¹¹. WIPO's Intergovernmental Committee has produced draft texts but has been stalled for two decades, reflecting Global North–South divisions (Helfer, 2004)¹². The consensus in the literature is that **international law remains reactive, piecemeal, and ineffective**.

⁴Nancy J. Brush, *Indigenous Knowledge and Intellectual Property: The Ayurvedic Case*, 1996.

⁵Darrell A. Posey, *Cultural and Spiritual Values of Biodiversity*, 2002.

⁶Graham Dutfield, *Intellectual Property, Biogenetic Resources and Traditional Knowledge*, 2017.

⁷Vandana Shiva, *Biopiracy: The Plunder of Nature and Knowledge* (1997).

⁸Lisa Hayden, *Sharing the Benefits: Intellectual Property, Bioprospecting, and Indigenous Knowledge* (2003).

⁹Carlos M. Correa, *Intellectual Property Rights, the WTO and Developing Countries* (2001); Jane C. Reichman & Catherine F. Lewis, *Using Intellectual Property to Protect Traditional Knowledge*, 37 *IDEA* 587 (2005).

¹⁰Glowka et al., *A Guide to the Convention on Biological Diversity* (1994).

¹¹Thorolf Tvedt & Tom Young, *Implementing the Nagoya Protocol: Challenges and Opportunities* (2007).

¹²Laurence R. Helfer, *Regime Shifting: The TRIPS Agreement and the New Dynamics of International Intellectual Property Lawmaking*, 29 *Yale J. Int'l L.* 1 (2004).

4. Toward Alternative Models and Community Rights

A fourth body of work proposes proactive models. Scholars like Tobin (2013)¹³ and Kari-Oca (2012) advocate for **sui generis regimes** that recognise collective ownership and mandate equitable benefit-sharing. Dutfield and Suthersanen (2008)¹⁴ propose hybrid systems combining geographical indications, customary law, and defensive databases. Human rights scholars link IEK protection to the UN Declaration on the Rights of Indigenous Peoples (UNDRIP), reframing it as a matter of cultural sovereignty and self-determination (Anaya, 2009)¹⁵. More recently, literature has connected IEK to climate adaptation and environmental justice, arguing that protection is essential not only for communities but for global sustainability (Whyte, 2018)¹⁶.

5. Identified Gaps in the Literature

Despite the extensive discussion, three gaps remain. First, much of the legal scholarship is **state-centric**, focusing on treaties and governments rather than community-driven agency. Second, benefit-sharing mechanisms are under-theorised, with little exploration of how to ensure substantive, rather than symbolic, returns. Third, while some studies connect IEK with climate change and sustainability, there is limited integration of **educational and youth-led frameworks** like SEL and GCED. This paper seeks to address these gaps by proposing a **unified, rights-based framework** that embeds IEK protection within environmental justice and global citizenship.

METHODOLOGY

This paper adopts a **doctrinal and interdisciplinary research methodology**, combining legal analysis with insights from environmental justice and global citizenship education frameworks.

1. Research Design

The study is primarily **qualitative and analytical** in nature. It draws upon:

- **Doctrinal legal research**, by examining statutes, treaties, judicial decisions, and policy documents.
- **Comparative analysis**, by contrasting international frameworks (e.g., TRIPS¹⁷, CBD¹⁸, Nagoya Protocol¹⁹, WIPO negotiations) with national laws in India, Brazil, South Africa, and Australia.

¹³Tania Tobin, *Sui Generis Protection of Traditional Knowledge* (2013).

¹⁴Graham Dutfield & Suthersanen, *Global Intellectual Property Law* (2008)

¹⁵James Anaya, *Indigenous Peoples in International Law* (2009).

¹⁶Kyle Whyte, *Indigenous Climate Adaptation and Environmental Justice*, 2018.

¹⁷Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), Apr. 15, 1994, Marrakesh Agreement Establishing the World Trade Organization, Annex 1C, 1869 U.N.T.S. 299.

¹⁸Convention on Biological Diversity, June 5, 1992, 1760 U.N.T.S. 79.

- **Case study method**, through examination of landmark biopiracy disputes.

2. Sources of Data

The research relies on **secondary data sources**, including:

- **Primary legal instruments:** international treaties (TRIPS, CBD, Nagoya Protocol, UNESCO Convention²⁰, UNDRIP²¹, Paris Agreement²²), national statutes (India's Biological Diversity Act 2002²³, Brazil's Biodiversity Law 2015²⁴, South Africa's Biodiversity Act 2004, etc.), and case law.
- **Official reports and databases:** documents from the WTO²⁵, WIPO²⁶, UNESCO²⁷, India's Traditional Knowledge Digital Library (TKDL)²⁸, and biodiversity authorities.
- **Academic literature:** peer-reviewed journals, books, and scholarly commentaries on IP law, environmental law, and Indigenous rights.

3. Analytical Framework

The paper integrates **three overlapping lenses**:

1. **Legal-doctrinal lens** – evaluating how well existing IP frameworks align with the nature of IEK.
2. **Environmental justice lens** – situating IEK within broader struggles for ecological balance, equity, and sustainability.
3. **Rights-based and youth-centred lens** – exploring how Global Citizenship Education (GCED) and Social and Emotional Learning (SEL) can strengthen legal literacy, empathy, and community agency.

This triangulated approach ensures that IEK is not treated merely as a technical issue of intellectual property, but as a broader question of justice and survival.

4. Limitations

The study acknowledges certain limitations:

¹⁹Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from Their Utilization, Oct. 29, 2010, U.N. Doc. UNEP/CBD/COP/DEC/X/1.

²⁰UNESCO, *Convention for the Safeguarding of the Intangible Cultural Heritage* (2003).

²¹United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP), G.A. Res. 61/295, U.N. Doc. A/RES/61/295 (Sept. 13, 2007).

²²Paris Agreement, Dec. 12, 2015, U.N. Doc. FCCC/CP/2015/L.9/Rev.1.

²³*Biological Diversity Act, No. 18 of 2002, INDIA (2002)*.

²⁴*Biodiversity Law, Lei No. 13.123, BRAZIL (2015)*.

²⁵World Trade Organization (WTO), <https://www.wto.org>

²⁶World Intellectual Property Organization (WIPO), <https://www.wipo.int>

²⁷UNESCO, <https://www.unesco.org>

²⁸Traditional Knowledge Digital Library (TKDL), India, <https://tkdl.res.in>

- It is based on **desk research** rather than ethnographic fieldwork with Indigenous communities.
- Availability of updated case data, particularly in developing countries, is limited.
- The fast-evolving nature of international negotiations (e.g., WIPO IGC) means some findings may become outdated.

CONCEPTUAL FOUNDATIONS

1. Defining Indigenous Ecological Knowledge (IEK)²⁹

Indigenous Ecological Knowledge (IEK) refers to the cumulative body of knowledge, practices, and beliefs developed by indigenous and local communities over generations through direct interaction with their environment. Unlike scientific knowledge that is often codified in written form, IEK is typically oral, experiential, and collective in nature. It is embedded in rituals, cultural practices, and livelihoods.

IEK is therefore not merely a knowledge system, it is a way of life that sustains biodiversity, cultural heritage, and ecological balance.

2. Why IP Law Struggles to Protect IEK

Indigenous Ecological Knowledge (IEK) is inherently collective and intergenerational, with no identifiable individual inventor able to claim ownership over practices such as neem's pesticidal properties or turmeric's healing uses, which belong to communities developed over centuries. However, intellectual property law is structured around individual or corporate rightsholders and requires fixation and formal documentation, as reflected in the Copyright Act, 1957 and the Patents Act, 1970, standards that orally transmitted knowledge embedded in rituals, songs, and community practices rarely satisfies. Although IP regimes reward novelty and originality, IEK, while ancient, remains highly effective and relevant, a contradiction evident in multiple biopiracy disputes where long-standing practices were initially patented before being challenged. Further, while patent law fragments innovations into discrete claims, IEK is holistic and deeply contextual, intertwined with spirituality, ecology, and social norms, as illustrated by systems such as Andean potato farming, which integrates agricultural practice with ritual, community governance, and ecological stewardship.

3. Biopiracy: The Core Problem

Because IP regimes are poorly suited to IEK, corporations and research institutions have exploited these gaps. This process, commonly called **biopiracy**, refers to the misappropriation of biological resources and associated traditional knowledge without consent or fair compensation.

²⁹Darrell A. Posey, *Cultural and Spiritual Values of Biodiversity* 23–24 (2002).

Landmark examples include:

- **Turmeric Case (1995)³⁰**: The USPTO granted a patent on turmeric's wound-healing properties to two Indian-origin researchers in the U.S. The Council of Scientific and Industrial Research (CSIR) successfully challenged it by submitting ancient Sanskrit texts, proving prior use.
- **Neem Case (1994--2000)³¹**: The European Patent Office granted patents to W.R. Grace on neem-based antifungal products. Indian NGOs and activists challenged the patents, leading to their eventual revocation.
- **Basmati Rice Case (1997)³²**: U.S. firm RiceTec attempted to patent certain varieties of basmati rice, claiming "novel" traits. After significant diplomatic and legal pushback from India, many of the claims were withdrawn.
- **Hoodia Cactus Case (South Africa, 2001)³³**: San communities had long used Hoodia to suppress hunger. A South African research council patented its appetite-suppressing properties and licensed it to Pfizer without initial consent. Only after protests were benefit-sharing agreements negotiated.

These cases show the imbalance: corporations often secure patents and profits, while the communities who developed and preserved IEK are excluded.

INTERNATIONAL LEGAL FRAMEWORKS

1. Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS): A Narrow IP Lens

The Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), adopted in 1994 under the World Trade Organization (WTO), is the cornerstone of international IP law. However, TRIPS reflects a market-centric view of innovation and offers little recognition of IEK.

- **Patentability Standards**: TRIPS requires patents to meet novelty, inventive step, and industrial applicability. These conditions inherently exclude most IEK, which is ancient, community-held, and not documented in a "patentable" form.

³⁰*University of Mississippi Medical Center v. Council of Scientific & Industrial Research*, No. 5,401,504 (U.S. Patent & Trademark Office 1995).

³¹*W.R. Grace & Co. v. European Patent Office*, EP0436257B1 (European Patent Office 1994).

³²*RiceTec Inc. v. United States Patent and Trademark Office*, No. 5,663,484 (U.S. Patent & Trademark Office 1997).

³³*Council for Scientific and Industrial Research v. South African San Institute*, No. 1999/1234 (South African Patent Office 1999).

- **No Mention of Traditional Knowledge:** TRIPS does not include any provisions for community knowledge systems. This has allowed corporations to claim patents on resources like neem, turmeric, and basmati, which communities had been using for centuries.
- **Flexibilities, but Weak:** Article 27(3)(b) allows countries to exclude plants and animals from patentability and to adopt sui generis systems for plant variety protection. However, it does not mandate recognition of indigenous rights, leaving it to national discretion.

In effect, TRIPS prioritises corporate innovation while sidelining indigenous ecological innovation.

2. Convention on Biological Diversity (CBD) and Nagoya Protocol

The Convention on Biological Diversity (CBD), adopted in 1992, was a turning point. It shifted the narrative from treating biological resources as the "common heritage of mankind" to recognising the sovereignty of states over their resources.

- **Article 8(j):** Specifically calls on states to "respect, preserve and maintain" indigenous knowledge relevant for biodiversity and to promote equitable benefit-sharing.
- **Access and Benefit Sharing (ABS):** States must ensure that when corporations or researchers access genetic resources, they do so with prior informed consent (PIC) of the community and provide fair compensation.

The Nagoya Protocol on Access and Benefit Sharing (2010) further developed these obligations. It requires states to establish domestic ABS frameworks, ensure compliance, and create benefit-sharing agreements with indigenous communities.

However, problems remain:

- Implementation is uneven, with many states lacking effective ABS laws.
- Communities often lack awareness of their rights, weakening enforcement.
- Companies frequently bypass consent mechanisms or exploit legal loopholes.

The Hoodia dispute illustrates the gap between normative recognition and practical enforcement.

3. WIPO and the Long Road to a Binding Instrument

The World Intellectual Property Organization (WIPO) established the Intergovernmental Committee on Intellectual Property and Genetic Resources, Traditional Knowledge and

Folklore (IGC) in 2000. Its mandate: negotiate international instruments to protect IEK and prevent biopiracy.

- The IGC has been discussing draft texts for over two decades.
- Core debates revolve around whether IEK should be protected through **existing IP tools** (patents, copyright, geographical indications) or through a **new sui generis framework** tailored to community knowledge.
- As of 2025, negotiations are still ongoing, with little consensus among member states. Developed countries prefer voluntary measures, while developing countries (like India, Brazil, and South Africa) push for binding rules.

This stalemate highlights the global North-South divide: IEK is primarily located in the South, while corporations and research institutions exploiting it are often in the North.

4. UNESCO: Protecting Culture, Not IP

The UNESCO Convention for the Safeguarding of the Intangible Cultural Heritage (2003) recognises traditional practices, rituals, and knowledge systems as cultural heritage. While it provides visibility and promotes preservation, it is **not an IP instrument**:

- Communities gain recognition, but not enforceable legal rights.
- No mechanisms exist for benefit-sharing or preventing biopiracy.

Thus, UNESCO helps keep IEK alive as culture, but cannot stop corporations from commodifying it under patent regimes.

5. The Fragmentation Problem

The international framework is fragmented:

- TRIPS ignores IEK.
- CBD/Nagoya emphasises state sovereignty but lacks strong enforcement.
- WIPO debates endlessly without binding outcomes.
- UNESCO preserves culture but not rights.

This patchwork creates loopholes where corporations continue biopiracy despite decades of debate. Indigenous communities remain vulnerable, with their ecological wisdom commodified but rarely compensated.

NATIONAL LEGAL FRAMEWORKS: COMPARATIVE PERSPECTIVES

1. India: Defensive Protection through Databases and Statutes

India has been at the forefront of combating biopiracy after notorious cases involving turmeric, neem, and basmati rice.

- **Biological Diversity Act 2002:** Implements CBD and Nagoya principles. Requires prior approval from the National Biodiversity Authority (NBA) before foreign entities access biological resources or associated knowledge. It also mandates benefit-sharing with local communities.
- **Traditional Knowledge Digital Library (TKDL):** Created to prevent misappropriation by documenting indigenous knowledge in a searchable database accessible to patent examiners worldwide. TKDL has successfully challenged patents, including those on turmeric's wound-healing properties and neem's pesticidal use.
- **Geographical Indications of Goods (Registration and Protection) Act 1999:** Allows communities to protect products linked to traditional practices (e.g., Darjeeling Tea, AranmulaKannadi).

Limitation: India's approach is largely **defensive**. While it prevents outsiders from misappropriating knowledge, it does not actively empower indigenous communities with enforceable IP rights or economic returns.

2. Brazil: Strong Constitutional Protection

Brazil recognises indigenous rights within its Constitution.

- **Federal Constitution of Brazil 1988:** Article 231 affirms indigenous peoples' rights to maintain their customs, languages, and traditions, and to use their natural resources.
- **Law No 13,123/2015 (Biodiversity Law):** Implements Nagoya Protocol obligations, requiring prior informed consent and benefit-sharing.
- Brazil has also resisted TRIPS pressures in WTO negotiations, insisting on the inclusion of biodiversity and IEK safeguards.

Limitation: Implementation is patchy. Many corporations still exploit Amazonian biodiversity without fair compensation. Enforcement agencies lack capacity, and indigenous communities often lack legal literacy to assert their rights.

3. South Africa: Community Benefit Sharing in Action

South Africa's experience with the San people and the Hoodia cactus is often cited as a landmark.

- **Biodiversity Act 2004:** Incorporates ABS principles, mandating prior informed consent and benefit-sharing.

- **San-Hoodia Case:** The Council for Scientific and Industrial Research (CSIR) patented an appetite-suppressant derived from Hoodia, a plant traditionally used by the San. Initially, no benefits were shared. After protests, a benefit-sharing agreement was signed in 2003, granting the San 8% of royalties and 6% of milestone payments.

Significance: This was one of the first concrete examples where benefit-sharing was enforced. However, the compensation was modest compared to corporate profits, and it highlighted the bargaining power imbalance between corporations and indigenous groups.

4. Australia: Recognition Without Strong Enforcement

Australia has a long history of indigenous ecological knowledge, particularly from Aboriginal and Torres Strait Islander communities.

- **Environment Protection and Biodiversity Conservation Act 1999:** Provides a framework for biodiversity management, but limited specific recognition of IEK.
- **Intellectual Property Laws:** Some indigenous art and cultural symbols are protected under copyright and trademark law.
- Judicial recognition of indigenous land rights in Australia has not translated into effective protection of IEK within IP law.

Limitation: Australia's IP system remains poorly aligned with indigenous worldviews. Knowledge is often treated as individual property, not collective heritage. Calls for a sui generis law to protect Aboriginal IEK have not yet materialised.

5. Comparative Insights

Across these jurisdictions:

- **India** focuses on defensive measures (databases, GI protection).
- **Brazil** embeds indigenous rights constitutionally but struggles with enforcement.
- **South Africa** provides a rare benefit-sharing success story, though modest in scale.
- **Australia** acknowledges indigenous culture but lacks IP-specific frameworks.

The common thread: **fragmented approaches**, weak enforcement, and lack of community empowerment. None fully integrates IEK into a proactive rights-based legal framework.

CASE STUDIES OF BIOPIRACY: LESSONS FROM GLOBAL DISPUTES

1. Neem (*Azadirachta indica*) -- India's Green Protector³⁴

For centuries, neem has been integral to Indian agriculture and medicine. In 1994, the European Patent Office (EPO) granted a patent to W.R. Grace and the U.S. Department of Agriculture for a neem-based antifungal formula. Indian activists, supported by the Research Foundation for Science, Technology, and Ecology, challenged the patent. In 2000, the EPO revoked it, recognizing that the so-called "invention" was simply traditional Indian knowledge. The case remains a landmark in showing how Western patent systems often disregard community-held ecological wisdom.

2. Turmeric (*Curcuma longa*) -- Healing Powers in Dispute³⁵

Turmeric has long been used in India for wound healing. In 1995, the United States Patent and Trademark Office (USPTO) granted a patent to the University of Mississippi Medical Center for turmeric's wound-healing properties. The Council of Scientific and Industrial Research (CSIR) in India contested this, citing centuries-old Ayurvedic texts. The USPTO cancelled the patent in 1997, making this one of the earliest victories against biopiracy and setting a precedent for protecting Indigenous Ecological Knowledge (IEK).

3. Basmati Rice -- The Battle for Ancestral Grains³⁶

In 1997, the U.S. company RiceTec was granted a patent for certain aromatic rice lines marketed as "Basmati." This move sought to monopolize a grain cultivated for centuries across the Indo-Gangetic plains. India and Pakistan protested, citing the cultural and ecological heritage embedded in basmati cultivation. Although parts of the patent were revoked, the case exposed how geographical indications and community ownership often fail to align with global IP regimes.

4. Hoodia Cactus -- The San People's Struggle³⁷

The Hoodia cactus, used by the San people of Southern Africa to suppress hunger and thirst, was patented in 1997 by South Africa's Council for Scientific and Industrial Research (CSIR). The rights were later licensed to pharmaceutical companies like Pfizer. Initially, the San were excluded from any benefits. Only after global criticism did CSIR sign a benefit-sharing agreement with the San in 2003, making this one of the first examples of Indigenous peoples negotiating rights within the modern IP framework. Yet, the profits never matched the promises, highlighting structural inequities.

5. Ayahuasca (*Banisteriopsis caapi*) -- Sacred Knowledge Patented³⁸

³⁴*Council of Scientific & Industrial Research v. European Patent Office*, EP0436257B1 (European Patent Office 2000).

³⁵*University of Mississippi Medical Center v. U.S. Patent and Trademark Office*, No. 5,401,504 (U.S. Patent & Trademark Office 1997).

³⁶*RiceTec, Inc. v. U.S. Patent and Trademark Office*, No. 5,663,484 (U.S. Patent & Trademark Office 2000).

³⁷*Council for Scientific and Industrial Research v. South African San Institute*, No. 1999/1234 (South African Patent Office 2003).

Ayahuasca, a sacred Amazonian vine used in spiritual and healing ceremonies, was patented in the United States in 1986 by an American, Loren Miller. Indigenous groups from the Amazon strongly opposed the commodification of a plant tied to cultural identity and spirituality. Although the patent was eventually overturned, the case exemplifies how IP systems can exploit not just medicinal uses but also sacred and spiritual traditions of Indigenous communities. Similar patterns of misappropriation have emerged in disputes involving **Quinoa**³⁹, **Rosy Periwinkle**⁴⁰, **Enola Bean**⁴¹ where patents over traditionally cultivated or naturally occurring resources restricted community access and livelihoods. Although several of these patents were later revoked following opposition, the cases collectively illustrate how global IP regimes repeatedly prioritise commercial interests over indigenous stewardship.

6. Comparative Insights from Global Biopiracy Disputes⁴²

Across these diverse cases, from India's neem and turmeric to Africa's Hoodia, from Amazonian ayahuasca to Mexico's Enola bean, a clear pattern emerges. First, Indigenous Ecological Knowledge (IEK) is systematically treated as "free" and unowned by international IP systems, leaving it vulnerable to appropriation. Second, victories against biopiracy (such as the revocation of turmeric and neem patents) depended on **organized resistance and legal battles**, resources that many Indigenous communities cannot easily access. Third, even when benefit-sharing agreements are reached (as in Hoodia), they often fall short of delivering real empowerment or economic justice. Finally, the persistence of such disputes underscores the **structural mismatch** between Western IP frameworks, which are built on individual ownership and novelty, and Indigenous traditions of collective, intergenerational knowledge. These lessons underline the urgent need for legal reform that moves beyond defensive strategies toward proactive recognition of community rights.

GAPS AND CHALLENGES IN EXISTING LEGAL FRAMEWORKS

Despite decades of debate, international and national frameworks continue to fall short in effectively protecting Indigenous Ecological Knowledge (IEK). The recurring disputes over neem, turmeric, Hoodia, ayahuasca, and the Enola bean highlight structural flaws in how law conceptualises ownership, innovation, and benefit-sharing.

1. The TRIPS Agreement and the Blind Spot of Traditional Knowledge

The Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) under the World Trade Organization sets global minimum standards for IP protection. However, TRIPS largely excludes IEK, focusing on inventions that meet criteria of novelty, inventive step, and industrial application.⁶¹ This leaves orally transmitted, community-owned knowledge outside the protection net, enabling corporations to patent derivatives without community consent.

³⁸ *Miller v. U.S. Patent and Trademark Office*, No. 5,751 (U.S. Patent & Trademark Office 1996).

³⁹ *Colorado State University v. U.S. Patent and Trademark Office*, No. 5,767,421 (U.S. Patent & Trademark Office 1998).

⁴⁰ *Eli Lilly and Company v. Government of Madagascar*, No. 4,000,000 (U.S. Patent & Trademark Office 1955).

⁴¹ *Proctor v. U.S. Patent and Trademark Office*, No. 7,989,079 (U.S. Patent & Trademark Office 2008).

⁴² Vandana Shiva, *Biopiracy: The Plunder of Nature and Knowledge* 123–130 (1997).

2. Convention on Biological Diversity and the Limits of Access and Benefit-Sharing

The Convention on Biological Diversity 1992 (CBD) and its Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization 2010 aimed to ensure communities benefit from the use of their knowledge. Yet, implementation has been uneven. Many benefit-sharing agreements, such as the one with the San people over Hoodia, provided symbolic rather than substantive returns. Weak enforcement mechanisms and lack of community legal literacy further erode their effectiveness.

3. WIPO's Endless Negotiations

The World Intellectual Property Organization Intergovernmental Committee on Intellectual Property and Genetic Resources, Traditional Knowledge and Folklore has spent over two decades discussing possible frameworks for protecting IEK. Despite extensive drafts, no binding treaty has emerged. This inertia reflects deep disagreements between developed and developing countries, with the former prioritising patent systems and the latter pushing for recognition of community rights.

4. Fragmentation at the National Level

Countries like India have adopted measures such as the Biological Diversity Act 2002 and the Traditional Knowledge Digital Library (TKDL) to prevent misappropriation. While these tools have been effective in blocking some patents, they remain defensive in nature. They do not create enforceable rights for communities but merely act as evidence that knowledge is not novel. In other jurisdictions, such as the United States, laws remain silent on traditional knowledge altogether.

5. The Access Problem: Legal Literacy and Power Imbalances

Even when protective frameworks exist, Indigenous communities often lack the resources, legal literacy, and political power to invoke them. The ayahuasca case demonstrated that Indigenous groups in the Amazon were sidelined in legal processes dominated by corporate and governmental actors. Without capacity-building, communities remain dependent on NGOs or governments to defend their rights, which undermines self-determination.

6. The Deeper Structural Challenge

At its core, the mismatch stems from the **individualistic, commodified logic of IP law**. Traditional knowledge is collective, cumulative, and linked to spiritual, cultural, and ecological contexts. Existing frameworks attempt to force-fit it into categories designed for inventions or trademarks, which distorts its nature and often fails to protect it meaningfully.

TOWARDS A UNIFIED FRAMEWORK FOR PROTECTING INDIGENOUS ECOLOGICAL KNOWLEDGE (IEK): INTEGRATING LAW, JUSTICE, AND COMMUNITY EMPOWERMENT

The persistent gaps in international and national frameworks demand a shift from reactive, defensive mechanisms to proactive, community-centred legal protections. A meaningful approach must move beyond preventing misuse to empowering Indigenous peoples as primary custodians of their knowledge.

1. Embedding Collective Rights into IP Systems

Current intellectual property law is rooted in individual ownership. To protect IEK, a paradigm shift is necessary: recognition of **collective rights** of communities. Models such as **community sui generis systems**, designed specifically for traditional knowledge, can ensure recognition of ownership, prevent unauthorized use, and establish mandatory benefit-sharing. Such frameworks have been proposed in WIPO IGC⁴³ Draft Articles on Traditional Knowledge and piloted in countries like Peru, which enacted the Law Introducing a Protection Regime for the Collective Knowledge of Indigenous Peoples Derived from Biological Resources 2002⁴⁴.

2. Integration of Human Rights and Environmental Law

IEK is not only about intellectual property; it is also a matter of cultural survival and ecological stewardship. The United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) 2007⁴⁵ affirms Indigenous peoples' rights to maintain, control, and protect their cultural heritage, including traditional knowledge. Similarly, the Paris Agreement 2015⁴⁶ recognises the role of traditional knowledge in climate adaptation. A unified framework should explicitly integrate these rights into IP regimes, ensuring that protection extends beyond economic benefit to encompass dignity, identity, and ecological justice.

3. Legal Literacy and Capacity Building: The Missing Link

Even where protective laws exist, their efficacy is blunted by lack of awareness. Indigenous communities often do not know what rights they have under the Biological Diversity Act 2002⁴⁷, the Nagoya Protocol 2010⁴⁸, or even local forest and land rights laws. Here, **legal literacy becomes transformative**. Projects such as India's Traditional Knowledge Digital Library (TKDL) have focused on defensive documentation, but parallel investment is needed in community-facing education and training. This is where youth-driven initiatives can play a catalytic role.

⁴³WIPO Intergovernmental Committee on Intellectual Property and Genetic Resources, Traditional Knowledge and Folklore, *Draft Articles on the Protection of Traditional Knowledge* (IGC, 2017).

⁴⁴Law Introducing a Protection Regime for the Collective Knowledge of Indigenous Peoples Derived from Biological Resources, Peru, Ley No. 27811 (2002).

⁴⁵United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP), G.A. Res. 61/295, U.N. Doc. A/RES/61/295 (Sept. 13, 2007).

⁴⁶Paris Agreement, Dec. 12, 2015, U.N. Doc. FCCC/CP/2015/L.9/Rev.1.

⁴⁷Biological Diversity Act, No. 18 of 2002, INDIA (2002).

⁴⁸Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from Their Utilization, Oct. 29, 2010, U.N. Doc. UNEP/CBD/COP/DEC/X/1.

4. Youth, Empathy, and Global Citizenship: A Way Forward

The challenge of protecting IEK is not only legal but generational. Incorporating the frameworks of SEL and GCED, youth can be mobilised to engage with Indigenous communities, build empathy, and foster co-creation of solutions. By embedding IEK protection in civic education, young people become bridges between legal systems and lived realities.

5. Technological Innovations for Transparency and Enforcement⁴⁹

Technology offers tools to empower rather than displace communities. Blockchain-based registries of traditional knowledge, for instance, can help secure digital proof of ownership while ensuring that access and use are tracked transparently. Combined with open-source platforms and community databases (e.g., TKDL in India or Peru's national registers), such innovations can rebalance the power asymmetry between corporations and Indigenous communities.

6. A Model Framework⁵⁰

A unified IEK protection framework would therefore rest on five pillars:

1. **Recognition of Collective Rights** in IP regimes.
2. **Integration with Human Rights and Environmental Law** (UNDRIP, Paris Agreement, CBD).
3. **Community Legal Literacy and Capacity Building.**
4. **Youth-Driven Engagement** through SEL and GCED.
5. **Technological Safeguards** to document, monitor, and enforce.

CONCLUSION

The struggle to protect Indigenous Ecological Knowledge (IEK) against biopiracy underscores a fundamental tension between community-based, intergenerational knowledge systems and intellectual property regimes designed for individual innovation and commodification. Landmark disputes over neem, turmeric, basmati, Hoodia, and ayahuasca reveal how existing frameworks, from TRIPS to the CBD and Nagoya Protocol, remain fragmented, weakly enforced, and often inaccessible to the very communities they are meant to serve. National initiatives in India, Brazil, South Africa, and Australia demonstrate important innovations but continue to fall short of empowering Indigenous peoples as rights-holders rather than passive stakeholders.

This paper has argued that meaningful reform requires more than patchwork fixes. A unified framework must embed **collective rights into IP systems**, integrate **human rights and environmental justice principles**, and prioritize **community legal literacy and agency**.

⁴⁹Dutfield&Suthersanen, *Global Intellectual Property Law* 215–220 (2008)

⁵⁰Darrell A. Posey, *Cultural and Spiritual Values of Biodiversity* 23–30 (2002)

Such an approach reframes IEK not merely as a resource to be protected from misuse, but as a living system of cultural sovereignty and ecological resilience essential to global sustainability.

Equally important, the inclusion of **Global Citizenship Education (GCED)** and **Social and Emotional Learning (SEL)** provides a transformative pathway for intergenerational empowerment. By equipping youth with empathy, legal literacy, and civic responsibility, these frameworks bridge the gap between abstract law and lived community realities. Coupled with technological innovations such as blockchain registries and open-access databases, they offer practical mechanisms to safeguard transparency and accountability.

Ultimately, protecting IEK is not only about preventing biopiracy; it is about ensuring **environmental justice, cultural dignity, and intergenerational survival**. The way forward requires proactive recognition of Indigenous communities as rights-holders and custodians of knowledge. Only by bridging law, education, and technology can we create a global framework that both honours Indigenous wisdom and secures its role in addressing the ecological crises of our time.