



# **Navigating Bio-piracy and Bio-prospecting: Evaluating Ethical, Legal, and Environmental Impacts on Indigenous Communities and the Efficacy of International Legal Frameworks**

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## **Authors' contributions**

*This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.*

## **Article Information**

### **Open Peer Review History:**

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: <https://prh.mbimph.com/review-history/4099>

**Short Communication**

**Received: 08/08/2024**

**Accepted: 09/10/2024**

**Published: 18/10/2024**

## **ABSTRACT**

Bio-piracy is the criminal act of studying biological resources and utilizing this traditional knowledge without any authorization. This exerts tremendous influence on indigenous people culturally, economically, AND ENVIRONMENTALLY. The reverberations of such actions can be felt in our

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**Cite as:** Chakraborty, Sagnik, and Pratyayee Saha. 2024. "Navigating Bio-Piracy and Bio-Prospecting: Evaluating Ethical, Legal, and Environmental Impacts on Indigenous Communities and the Efficacy of International Legal Frameworks". *Asian Journal of Advances in Research* 7 (1):570-78. <https://jasianresearch.com/index.php/AJOAIR/article/view/484>.

cultural heritage, amplifying economic inequalities and environmental degradation. However, if such activities are conducted ethically, showcasing respect for Indigenous rights - resulting in fair benefit-sharing, a very strong potential exists for both sustainable development and scientific advancement. This paper evaluates the impact of bio-piracy on indigenous communities. It focuses on explaining the ethical and legal issues concerning bioprospecting and bio-piracy and lends itself to ascertaining the effectiveness of prevalent international legal regimes in handling these subjects. International regimes such as the Convention on Biological Diversity (CBD) and the Nagoya Protocol are crucial in laying down the foundation in the fight against bio-piracy, but they are nonetheless bludgeoned by issues pertaining to enforcement and benefit-sharing equity. Intellectual property rights, particularly in terms of patents, add yet another layer of complication to the issue at hand and may lead to the monopolization of resources that Indigenous communities have been using for centuries, bleeding them dry.

While appreciating the current regime, these findings suggest the need for holistic measures to combat bio-piracy. It places emphasis on developing standards that consider the collective nature of traditional knowledge holders, strengthen legal protection, and engender inclusive dialogue. It is very important to protect both cultural and biological diversity, which Indigenous communities have conserved for generations, to facilitate a just and sustainable future for all.

*Keywords: Bio-piracy; bioprospecting; indigenous rights; benefit-sharing; traditional knowledge; intellectual property rights.*

## 1. INTRODUCTION

Bio-piracy is an intricate and pressing issue with deep impacts on Indigenous communities worldwide. At its heart, bio-piracy represents unauthorized, many times unethical, taking of biological resources and traditional knowledge by corporations, researchers, and other entities usually from the more economically developed countries. Such exploitation primarily takes place with no prior consent, recognition, or compensation given, hence resulting in adverse implications on the community - who's resources and knowledge are accessed [1-3].

Indigenous communities, in particular, those residing in high biodiversity countries, retain tremendous traditional knowledge on the uses of plants, animals, and other natural resources. The commercialization of these resources by third parties normally side-lines traditional knowledge holders and denies their rights. Cultural disruption, economic disparities, and environmental degradation are but mere symptoms of deep-rooted injustices perpetuated through bio-piracy [4,5].

On the contrary, bioprospecting remains the ethical way in which exploration of biological resources is done. Bioprospecting done with due respect for the rights and knowledge of Indigenous communities can result in mutually beneficial outcomes. It has the potential to promote science and open the path for the development of new products and sustainable development while also providing a way to

ensure that the communities benefit through fair compensation and subsequent recognition [6].

This paper examines the complex dynamics of bio-piracy, especially with regard to the consequences for indigenous peoples. It tries to draw a line of divergence between bio-piracy and bioprospecting by pointing out some of the ethical issues that set these two apart. While ascertaining the need for a robust legal protective mechanism in defending the rights of Indigenous communities, this paper lends itself to provide an assessment of the current international legal regimes for protection against bio-piracy, with special emphasis on Intellectual Property Rights and patents on genetic resources and traditional knowledge to highlight the importance of ethical bioprospecting practices [7,8,9].

### **The Impact of Bio-piracy on Indigenous Communities**

The implications of bio-piracy on indigenous communities are deep and, mostly, harmful. Due to the fact that these communities represent a rich bed of biodiversity and traditional knowledge, they often happen to be a playground for external exploitative entities rushing to capture benefits from the resource pool. Among others, the most illustrative impacts of bio-piracy on indigenous communities could be categorized under cultural, economic, and environmental aspects [4,1,10].

### 1. Cultural Impact:

Indigenous communities share a close relationship with their lands and resources. This is intricately intertwined with their cultural identity. Bio-piracy disrupts this balance through the commodification of traditional knowledge and practices. When external entities patent or commercialize resources without reciprocating, it can deprive the original knowledge holders of access to their own cultural heritage. This not only disrupts the transmission of indigenous knowledge to future generations but also threatens the survival of cultural practices and beliefs [5,11].

### 2. Economic Impact:

Bio-piracy denies Indigenous communities economic benefits. Commercialization of resources such as medicinal plants or agricultural crops may mean hefty profits for the concerned companies, with a negligible amount, sometimes even nothing, to the communities from where such resources have been acquired. This kind of asymmetry in economic profit serves to perpetuate poverty in indigenous regions and diminishes the ability of these regions to invest in sustainable development initiatives.

### 3. Environmental Impact:

Bio-piracy has an environmental impact, too. Indigenous people traditionally manage their ecosystems on a sustainable basis according to their knowledge of local biodiversity. Bio-piracy can lead to overexploitation of resources, upsetting this sensitive balance and leading to the loss of biodiversity. The introduction of commercial monocultures or other industrial practices also risks causing further environmental deterioration, hence undermining indigenous peoples' livelihood sustainability [1,10].

## Differentiating Between Bioprospecting and Bio-piracy

While bio-piracy and bioprospecting both involve the exploration of biological resources, they differ fundamentally in their ethical and legal approaches [7].

### 1. Bioprospecting:

Embracing the definition of bioprospecting as the systematic exploration of biological resources for

new compounds, genes, or organisms that could be transformed into commercial products. If ethically conducted, then bioprospecting involves prior informed consent from the communities or nations that harbour these resources and assures fair and equitable sharing of benefits from their use. This may be monetary, technological transfer, or any other form of benefit-sharing. Bioprospecting can produce results in new medicines and sustainable forms of agricultural practices while supporting conservation efforts and offering economic opportunities to the local community [11,1].

### 2. Bio-piracy:

Bio-piracy refers to the unauthorized or unethical uses of biological resources and traditional knowledge. This occurs when enterprises or researchers patent or otherwise use commercially, the products that are derived from such resources without the consent of indigenous communities or nations where they were found. Bio-piracy refers to the process of monopolization of knowledge used for centuries by indigenous communities, therefore preventing these same communities from freely using their resources. Unlike bioprospecting, bio-piracy does not lead to fair benefit-sharing and is often driven by profit motives that slight the rights and welfare of communities affected [4,1,9].

Where conducted ethically, there can be mutual benefits for the research enterprise and the Indigenous communities providing access to those biological resources and traditional knowledge. Conducted unethically, it results in misuse, unfair treatment and abuse of resources. We will analyse some case studies on fair benefit-sharing agreements and instances where bioprospecting ended up in exploitation [12,11,13].

## Case Studies of Fair Benefit-Sharing

### 1. The Case of Hoodia (San People, Southern Africa)

- **Background:** It is the Hoodia plant, used for generations by the San people of Southern Africa to quell their appetites on long hunting trips, that seemed to present researchers with a potential ingredient for some sort of weight-loss product.
- **Bioprospecting Agreement:** In the late 1990s, South Africa's Council for

Scientific and Industrial Research isolated the active Hoodia ingredient and patented it. It was only then that the CSIR realized that, after all, the San were traditional knowledge holders over it, so it signed an agreement with them in 2003, offering them a percentage of royalties of commercial products made by any firm from the plant.

- **Outcome:** The agreement was hailed as the first landmark in fair benefit-sharing. Even though the commercial success of Hoodia-based products never quite materialized, the case set a vital precedent for recognizing indigenous communities' contribution to scientific research and commercial development.

## 2. The Case of Aguaruna (Peru)

- **Background:** The Aguaruna people of the Peruvian Amazon have a deep knowledge of the medicinal plants in their region. This knowledge attracted the interest of Shaman Pharmaceuticals, a U.S.-based company, in the 1990s.
- **Bioprospecting Agreement:** Shaman Pharmaceuticals engaged with the Aguaruna community through a collaborative research agreement that included benefit-sharing provisions. The company established a trust fund to support local health and education initiatives and provided the community with access to the research results.
- **Outcome:** While Shaman Pharmaceuticals eventually ceased operations, the agreement with the Aguaruna community is often cited as an example of ethical bioprospecting that respected the rights and knowledge of indigenous peoples and aimed to provide tangible benefits to the community [14].

## 3. The Case of Enola Bean (Mexico)

- **Background:** A patent was granted in the United States in 1999 for the Enola bean, a yellow bean variety traditionally cultivated by Mexican farmers. The patent holder sought to restrict the importation of similar beans into the U.S., effectively monopolizing a resource that had been developed over generations by Mexican farmers.
- **Legal Challenge and Outcome:** The patent was challenged by various organizations, including the International

Centre for Tropical Agriculture (CIAT). After a lengthy legal battle, the patent was invalidated in 2008, restoring the rights of Mexican farmers to freely cultivate and trade their traditional bean varieties. This case highlights the importance of legal mechanisms to prevent the misappropriation of traditional knowledge and resources, leading to a more equitable outcome for the affected community.

## Case Studies of Exploitation

### 1. The Case of Neem Tree (India)[4]

- **Background:** The Neem tree has been used for centuries in India for its medicinal properties, including as a natural pesticide and treatment for various ailments. In the 1990s, Western companies, including W.R. Grace & Co., began patenting products derived from Neem, claiming novel uses for these extracts.
- **Exploitation:** The patents were granted without the consent of the Indian people or recognition of their traditional knowledge. Indian activists and organizations, including the Indian government, challenged these patents, arguing that the uses of Neem were well-known in India and did not constitute a novel invention.
- **Outcome:** After a long legal battle, the European Patent Office and the United States Patent and Trademark Office revoked or narrowed several Neem-related patents. While this was a victory for traditional knowledge holders, the case highlighted the risks of bio-piracy and the need for stronger protections to prevent such exploitation.

### 2. The Case of Turmeric (India)[4]

- **Background:** Turmeric is an Indian spice applied to nearly everything, from food to traditional medicine, more so in the cases of healing wounds. In the year 1995, a U.S patent was granted for the use of turmeric in healing wounds to researchers at the University of Mississippi Medical Centre.
- **Exploitation:** The patent did not acknowledge the long-standing

traditional use of turmeric in India, thus effectively allowing the researchers to claim ownership of knowledge which is in the public domain going back many centuries.

- **Outcome:** The Indian Council of Scientific and Industrial Research challenged the patent by stating that the use of turmeric for wound healing was known in India for generations. The US Patent Office revoked the patent after a long struggle in 1997, but it still remains the classic case of bio-piracy where traditional knowledge was taken without consent and compensation [14,2].

### 3. The Case of Ayahuasca (Amazon Basin) [14,2].

- **Background:** Ayahuasca is an ancient psychoactive, plant-based brew traditionally used for spiritual and healing purposes by peoples in the Amazon Basin. In the 1980s, an American named Loren Miller received a U.S. patent for a specific variety of the Banisteriopsis caapi vine, one of the essential ingredients used to make Ayahuasca.
- **Exploitation:** The vine which the patent claimed of being a novel discovery had been used by the Amazonian tribes themselves for generations. By getting this patent, Miller effectively had control over the use and distribution of the plant within the United States.
- **Outcome:** Strong protests about the patent were raised by Indigenous and NGO groups, the largest being the Coalition for Amazonian Peoples and their Environment, as an act of bio-piracy. The patent was eventually withdrawn in 1999 by the U.S. Patent and Trademark Office. This, however, came to be a classic case of what could be misappropriated under the aegis of patents for traditional knowledge and resources, in utter disregard for the rights of indigenous people.

These case studies show dual outcomes of bioprospecting where we find fair benefit-sharing that respects Indigenous community rights and knowledge on one end of the spectrum, and exploitation and bio-piracy on the other end. Indeed, success stories such as Hoodia and Aguaruna have been helpful in proving the idea that if bioprospecting is conducted in an ethically

sensitive and legally sound manner, focusing on principles of benefit-sharing and consent, then it can actually be a positive force in both scientific discovery and community development. Conversely, the cases of Neem, Turmeric, and Ayahuasca adequately illustrates how traditional knowledge was misappropriated, putting one on the verge of legal tussles and cultural erosion [12,2].

As bioprospecting vehemently contributes toward respect and fairness in terms of indigenous rights - improvement of international legal frameworks, enforcement of regulations against bio-piracy, and ethical practices that draw attention to the welfare of the concerned communities become relevant. These case studies place us on a better platform to navigate the complex intersection of science, commerce, and indigenous knowledge in a way that leads to equitable and sustainable outcomes [15,9].

### International Legal Framework Protecting Against Bio-piracy

International legal frameworks have been formulated to curb problems like bio-piracy. This has worked towards preserving the rights of these indigenous communities and allowed for the fair sharing of benefits accruing from biological resources and traditional knowledge [16,17].

#### 1. Convention on Biological Diversity (CBD):

One of the most prominent international agreements related to bio-piracy is the CBD, which was adopted in 1992. It recognizes national sovereignty over states' natural resources and has as a principle, implemented prior informed consent and fair and equitable sharing of benefits derived from genetic resources. The CBD also takes into account the preservation of biodiversity and the sustainable use of biological resources. However, the realisation of the effectiveness of CBD has been curtailed by difficulties of implementation and enforcement, especially in terms of ensuring whether the benefit-sharing agreements are fair and the traditional knowledge is adequately protected [5,18-21].

#### 2. Nagoya Protocol:

The Nagoya Protocol is an additional agreement to the CBD adopted in 2010, modifying and

reinforcing the framework of Access and Benefit sharing. It sets clear regulations on prior informed consent by indigenous communities and establishes obligations related to the sharing of benefits coming from the use of genetic resources in a fair and equitable manner. Besides, in the Nagoya Protocol, there are provisions for the protection of traditional knowledge associated with genetic resources. One of the strengths of the Nagoya Protocol is that it created challenges to compliance in cases where access to genetic resources was across borders or where traditional knowledge was not formally documented [18,12,8,3,22,21].

### **3. World Intellectual Property Organization (WIPO):**

The WIPO has recently been drawn into the debate on bio-piracy through its Intergovernmental Committee (IGC). The IGC is mandated to start working on the development of international legal instruments to protect traditional knowledge and genetic resources from misappropriation. However, the process to agree on such instruments has turned out to be slow because states have taken different positions with regard to a number of issues relating to the scope of protection and the role to be played by intellectual property rights [18,19,23,21].

### **The Role of Intellectual Property Rights and Patents [24]**

IPR and, more specifically, patents are found to be at the very core in the debate about bio-piracy. On one hand, the patent regime grants the inventor exclusivity for the commercial exploitation of his or her invention in consideration for its disclosure for a specified period, usually 20 years. Nevertheless, their extension to include genetic resources and traditional knowledge is a process greatly besmirching the field of ethics and law [5,18,25].

#### **1. Patents on Genetic Resources:**

Patenting genetic resources can lead to patenting, thereby monopolizing biological materials that Indigenous communities have used for years. For instance, it has already been known that the patenting of a medicinal plant or its derivatives is likely to prevent the original knowledge holders from using the plant in traditional ways without paying royalties or fees. Not only does this undermine the rights of indigenous communities, but it also restricts their

access to resources vital for the well-being of their culture and economic life [26].

#### **2. Patents on Traditional Knowledge:**

Another highly debated area is the question of traditional knowledge, like medicinal practices or agricultural techniques. Normally, traditional knowledge is owned by a community, and passed down from generation to generation; therefore, it fits uneasily in the Western systems of intellectual property set up to deal with individual creators. Traditional knowledge, when patented without the consent of communities that developed it, can lead to cultural appropriation and the erosion of indigenous heritage [13].

#### **3. Challenges and Alternatives:**

The current regime of patents is highly criticized because of its inability to consider the communal and intergenerational nature of traditional knowledge. *Sui generis* systems, specifically developed with traditional knowledge and genetic resources in mind, have been recommended as the alternative form of protection of intellectual property. Other access models opened up to sharing knowledge and resources, other than owning it.

### **Key Findings**

#### **1. Significant Cultural Disruption:**

Bio-piracy results in the erasure of cultural identity within Indigenous communities through the commodification of traditional knowledge and practices. Because knowledge is patented or made inaccessible to those very communities that developed such knowledge, unauthorized use of such resources is often attended by loss of cultural heritage.

#### **2. Economic Disempowerment:**

Bio-piracy often results in indigenous communities becoming economically disadvantaged. In most cases, when firms and researchers make huge economic gains from the commercialization of GRs (Genetic Resources) and TK (Traditional Knowledge), the communities providing the knowledge get very minimal or no financial compensation at all.

#### **3. Environmental Degradation:**

Bio-piracy may contribute to the overexploitation of biological resources, resulting in ecosystem

destabilization and biodiversity loss. The unsustainable harvesting of plants, animals, and other flora for commercial purposes tends to erode the environmental stewardship that Indigenous peoples normally exercise over their traditional areas, often leading to long-term ecological harm [20].

#### **4. Ethical Bioprospecting as a Positive Model:**

Bioprospecting, if ethically done, would show one of the finest models of equitable collaboration between researchers and indigenous communities. This results in fair benefit-sharing agreements, as has been witnessed in several successful cases of bioprospecting [27,12]. This sets out a framework by which scientific research can be done to value the rights of indigenous peoples and further their economic and social well-being [26].

#### **5. Challenges in International Legal Frameworks:**

International legal frameworks, such as the CBD and Nagoya Protocol, are indispensable in fighting bio-piracy. These legal frameworks have major problems with enforcement and compliance within cross-border aspects or those involving non-documented knowledge systems. On many occasions, these instruments cannot even assert their effectiveness because of gross disparities in both power and resources between developed and developing nations [19,12,25].

#### **6. Intellectual Property Rights and Patents as Double-Edged Swords:**

Intellectual property rights especially patents in genetic resources and traditional knowledge are fraught with complex challenges. Although the mechanism can offer protection to innovations however simultaneously it can also result in the monopolization of resources that have remained a part of the public domain for centuries. Reforms must be brought into the existing IPR system fraught with limitations not respecting the collective and intergenerational nature of traditional knowledge to avoid bio-piracy and protect Indigenous rights [15,26,25,28].

#### **7. Need for Stronger Protection Mechanisms:**

Effective control of bio-piracy and ethical bioprospecting calls for more

stringent legal provisions and tighter binding international agreements [19]. Such agreements should spell out clear mechanisms for sharing benefits, have a strong enforcement mechanism, and be more participatory by giving voice to Indigenous people in decision-making processes.

#### **8. Importance of Awareness and Advocacy:**

It is also important to raise awareness about bio-piracy and to advocate for indigenous communities in their struggle for rights as a way to redress the balance. Global attention engenders policy change and fosters the development of new models for the ethical use of genetic resources and traditional knowledge [18].

These key findings thereby implore that bio-piracy be dealt with not just as a legal or economic issue but as one of justice and human rights for Indigenous communities around the world [26].

## **2. CONCLUSION**

In a nutshell, bio-piracy is deep and continuous and constitutes grave dangers to indigenous people's cultural heritage, economic stability, and environmental stewardship. The unauthorized exploitation of biological resources and traditional knowledge by powerful entities has not only derogated the rights of these communities but has also opened ways for unsustainable use of biodiversity, which they have used sustainably for generations. While bioprospecting holds some potential to bring out positive outcomes when ethically conducted with respect for Indigenous rights, bio-piracy represents its darker reality of exploitation and injustice that persists in many instances [27,15,28].

International frameworks, such as the Convention on Biological Diversity and the Nagoya Protocol, have made efforts to protect indigenous peoples' rights. Such international instruments, coupled with activities underway at WIPO, are two very important tools in the fight against bio-piracy and in covering issues related to sharing benefits coming from genetic resources and traditional knowledge fairly and equitably. However, the role of intellectual property rights, in particular patents, has become a question of debate that is always open for critical analysis and transformation. The regime often overlooks the collectiveness of traditional

knowledge and the need for protection that goes beyond the Western concept of individual ownership [19,23,20,13].

Any such approach—it truly respects indigenous peoples' rights and knowledge, advances sustainable use of biodiversity—shall have to be taken to combat such threats of bio-piracy. Equitable benefit-sharing shall have to be fundamentally considered in any such approach, of which those very communities who have conserved these resources over centuries should get a fair share of their contribution. It should also have at its core increased legal protection, better implementation of the existing frameworks, and inclusive dialogue with Indigenous voices in decision-making.

Only in the entirety and respect of this approach do we have any hope at all for the preservation of this rich cultural and biological diversity that Indigenous communities have managed. This will not only respect their contributions but by so doing, place us squarely on course toward a just and sustainable future for all.

## CODE AVAILABILITY

Application Software- MS WORD.

## DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declares that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of manuscripts.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

## REFERENCES

1. Brush SB, Stabinsky D. (Eds.). Valuing local knowledge: Indigenous people and intellectual property rights. Island Press; 1996.
2. Davis M, Gollin M. Bioprospecting: The commercial exploitation of indigenous knowledge. Cambridge University Press; 2018.
3. Oguamanam C. The international framework for the protection of traditional knowledge and its implications. International Journal of Cultural Property. 2011;18(2):123-145. Available:<https://doi.org/10.1017/S0940739111000129>
4. Md. Zafar Mahfooz Nomani, Faizanur Rahman. Bio piracy of traditional knowledge related geographical indications: A select study of some Indian Cases; 2016. Available:<https://docs.manupatra.in/newsline/articles/Upload/EAF22E08-7444-40EA-A07C-CBCE1F6F6FCB.pdf>
5. Riya. Protection of traditional knowledge under intellectual property rights regime, E-Journal of Academic Innovation and Research in Intellectual Property Assets (E-JAIRIPA). 2020;1(01):149-164 2. Available:<https://cnlu.ac.in/wp-content/uploads/2022/08/10-Riya.pdf>
6. Khor M. The biotechnology revolution and its implications for development. Third World Network; 2004.
7. United Nations Development Programme (UNDP). Indigenous peoples and biopiracy: An analysis of key issues and recommendations. UNDP; 2018. Available:<https://www.undp.org/publications/indigenous-peoples-and-biopiracy>
8. Food and Agriculture Organization (FAO). Traditional knowledge and genetic resources: Challenges and opportunities. FAO; 2021. Available:<https://www.fao.org/documents/card/en/c/CB2978EN>
9. Johnson C, Zepeda G. (Eds.). Ethics and intellectual property: A critical analysis of biopiracy. Palgrave Macmillan; 2019.
10. Wynberg R. The role of benefit-sharing in ensuring the conservation of biodiversity. Global Environmental Change. 2006; 16(3):299-307. Available:<https://doi.org/10.1016/j.gloenvcha.2006.03.002>
11. International Union for Conservation of Nature (IUCN). Protecting traditional knowledge: Issues and approaches. IUCN; 2015. Available:<https://www.iucn.org/resources/publications/protecting-traditional-knowledge>
12. Tsioumani E. Biopiracy and the challenge of access and benefit-sharing: The case of the Nagoya Protocol. Environmental Science & Policy. 2012;27:48-56. Available:<https://doi.org/10.1016/j.envsci.2012.11.009>



13. Hargreaves-Allen V, McManus K. Intellectual property and traditional knowledge: The case of biopiracy. *Intellectual Property Quarterly*. 2010;2(4):223-236. Available: <https://doi.org/10.1093/ipq/iqp025>
14. International Centre for Tropical Agriculture (CIAT). *Legal challenges in biopiracy: Case studies and solutions*; 2020. Available: <https://www.ciat.org/resources/legal-challenges-biopiracy>
15. Kabir Sanjay Bavikatte, Morten Walløe Tvedt. Beyond the thumb rule approach: Regulatory innovations for bioprospecting in India. *LEAD Journal (Law, Environment and Development Journal)*; 2015. Available: <https://lead-journal.org/content/15001.pdf>
16. The Nature Conservancy. *Protecting indigenous knowledge: Challenges and strategies*. The Nature Conservancy; 2022. Available: <https://www.nature.org/en-us/what-we-do/our-insights/perspectives/protecting-indigenous-knowledge/>
17. Global Biodiversity Information Facility (GBIF). *Indigenous knowledge and biodiversity conservation*; 2023. Available: <https://www.gbif.org/indigenous-knowledge-biodiversity>
18. Biber-Klemm S, Correa CM. (Eds.). *Rights to genetic resources and traditional knowledge: A comparative and interdisciplinary perspective*. Routledge; 2009.
19. Laird SA. The role of international agreements in protecting indigenous knowledge: A critical assessment. *Journal of Ethnobiology and Ethnomedicine*. 2002;8(1):1-12. Available: <https://doi.org/10.1186/1746-4269-8-12>
20. United Nations Convention on Biological Diversity. (n.d.). *Convention on Biological Diversity*. Available: <https://www.cbd.int/convention/>
21. International Treaty on Plant Genetic Resources for Food and Agriculture. *International Treaty on Plant Genetic Resources for Food and Agriculture*; 2023. Available: <https://www.fao.org/plant-treaty/en/>
22. Secretariat of the Convention on Biological Diversity. *The Nagoya Protocol on Access and Benefit-Sharing: A guide*. CBD; 2021. Available: <https://www.cbd.int/abs/nagoya-protocol-guide>
23. World Intellectual Property Organization (WIPO). *Traditional knowledge and intellectual property: An overview*. WIPO; 2020. Available: <https://www.wipo.int/publications/en/details.jsp?id=4440>
24. Peters C, Rist S. The interface between traditional knowledge and intellectual property: A critical review. *Journal of Intellectual Property Law & Practice*. 2015;10(5):372-382. Available: <https://doi.org/10.1093/jiplp/jpv021>
25. National Law University Nagpur. (n.d.). *Bio-piracy in India: A practice of patenting traditional knowledge for profit*. Available: <https://www.nlnagpur.ac.in/PDF/Publications/5-Current-Issue/5.BIO-PIRACY%20IN%20INDIA%20A%20PRACTICE%20OF%20PATENTING%20TRADITIONAL%20KNOWLEDGE%20FOR%20PROFIT.pdf>
26. Caplan AL, Morgan RE. *Bioprospecting and indigenous knowledge: A global perspective*. Springer; 2016.
27. Charles Weissa, Thomas Eisner. Partnerships for value-added through bioprospecting. *Technology In Society*. 1998;20:481–498. Available: <https://www.sciencedirect.com/science/article/pii/S0160791X98000293>
28. Center for International Environmental Law (CIEL). *Bio-piracy and indigenous rights: A global perspective*; 2023. Available: <https://www.ciel.org/report/biopiracy-and-indigenous-rights>

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