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Article

From Mismatch to Unity: Integrating Indigenous Wisdom into Environmental Policy for Biodiversity

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Abstract: Indigenous Knowledge (IK) encompasses the profound, long-term observations, sustainable practices, and holistic management of the natural environment developed by indigenous communities over millennia. While this invaluable wisdom is highly beneficial for global biodiversity conservation, it remains significantly underutilized and rarely integrated into actual environmental policies. For instance, within the Pacific fishing industry, critical ecological knowledge is predominantly passed down orally within specific localized regions, rendering it largely inaccessible to external policy makers and scientific researchers. Concurrently, contemporary environmental management systems tend to prioritize short-term commercial interests and economic growth, frequently marginalizing or entirely ignoring the sustainable practices of indigenous populations. To address this critical mismatch, modern environmental policies must actively draw upon these traditional experiences to generate innovative, resilient strategies for contemporary ecological management. It is imperative that policy-making groups systematically learn from the accumulated wisdom of indigenous residents, thereby allowing their unique knowledge systems to provide a practical, culturally inclusive perspective for modern governance. International instruments, such as the United Nations Declaration on the Rights of Indigenous Peoples and the Post-2020 Global Biodiversity Framework, have begun to formally incorporate IK into environmental protection paradigms. By fully embracing these frameworks, global stakeholders can ensure that nature is more effectively protected, the fundamental rights and sovereignty of indigenous peoples are respected, and environmental management systems become significantly more adaptive to ongoing climate changes.

Keywords: indigenous knowledge; environmental policy; biodiversity conservation; indigenous sovereignty; knowledge integration

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1. Introduction

The climate change caused by such activities has accelerated and worsened, posing a significant challenge to the stability of the global environment. This situation underscores the importance of prioritizing biodiversity protection as a cornerstone for ensuring sustainable development in the future [1]. In this context, indigenous knowledge is increasingly recognized as a valuable resource for safeguarding the Earth's biodiversity. This knowledge, developed through the close interaction of countless generations with the natural environment, embodies a deep understanding of ecological processes and sustainable resource management. The indigenous-led approach to biodiversity protection offers a practical and effective method for achieving international conservation goals. Furthermore, it represents a model that integrates principles of justice and respect into environmental decision-making, which is intrinsically linked to the sovereignty and self-determination rights of indigenous communities.

Indigenous knowledge has proven to be highly beneficial in biodiversity conservation, yet it remains significantly marginalized in formal environmental policy-making processes. The global environmental community often fails to fully recognize the practical applications and epistemological value of indigenous knowledge. This oversight creates a substantial gap between its theoretical importance and its actual impact on conservation efforts [1]. In the face of increasingly severe climate change, this disconnect represents a missed opportunity to enhance the effectiveness of biodiversity protection strategies [1, 2]. Moreover, it raises ethical and practical challenges, as the exclusion of indigenous knowledge perpetuates injustices against indigenous communities. The failure to integrate this knowledge into biodiversity protection frameworks not only undermines conservation efforts but also exacerbates the marginalization of these communities, further deepening the inequities they face.

This paper examines the disconnection between indigenous knowledge and environmental policies, delving into the underlying causes of this issue and its implications for biodiversity conservation. It highlights the need for a more inclusive approach to environmental policy-making, one that incorporates indigenous knowledge into decision-making processes. By addressing this gap, it is possible to create more effective and equitable conservation strategies that respect the rights and contributions of indigenous communities [3, 4]. Such an approach not only enhances the practical outcomes of biodiversity protection but also fosters a more just and sustainable relationship between human societies and the natural world.

2. Background of Indigenous Knowledge

Indigenous Knowledge (IK) is described in various ways within academic discussions, such as local knowledge, traditional wisdom, traditional science, folk knowledge, traditional ecological knowledge, and tacit knowledge. It has been noted that IK is deeply rooted in the specific cultural and environmental context of a region, which means its applicability and effectiveness can vary greatly depending on geographical and cultural differences [2, 5]. This localized nature of IK facilitates its widespread acceptance within the same community, as shared language and cultural traditions make it more relatable and accessible compared to external knowledge systems, such as professional scientific knowledge. Additionally, IK is not centralized or confined to a single individual or location but is instead distributed collectively across communities. This dispersed nature means that IK is often preserved through oral traditions, communal memory, and non-textual methods rather than formal written documentation [6]. Such characteristics highlight the unique ways in which IK is maintained and transmitted across generations.

IK is recognized as the cumulative wisdom of numerous generations, refined and strengthened through continuous experience, practice, and even failure. It originates from the long-term interactions between local communities and their natural surroundings. Over time, these interactions lead to the development of practical methods for addressing challenges, as IK incorporates life experiences, observations, and practices into its framework [7]. This adaptability ensures that IK remains relevant and capable of addressing new and evolving situations. The iterative process of learning and refining through trial and error further enhances the reliability and applicability of this knowledge system, making it a vital resource for problem-solving in diverse contexts.

IK places significant emphasis on the interconnected and interdependent relationship between humans and nature. It views this relationship as a cohesive whole, where regional progress is achieved through co-evolution with the environment. This perspective underscores the importance of respecting the carrying capacity and limitations of ecosystems. Because IK is grounded in long-term observations and tailored to local conditions, it offers sustainable approaches to environmental management [8, 9]. Communities equipped with IK are better positioned to adapt to environmental changes, ensuring resilience and sustainability. Furthermore, IK has the potential to contribute to broader biological and ecological understanding, enhance conservation education, and support natural resource management and environmental planning across various scales.

These attributes make IK an invaluable tool for addressing contemporary environmental challenges.

The role of IK in biodiversity conservation is increasingly recognized, both at local and global levels. Indigenous communities are custodians of more than half of the Earth's remaining intact ecosystems, which serve as habitats for nearly 80 percent of the world's unique and threatened species. This highlights the critical importance of Indigenous territories and practices in achieving effective conservation outcomes [10, 11]. Global conservation targets, such as the goal to protect at least 30% of the planet's land and water areas by 2030, underscore the need for ecologically representative and well-connected conservation measures. These measures must also be governed through equitable frameworks that acknowledge and integrate Indigenous and traditional knowledge systems. By doing so, conservation efforts can become more inclusive and effective, addressing the urgent need to safeguard biodiversity while respecting the rights and contributions of Indigenous communities.

Numerous examples illustrate the practical applications and effectiveness of IK at the local level. For instance, Indigenous Cree hunters in subarctic Canada possess intricate knowledge that enables them to manage multiple factors affecting Canada goose populations, ensuring sustainable harvesting practices. Similarly, Indigenous peoples in Australia have utilized traditional burning techniques for thousands of years to enhance habitats for game animals, support hunting activities, and reduce the risk of catastrophic wildfires. In the Canadian Arctic, Inuit communities demonstrate remarkable adaptability by monitoring changes in animal population patterns. When the population of one species declines, Inuit hunters shift their focus to other species, thereby maintaining ecological balance and ensuring the sustainability of their harvesting practices. These examples underscore the practical value of IK in promoting ecological harmony and sustainability [12].

The recognition of IK's value continues to grow, with increasing evidence demonstrating its effectiveness in practice. However, despite its proven utility, IK remains underutilized in environmental policy frameworks. To achieve meaningful progress in global biodiversity conservation, it is essential to address this gap and fully integrate IK into policy and decision-making processes. By doing so, the potential of IK to contribute to sustainable environmental management and biodiversity preservation can be fully realized, benefiting both local communities and the global ecosystem.

3. The "Mismatch" and Its Implications

Monitoring Indigenous perspectives and voices in the policymaking process is a complex issue rooted in the gradual disappearance of Indigenous Knowledge, often referred to as IK. This decline has weakened an important pathway for protecting biodiversity and sustaining long established ecological relationships. In other words, the recognized importance of IK in theory does not correspond to the role it is allowed to play in practice. This mismatch is especially visible in the Pacific Islands fishing sector. Indigenous communities across the Pacific region have relied on fishing for generations, not only as a source of food and income but also as a foundation of cultural identity, social organization, and environmental stewardship [13]. Their traditional knowledge provides an important basis for the development of sustainable fisheries management because it is closely tied to seasonal cycles, species behavior, habitat conditions, and customary rules of resource use. However, over the past few decades, Indigenous fishing knowledge has begun to decline in many Pacific communities. This weakening of knowledge systems is not the result of a single cause, but rather of several interconnected pressures. Three major reasons for the declining influence of Indigenous fishing knowledge are the loss of Indigenous language use, power imbalances created by current regulatory systems, and the long term historical effects of colonial expansion on Indigenous communities. Together, these factors reduce the visibility, authority, and practical application of IK in environmental governance, even when its value is widely acknowledged in academic and policy discussions.

Figure 1 illustrates the conceptual framework of the mismatch between Indigenous Knowledge and environmental policy, showing the three primary contributing factors and their consequences for biodiversity conservation. More specifically, the figure can be understood as a model of disconnection in which knowledge systems that have strong local relevance are prevented from shaping formal decision making. It highlights how linguistic erosion, institutional inequality, and historical domination interact rather than operate in isolation. The figure also suggests that the consequences of this mismatch extend beyond the loss of cultural heritage, because they directly affect conservation outcomes, species protection, and the long term resilience of fisheries governance. By presenting these relationships visually, Figure 1 helps clarify that the problem is not simply the decline of a body of knowledge, but the weakening of a governance relationship between communities, ecosystems, and policy institutions.

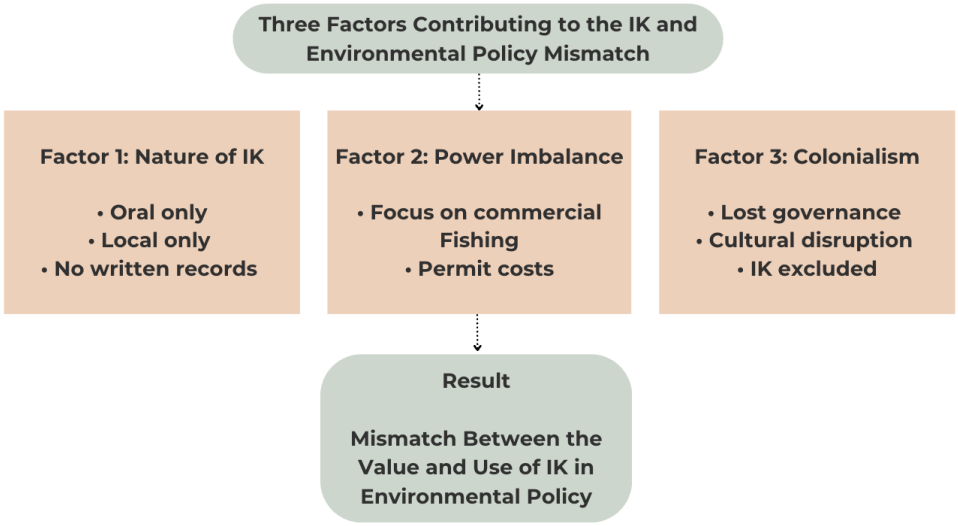

Figure 1. Factors Contributing to the IK Policy Mismatch

First, the characteristics of IK can themselves become a barrier to broader public understanding of Indigenous cultures and knowledge systems. The local, place based, and largely oral nature of IK can limit its transmission beyond the communities in which it is embedded. At the same time, converting oral knowledge into written form is not a simple solution, because the process of documentation may alter meanings, remove context, or encourage inappropriate use by outsiders. In the Pacific Islands, fishers often target species that have high value to communities and markets, such as seaweeds, finfish, and marine mammals, in order to obtain greater economic returns. However, the concentration of fishing effort on high value species has contributed to unsustainable fisheries in some Pacific areas. Indigenous communities have developed their own classification systems for marine life, reflecting detailed observations of species, habitats, and ecological relationships. Yet because IK is often transmitted orally and because local language use has declined, this knowledge has not been fully incorporated into fisheries development planning. The oral nature of IK has also contributed to an incomplete nomenclatural system for fishes in the Pacific region. In many cases, the names of Indigenous fish species have not been systematically recorded in written form, and they are rarely linked clearly with scientific names used in formal management systems. As a result, when there is limited interaction with Indigenous communities or insufficient interest in learning from them, many fish recognized within local knowledge systems remain invisible to external institutions. Species that are not adequately represented in official classification and management frameworks may gradually lose their perceived value along with the knowledge attached to them, and they may fail to receive proper protection until ecological decline becomes severe. This problem is not merely linguistic.

It reflects a deeper issue of epistemic accessibility, in which knowledge that is highly functional within a community becomes undervalued when assessed by external standards of documentation and administration. The barriers created by the form and transmission of IK reduce its accessibility to the outside world and limit its ability to participate fully in policy formulation. Consequently, IK cannot exert its full practical value in environmental governance. This is one of the central dimensions of the mismatch described above [14, 15]. The mode of communication through which IK is preserved and shared is therefore a major factor contributing to the disconnect between Indigenous Knowledge and environmental policy. In addition, the loss of oral transmission weakens intergenerational continuity, making it more difficult for younger community members to inherit ecological knowledge in a complete and meaningful way. Once this continuity is disrupted, policy institutions face an even narrower representation of Indigenous perspectives, and the gap between local ecological understanding and formal governance becomes wider.

The second reason, partly embedded within the first, is that current fishing regulations are often more favorable to commercial fishing interests than to Indigenous communities. The overfishing of high value species in the Pacific region is linked in part to regulatory systems that do not fully account for local ecological knowledge, customary access rights, or community based management traditions. As a result, Indigenous people are placed at a disadvantage and have less power to compete with commercial fisheries in accessing and managing marine resources. In relation to licensing and permits for fishing in Pacific Island contexts, several regulatory arrangements illustrate this imbalance. State and territorial fishing regulations may require permits and licenses for the harvesting of certain species in state and territorial waters. In addition, fishing for non commercial bottom fish in Hawaii federal waters may require a commercial marine license or a permit application. Federal law also requires certain Hawaiian fishers to register with the National Saltwater Anglers Registry, although registration may be optional for those who engage only in freshwater fishing in state waters or who already hold a valid commercial marine license. While such regulations are often presented as neutral administrative tools, in practice they can restrict Indigenous access to traditional fishing areas and customary resources. Resources that were once governed through community norms and inherited rights may become subject to fees, permits, and external approval. This shift can increase the likelihood of conflict between commercial fishers and Indigenous communities over access to marine resources. It can also create procedural barriers that disproportionately affect communities with fewer financial resources, less administrative support, or limited representation in formal governance institutions. Moreover, the expansion of commercial fishing licenses can contribute to a rise in total catches, placing additional pressure on fish populations and threatening both species diversity and the long term sustainability of fisheries governance. The issue is therefore not simply regulation itself, but the design and orientation of regulation. When policy frameworks prioritize market efficiency, extractive output, and centralized administration over customary stewardship and local participation, they reinforce unequal power relations. Indigenous communities may then be treated as stakeholders to be consulted only marginally rather than as rights bearing knowledge holders with longstanding governance roles. This imbalance reduces the practical influence of IK in decision making and weakens opportunities for collaborative management. In a broader sense, the regulatory environment can transform traditional fishing from a lived cultural practice into an activity constrained by external legal categories that do not reflect local realities. Such conditions deepen the mismatch between environmental policy and Indigenous Knowledge by separating resource governance from the communities that have historically maintained close and adaptive relationships with those ecosystems.

The third factor contributing to the low level of IK involvement in environmental policy is the historical process of colonization and its continuing institutional effects. For example, Pacific salmon has long been an important living resource for Indigenous peoples in the Northern Pacific Rim. Indigenous communities developed sustainable

approaches to salmon management by controlling the risk of species collapse and overfishing, thereby supporting biodiversity and long term ecological balance. However, beginning in the mid nineteenth century, many Indigenous governance powers were removed by colonial authorities. This process involved not only territorial occupation and political control but also deep cultural intervention. As governance authority shifted away from Indigenous communities, cultural values embedded in resource management also changed. Administrative systems shaped by colonial expansion often emphasized short term extraction and centralized control, whereas Indigenous communities generally maintained approaches that stressed reciprocity, continuity, and the long term well being of both people and nature. Under externally imposed governance structures, overfishing became increasingly serious in many areas, and natural resources began to decline. Such governance arrangements frequently failed to respect Indigenous autonomy, resulting in IK being excluded from policy development and implementation. The cultural disruption associated with colonization also led to the suppression of traditions and knowledge systems within Indigenous communities. This suppression affected language use, ceremonial practices, customary law, and the intergenerational transmission of ecological knowledge. When younger generations are separated from traditional territories, educational practices, and community authority structures, their capacity to inherit and apply IK is significantly reduced. This in turn limits the ability of Indigenous peoples to participate effectively in environmental policymaking, because the institutions of governance often recognize only forms of expertise that align with external administrative norms. The effects of colonization should therefore be understood not only as historical events but also as continuing structural conditions that shape whose knowledge is considered legitimate [16]. Even where formal inclusion is discussed, the legacy of dispossession and cultural disruption can continue to constrain meaningful participation. In this sense, the marginalization of IK in environmental policy is not accidental. It is linked to long standing patterns of institutional exclusion that have altered governance systems, weakened community authority, and narrowed the space for Indigenous perspectives in resource management. Recognizing these historical dynamics is essential for understanding why the mismatch between IK and policy persists across generations and why technical reforms alone may be insufficient without deeper institutional change.

In short, the characteristics of IK have indirectly influenced the spread and recognition of knowledge, current regulations have produced an imbalance of power, and colonialism has historically and continuously affected Indigenous peoples by dispossessing them of lands and resources, damaging cultural systems, weakening community authority through external governance, and pushing them to the margins of decision making. Together, these factors contribute to the low level of involvement of Indigenous Knowledge in the environmental policy process. The mismatch is therefore not a simple communication problem, but a multidimensional governance issue involving language, institutions, history, and unequal authority. If environmental policy continues to treat IK as supplementary rather than foundational in relevant contexts, opportunities for effective biodiversity conservation will remain limited [17, 18]. Addressing these mismatches and recognizing the importance of IK and Indigenous rights are critical for promoting more inclusive, balanced, and effective environmental policy for biodiversity conservation. Such efforts require more than symbolic acknowledgment. They call for practical mechanisms that support language preservation, improve equitable participation in regulatory systems, strengthen community based governance, and create respectful pathways for integrating different knowledge traditions. Only when Indigenous communities are able to participate as active decision makers, rather than as peripheral contributors, can environmental policy better reflect ecological complexity and social justice at the same time.

4. Ways Forward

It is essential to identify effective strategies to bridge the gap between the application of indigenous knowledge and the formulation of environmental policies aimed at

biodiversity conservation. While historical colonialism may have diminished the influence of indigenous governance systems, it did not eradicate the value or relevance of indigenous knowledge. This knowledge retains the potential to address critical mismatches in policy frameworks, provided it is fully integrated into the decision-making processes [19]. Such integration requires a deliberate effort to recognize and utilize indigenous perspectives as a vital resource for sustainable environmental management.

A fundamental solution to this challenge lies in reshaping societal values to better align with the perspectives of indigenous communities. By understanding the intrinsic views of indigenous peoples regarding nature, policymakers can more effectively incorporate indigenous knowledge into environmental strategies. For instance, the Marine Protected Area Network (MPAN) serves as a model that not only safeguards marine ecosystems but also fosters collaboration among indigenous communities, local governments, and environmental organizations. This network is structured around four traditional principles, which emphasize harmony, cooperation, and sustainability, ensuring that conservation efforts are both inclusive and effective.

Table 1 provides a concise summary of the four traditional principles that form the foundation of the MPAN approach, highlighting the importance of integrating cultural values into conservation strategies.

Table 1. Traditional Principles for MPAN Design

Principle	Description	Conservation Implication
Respect	Honor every creature when interacting with nature	Ensures ecological integrity [18]
Balance	Intergenerational equity in decisions	Promotes sustainable management [17]
Intergenerational Knowledge	Transmission of knowledge across generations	Enables future use and adaptation of IK [18]
Reciprocity	Mutual giving between humans and nature	Maintains harmonious relationships [18]

Another critical aspect of advancing biodiversity conservation lies in the development of collaborative policymaking processes. Involving indigenous communities in both the collection of knowledge and the formulation of policies is indispensable for creating frameworks that are equitable and effective. The Global Assessment conducted by international organizations has played a pivotal role in ensuring the active participation of indigenous peoples in biodiversity conservation efforts [20, 21]. Such initiatives underscore the importance of inclusivity and cooperation in addressing global environmental challenges.

Table 2 outlines the key elements that define collaborative policymaking processes, emphasizing the need for mutual respect, shared responsibilities, and transparent communication among all stakeholders.

Table 2. Key Elements of Collaborative Policymaking

Element	Description	Expected Outcome
Knowledge Co Production	Involve indigenous people in knowledge collection	Enhanced understanding of natural systems [21]
Diverse Engagement	Include indigenous communities and governments	Broader perspectives in decision making [21]
Biocultural Indicators	Use culturally relevant measurement tools	Better identification of environmental trends [21]
Cross Scale Relevance	Address local and global questions	More effective policies [21]

The simultaneous use of diverse knowledge systems is crucial for achieving comprehensive and balanced policy outcomes. Indigenous knowledge must be treated as an integral component of decision-making rather than merely as a data source. This approach ensures respect for indigenous sovereignty and acknowledges the inseparability of indigenous communities from their knowledge systems. By adopting such principles, policymakers can create frameworks that honor the cultural and intellectual contributions of indigenous peoples while addressing environmental challenges effectively [20, 22].

Table 3 delineates the principles necessary for safeguarding indigenous sovereignty within policymaking processes, ensuring that their rights and perspectives are fully respected and integrated.

Table 3. Principles for Ensuring Indigenous Sovereignty

Principle	Description	Key Consideration
Knowledge System Equality	Use different knowledge systems together	No system dominates another [20]
Indigenous Authority	Recognize Indigenous nations as decision makers	IK cannot be separated from people [23]
Sovereignty Respect	Honor authority over lands and knowledge	Communities are rights holders [23]
Inclusive Design	Involve both IK and Indigenous people	Decisions made with communities [23]

Developing inclusive policy frameworks represents another significant pathway for advancing biodiversity conservation. Prioritizing the rights of indigenous peoples within global environmental policies is essential for achieving equitable and sustainable outcomes. International declarations and agreements, such as those emphasizing self-determination and active participation in decision-making, provide a foundation for integrating traditional knowledge into biodiversity strategies [6, 23]. Recent global frameworks have incorporated specific targets related to indigenous rights and traditional knowledge, reflecting a growing recognition of their importance in addressing environmental challenges.

Table 4 summarizes the key international policy frameworks that support the integration of indigenous knowledge into biodiversity conservation efforts, highlighting their role in fostering inclusivity and sustainability.

Table 4. International Policy Frameworks

Framework	Key Focus	Relevance to IK Integration
UNDRIP	Indigenous rights to self determination	Foundation for Indigenous involvement
Post 2020 BGF	Global biodiversity targets	Includes traditional knowledge targets
Target 20	Traditional knowledge	Directly addresses IK integration
Indigenous Territories	Legal title to lands and resources	Recognizes Indigenous governance

In summary, future directions for biodiversity conservation may include reshaping societal values to align with indigenous perspectives, designing cooperative policies that respect indigenous rights, and establishing inclusive frameworks that prioritize cultural and ecological sustainability [24–26]. These approaches collectively aim to bridge the gap between traditional knowledge systems and modern environmental policies, ensuring a harmonious and effective path forward.

5. Conclusion

This paper explores the significant gap between the theoretical recognition of traditional knowledge in biodiversity conservation policies and its practical implementation. Using Pacific fisheries as a case study, three primary challenges were identified. First, traditional knowledge is predominantly transmitted orally and is deeply rooted in specific regional contexts, which makes it challenging for policymakers to access and integrate into formal frameworks. Second, existing regulatory systems often prioritize commercial interests over local practices, leading to a systemic bias that marginalizes indigenous contributions. Third, the colonial history of many regions has disrupted indigenous governance structures and interrupted the intergenerational transmission of traditional ecological knowledge, further compounding the issue. These challenges highlight the systemic barriers that prevent the effective incorporation of traditional knowledge into conservation strategies, despite its recognized value in fostering sustainable resource management.

The consequences of this disconnection are profound and multifaceted. The exclusion of traditional knowledge from conservation efforts can result in unsustainable resource management practices, as indigenous methods often provide critical insights into ecosystem dynamics and species behavior. Furthermore, the loss of traditional species identification systems undermines biodiversity monitoring and conservation efforts. The erosion of intergenerational knowledge transfer not only weakens cultural heritage but also diminishes the capacity of future generations to engage in sustainable practices. Additionally, the marginalization of indigenous communities exacerbates social inequities and undermines their role as stewards of biodiversity. These outcomes underscore the centrality of traditional knowledge in addressing the shortcomings of current conservation methodologies and highlight the urgent need for its integration into policy frameworks.

Addressing this issue requires a multifaceted approach that prioritizes the inclusion of indigenous perspectives in conservation decision-making. Policymakers can draw on the extensive ecological observations and experiential knowledge of indigenous communities, ensuring that their voices are integral to the formulation and implementation of conservation strategies. Institutionalizing consultation mechanisms, as exemplified by the inclusive policies outlined in frameworks such as the UN Declaration on the Rights of Indigenous Peoples (UNDRIP) and the Post-2020 Global Biodiversity Framework, can serve as a model for fostering collaboration. Practical applications, such as the Marine Protected Area Network, demonstrate the potential for integrating indigenous knowledge into conservation practices. These initiatives not only enhance biodiversity outcomes but also promote mutual respect and facilitate the preservation of traditional ecological knowledge for future generations.

Protecting indigenous knowledge and rights is intrinsically linked to the broader goal of biodiversity conservation. Indigenous communities have historically maintained a harmonious relationship with nature, offering valuable insights into sustainable resource management. Environmental policies must therefore be developed in collaboration with these communities, ensuring that their knowledge systems, decision-making authority, and cultural connections to nature are fully acknowledged and respected. Such an approach can lead to improved ecosystem health, the creation of a more equitable and sustainable living environment, and benefits that extend to all members of society. By fostering partnerships with indigenous peoples, conservation efforts can achieve greater ecological resilience and social justice, paving the way for a more inclusive and sustainable future.

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