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Between technological innovation and the ocean commons: intellectual property and benefit-sharing under the BBNJ agreement

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This article examines the normative conflict between intellectual property (IP) regimes and the benefit-sharing framework established under the Agreement on Marine Biodiversity Beyond National Jurisdiction (BBNJ Agreement). The BBNJ Agreement reaffirms the principle of the common heritage of humankind (CHH). Its distributive objectives remain structurally constrained by international IP rules that prioritise exclusivity and market-driven innovation. The article interrogates the role of patents over upstream technologies (including sequencing platforms, bioinformatics infrastructures, and synthetic biology tools) in creating cumulative access barriers that disproportionately disadvantage states with limited scientific and institutional capacity. Through doctrinal legal analysis and institutional design theory, the article evaluates the clearing-house mechanism (CHM) and the Capacity-Building and Transfer of Marine Technology (CBTMT) Committee as potential governance infrastructures capable of embedding equity into the BBNJ framework. It demonstrates how these mechanisms operationalise traceability, transparency, and inclusive knowledge flows, effectively tethering IP-based innovation to the distributive logic of the ocean commons. The article proposes adaptive licensing models, mandatory disclosure requirements for digital sequence information (DSI), and the reconceptualisation of property as stewardship-bound obligation. It concludes that equitable access to marine genetic resources depends on integrating CHH into the governance of knowledge production, ensuring that value derived from the ocean commons remains legally connected to collective benefit.

KEYWORDS
access and benefit-sharing, biodiversity beyond national jurisdiction (BBNJ) agreement, common heritage of humankind, intellectual property rights, MGR governance

1 Introduction

Marine genetic resources (MGRs) and their associated digital sequence information (DSI) from areas beyond national jurisdiction (ABNJ) sit at the centre of a structural governance tension that the new Agreement under the United Nations Convention on the Law of the Sea (UNCLOS) on the Conservation and Sustainable Use of Marine Biological Diversity of Areas Beyond National Jurisdiction (BBNJ Agreement) seeks to resolve. Article 7(b) affirms the principle of the common heritage of humankind (CHH) as a guiding norm for the governance of marine biodiversity, signalling a deliberate move away from a fragmented legal landscape in which freedom of the high seas and proprietary models of innovation have dominated access to ocean knowledge. While CHH requires that benefits be shared equitably and resources stewarded collectively, the global innovation ecosystem, surrounding MGRs and DSI, is increasingly mediated by intellectual property (IP) regimes that privilege exclusivity and concentrate technological capacity.

Contemporary marine biodiscovery depends on high-throughput sequencing, advanced bioinformatics and synthetic biology tools, many of which are covered by expansive patent claims. Studies of marine biotechnology markets and patent landscapes reveal a consolidation of control over upstream enabling technologies in the hands of a small number of technologically advanced states and corporations, including in deep-sea contexts largely located in ABNJ (Dunshirn and Zhivkoplias, 2024; Zhivkoplias et al., 2024). Such dynamics reproduce long-standing asymmetries in scientific capacity, access to platforms, and the ability to convert genetic material into downstream value. In practice, this means that while all states may access ABNJ as a matter of law, only a minority have the tools to translate that access into scientific or economic benefits; a pattern well documented in scholarship on epistemic inequality and CHH (Massimi, 2024; Vadrot et al., 2022; Mickelson, 2019).

Against this backdrop, the BBNJ Agreement establishes an integrated framework linking access, utilisation and benefit-sharing in respect of MGRs and associated DSI. Article 14 provides for non-monetary and monetary benefit-sharing, operating in conjunction with Articles 11 and 12, which regulate notification and transparency in relation to access and collection activities and situate benefit-sharing within a broader access–utilisation continuum. Article 51, in turn, establishes a clearing-house mechanism (CHM) designed not only to host data but to support transparency, traceability and cooperation across all four pillars of the BBNJ Agreement (Gaebel et al., 2025). Part V institutionalises a Capacity-Building and Transfer of Marine Technology (CBTMT) Committee with a mandate to address structural inequalities that have hindered the implementation of technology transfer provisions under UNCLOS for more than four decades (Harden-Davies and Schütz Veiga, 2025). These arrangements matter because access to high-quality data, enabling technologies and interoperable infrastructures constitutes a precondition for equitable participation in ABNJ governance, particularly for small island developing States (SIDS), least developed countries, and coastal and landlocked developing States with limited scientific and technological infrastructure.

At the same time, the normative landscape surrounding genetic resources is undergoing rapid transformation. The adoption of a multilateral approach to DSI under the Kunming-Montreal Global Biodiversity Framework (GBF) confirms that informational components of genetic resources cannot be exempt from benefit-sharing obligations (Oldham et al., 2023). Distinctions between physical samples and digital representations, increasingly blurred by synthetic biology, have become difficult to sustain in both practice and law. Negotiations under the BBNJ Agreement reflect this reality: attempts to separate MGRs from their informational outputs risk creating governance gaps and enabling benefit capture through IP rights even where access to material samples complies with the procedural requirements set out in Articles 11 and 12. Hidden heuristics in negotiations, including assumptions about tangibility, territoriality and the neutrality of scientific data, continue to shape outcomes in ways that privilege technologically advanced actors (Thambisetty, 2020).

This article brings these developments together, arguing that the interaction among intellectual property law, the law of the sea and biodiversity law should be understood as a normative conflict between legal orders with divergent constitutional logics. IP law structures innovation around exclusivity; the law of the sea frames areas beyond national jurisdiction through the CHH and the FoHS; biodiversity law, as developed under the Convention on Biological Diversity and the Nagoya Protocol, combines the CHH with the principle of permanent sovereignty over natural resources. Earlier efforts to mediate tensions between biodiversity objectives and intellectual property protection are reflected in Article 16 of the Convention on Biological Diversity, which addresses access to and transfer of technology. The challenge for the BBNJ Agreement is therefore not simply technical coordination but the construction of governance mechanisms capable of reconciling these competing logics while maintaining the distributive commitments embedded in Article 7(b).

Through doctrinal analysis grounded in Article 31 of the Vienna Convention on the Law of Treaties, together with institutional design theory, we evaluate whether the CHM and CBTMT Committee can serve as infrastructures that realign innovation pathways with CHH. The institutional design literature, including Ostrom's principles on polycentric governance, suggests that transparency, monitoring, accountability and inclusive participation are necessary to prevent commons regimes from reproducing existing inequalities (Dalaker, 2025). These insights inform our assessment of adaptive licensing models, disclosure-of-origin requirements for DSI-related patents, and reframing property as an obligation-bound relation rather than a unilateral entitlement.

The article is structured as follows. Section 2 surveys the existing scholarly debates on the common heritage of humankind, benefit-sharing frameworks, and the role of exclusive rights in marine biodiversity governance. Section 3 examines the constitutional conflict between international IP regimes and the CHH principle, examining how patenting upstream technologies complicates equitable access to MGRs/DSI. Section 4 turns to institutional design, assessing the potential of the CHM and CBTMT Committee to embed equity into the BBNJ framework. Section 5 outlines a normative framework for rebalancing proprietary claims

with collective stewardship through adaptive licensing, disclosure requirements, and the reconceptualisation of property as stewardship. We conclude by reflecting on the constitutional potential of the BBNJ Agreement to anchor innovation governance in justice, sustainability, and legal accountability.

2 Competing legal paradigms: CHH, benefit-sharing, and exclusive rights

The ABNJ MGRs/DSI have generated extensive legal, political and empirical scholarship. Much of this literature converges on a central theme: the normative landscape is shaped by three competing legal paradigms. The CHH principle promotes collective stewardship and equitable distribution (Tladi 2014). Benefit-sharing frameworks seek to operationalise fairness but remain legally and institutionally fragmented (Morgera, 2024). IP systems, by contrast, prioritise exclusivity, private appropriation and technological enclosure (Blasiak et al., 2020). This section reviews the literature across these three paradigms to establish the conceptual foundations for the analysis that follows.

2.1 Common heritage of humankind

CHH emerged as a normative response to unilateral claims over global commons. Scholarship on its origins centres on Arvid Pardo's proposal for the deep seabed, which cast CHH as a principle designed to prevent enclosure, moderate geopolitical tensions and embed distributive justice in ocean governance (Mickelson, 2019). Pardo's vision emphasised shared stewardship, intergenerational equity, and the prevention of appropriation that produces inequality.

More recent work interrogates how CHH operates in contemporary governance settings. Vadrot et al. (2022) argue that CHH has evolved into a "practice of contestation" deployed by developing states to challenge epistemic and material hierarchies in global ocean governance. On this reading, CHH is at once a legal principle and a political tool for articulating claims to fairness in ABNJ biodiversity governance. Massimi (2024) pushes further, showing how prevailing interpretations of CHH are shaped by 'epistemic severing' and 'epistemic trademarking', which marginalise non-Western knowledge systems and reproduce elitist scientific hierarchies. What emerges from this scholarship is that CHH's relevance today lies not merely in its distributive logic but also in its capacity to expose deeper power asymmetries in knowledge production, scientific infrastructures and governance authority.

Commentary on the BBNJ Agreement itself reinforces CHH's continuing relevance. Tladi's analysis of the negotiations shows that states oscillated between pragmatic formulations and sustainability-oriented approaches, with CHH emerging as a symbolic anchor even when not explicitly codified (Tladi, 2014). Taghizadeh's detailed evaluation of Article 7 confirms that, while CHH is affirmed as a guiding principle, whether it has operative force will depend on the institutional robustness of the Agreement's benefit-sharing and technology-transfer mechanisms (Taghizadeh and Asgarian, 2024). These contributions, read together, position CHH as the normative baseline against which competing governance models fall to be assessed.

2.2 Fair and equitable benefit-sharing

Benefit-sharing occupies an intermediate position between CHH and exclusive rights (Morgera, 2016). Under the Convention on Biological Diversity (CBD) and the Nagoya Protocol, benefit-sharing frameworks have been developed primarily for genetic resources within national jurisdiction. Nevertheless, these instruments have shaped expectations for ABNJ governance, particularly regarding equity, access to technology, and participation in scientific research (Humphries et al., 2025).

The persistent challenges of benefit-sharing in practice are well documented. Salpin and Germani (2007) emphasise that bioprospecting in ABNJ has historically taken place without clear legal obligations, enabling private actors to secure patents over discoveries without sharing benefits. Chiarolla (2014) identifies further obstacles: fragmented institutional mandates, limited traceability of genetic material and divergent national approaches to IP and disclosure. The informational turn in genetic resource governance — particularly the rise of DSI — has intensified these challenges. Oldham et al. (2023) demonstrate that without explicit regulation of the informational components of MGRs, users can derive significant value from sequences without accessing physical samples, effectively bypassing benefit-sharing mechanisms. Their work lends support to multilateral approaches to DSI benefit-sharing under the GBF, including the establishment of the Cali Fund, and illustrates a broader normative shift toward collective governance of digital genetic information, a shift that informs parallel developments under the BBNJ Agreement (Orozco & Scholz 2025).

The institutional architecture of Part II of the BBNJ Agreement, and in particular Article 14, has attracted attention for its potential to rebalance global knowledge flows. Harden-Davies and Schütz Veiga (2025) argue that Part V of the BBNJ Agreement marks a departure from decades of ambiguous and under-implemented technology transfer obligations under UNCLOS, establishing monitoring structures and a CBTMT Committee designed to institutionalise accountability. Gaebel et al. (2025) highlight the role of the CHM in enabling transparency, matching capacity needs and supporting inclusive data governance across all treaty pillars. At the same time, the limits of generic benefit-sharing language have drawn scrutiny. Tladi (2014) warns that overly pragmatic formulations risk diluting the distributive force of CHH, while Taghizadeh and Asgarian (2024) note that without operational detail, benefit-sharing may fail to address deep-rooted inequities in scientific capacity and participation. The literature, on balance, converges on a recognition that existing benefit-sharing frameworks face serious challenges in addressing gaps relating to DSI, upstream technologies, and structural inequalities.

2.3 Exclusive rights and intellectual property

IP occupies an ambivalent position in the BBNJ framework. It can function as a source of economic returns relevant to monetary benefit-sharing, but it also operates as a structural counterpoint to the distributive commitments of CHH. The scholarship is clear that contemporary marine biotechnology is embedded within global innovation systems defined by exclusivity, enclosure and cumulative control over enabling technologies (Blasiak et al., 2020). Dunshirn and Zhivkoplias (2024) show that scientific publications on MGRs originate from a wide range of states, but the transformation of these findings into patents is dominated by technologically advanced jurisdictions. Their analysis of 'knowledge flows' demonstrates that research produced in developing states rarely enters commercial value chains. Zhivkoplias et al. (2024) further reveal that a handful of corporate actors hold the majority of patents referencing deep-sea species, including those in ABNJ, reinforcing Chiarolla's (2014) description of the 'anti-commons'.

Several scholars have sought to explain the structural drivers of this concentration. Thambisetty's (2020) work on IP heuristics shows how assumptions about tangibility and territoriality obscure the reality that, once sequenced, genetic information becomes dissociated from its environmental origin, enabling enclosure through patents even when material samples remain accessible. Cifrodelli's (2024) analysis of commons-oriented models in IP provides additional theoretical support for re-evaluating property concepts in contexts involving public funding, global commons and technologies with transboundary impacts. Alongside these doctrinal insights, empirical work documents how the expansion of marine biotechnology and synthetic biology reinforces market incentives to privatise upstream technologies and data infrastructures (Zhivkoplias et al., 2024). This reinforces the asymmetry between actors who possess sequencing platforms, data-processing capacity and computational infrastructures, and those who rely on externally controlled tools. The cumulative picture is that IP systems shape not only access to innovations but the global distribution of scientific capacity and authority. That dynamic sits in fundamental tension with both the distributive logic of CHH and the procedural ambitions of benefit-sharing. These structural gaps set the stage for exclusive rights to consolidate rather than redistribute value, a point we develop in the next subsection.

3 Intellectual property and the erosion of the commons

The interaction between IP regimes and the CHH constitutes a constitutional tension between legal orders grounded in distinct normative logics. This tension does not arise from a hierarchy of norms, but from the coexistence of principles that structure authority, entitlement and obligation in fundamentally different ways, and that require coordination through techniques of systemic interpretation rather than displacement (International Law Commission, 2007). On the one hand, the CHH principle establishes a distributive and stewardship-based framework for ABNJ MGRs/DSI. On the other hand, the IP system, anchored in exclusivity and private appropriation, has progressively expanded into the domain of upstream technologies, data infrastructures and synthetic biology tools that structure the global bioeconomy. Between these two poles sits the BBNJ Agreement's benefit-sharing framework, which attempts to mediate equity aspirations through procedural instruments but risks being overwhelmed by proprietary logics unless supported by robust institutional design. This section unpacks that constitutional conflict. We first examine the normative tension between CHH and the freedom of the high seas (FoHS) as competing interpretative pathways under UNCLOS. We then explore how market-driven innovation under TRIPS-oriented regimes collides with equity-based obligations in the BBNJ Agreement. Finally, we analyse DSI as the pivotal test of whether the BBNJ Agreement's institutional architecture can govern not only physical resources but also the intangible informational derivatives that now constitute the primary site of value appropriation.

3.1 Competing legal frameworks: CHH and the freedom of the high seas

The tension between CHH and the FoHS has shaped ABNJ governance debates for decades. Early analyses of MGRs and marine scientific research in the Area already identified the friction between freedom-based access and emerging distributive claims (Glowka, 1996). The legal architecture of UNCLOS entrenches this tension: Article 136 declares the Area and its resources as the CHH, whereas Article 87 enshrines the FoHS for navigation, scientific research, and use of the water column. Although UNCLOS does not explicitly address MGRs in ABNJ, this silence has led to divergent interpretations of their legal status (De Lucia, 2020). Developed states have frequently advanced the view that biological resources in the high seas fall under the FoHS regime, which they interpret as permitting unregulated access, sample collection, and downstream utilisation, including through patenting. That reading implicitly aligns MGR governance with open-access models historically associated with fisheries and marine scientific research, centring scientific freedom and market-based innovation as primary governance values (Thambisetty, 2025).

The political consensus on DSI reached under the Convention on Biological Diversity provides an important interpretative backdrop. Target 13 of the Global Biodiversity Framework and subsequent Conference of the Parties decisions, including Decision 15/9 and the modalities elaborated in Decision 16/2, recognise the need for a multilateral approach to benefit-sharing from the use of DSI, including through the establishment of the Cali Fund. While this mechanism operates alongside the existing bilateral access and benefit-sharing regime and is framed in largely voluntary terms, it signals a broader acknowledgement that informational components of genetic resources raise distributive questions that extend beyond physical access to material samples. This development bears directly on parallel debates under the BBNJ Agreement concerning the governance of MGRs and associated DSI.

Developing states have pressed for a unified spatial and normative interpretation that treats MGRs and their informational outputs as covered by the distributive logic of CHH. Two arguments underpin this position. First, biological and mineral resources in the

deep ocean are not conceptually separable: both are extracted from ecologically interconnected spaces that should be governed as commons (Thambisetty, 2025). Second, CHH embodies a constitutional principle of equity, requiring not only regulated access but also shared governance and benefit-sharing (Taghizadeh, 2025). On this view, access without redistribution is not neutrality but a form of appropriation that entrenches scientific and economic asymmetries. This reading interprets CHH as a corrective to historical inequities in MSR capacity, data access, and technological capabilities, inequities well documented in recent empirical work on the geography of deep-sea biodiversity research and patent activity (Dunshirn and Zhivkoplias, 2024).

The divergence is not merely doctrinal but ideological. For many developed states, CHH is seen as a constraint: a redistributive logic that introduces obligations, oversight mechanisms and potential limitations on proprietary claims (Salavitch, 2025). For many developing states, FoHS, as currently interpreted, functions as a structural enabler of inequity, allowing technologically advanced actors to transform common resources into exclusive assets. The BBNJ negotiations made this clash explicit, with states debating not only legal terminology but competing visions of the global order. The debates echo earlier contestations around the New International Economic Order, in which redistributive claims grounded in common heritage reasoning confronted market-oriented visions of a liberal international economic order. While the final text adopts CHH as a guiding principle, the BBNJ Agreement also encompasses the FoHS for MSR in Article 7(c). Considering this approach, its operational force depends on the institutions created under the BBNJ Agreement. The tension between CHH and FoHS provides the conceptual backdrop against which the constitutional conflict between innovation and equity unfolds. This duality raises an interpretative question of real consequence: whether access to MGRs/DSI remains governed by the freedom of the high seas, while their utilisation (and the informational and economic value derived from them) is guided by the distributive logic of CHH. The coexistence of Articles 7(b) and 7(c), read together with the access, notification, and benefit-sharing provisions in Articles 11, 12, and 14, suggests a bifurcated regulatory structure in which freedom governs access to areas beyond national jurisdiction, while distributive obligations attach to utilisation. Whether this structure holds together in practice depends on institutional implementation.

Article 7 situates the CHH and the FoHS within the same catalogue of principles and accords each formal parity within the treaty structure. Their coexistence generates interpretative complexity at the stage of application to MGRs and associated DSI. This section examines how concurrent reliance on both principles shapes the legal framework access and utilisation, and clarifies that the analysis concerns their interaction within the BBNJ Agreement rather than hierarchical displacement.

3.2 Normative conflict: innovation versus equity

MGR/DSI governance is increasingly shaped by global innovation systems whose legal infrastructure rests on IP rights, especially patents. The Trade-Related Aspects of Intellectual Property Rights (TRIPS) Agreement frames patents as essential incentives for technological progress, presuming that market-driven innovation ultimately benefits society through knowledge diffusion and technological advancement (Salpin and Germani, 2007). Yet in fields where upstream research capacity, sequencing infrastructure, and computational tools are concentrated in a few jurisdictions, this diffusion is neither automatic nor equitable. Instead, as Dunshirn and Zhivkoplias (2024) demonstrate empirically, patent uptake in marine biotechnology overwhelmingly favours actors with pre-existing technological dominance, while research produced in developing states rarely transitions into commercial value chains. IP, in other words, does not merely regulate innovation; it structures global hierarchies of scientific capability.

The TRIPS framework and the equity-oriented commitments of the BBNJ Agreement interact in ways that generate structural tension. Article 7(b) affirms the common heritage of humankind as a guiding principle for the utilisation of marine genetic resources and associated DSI, while Article 7(d) recognises fair and equitable sharing of benefits as a further guiding principle. Article 14 gives operational expression to these commitments through specific benefit-sharing obligations that presume some redistribution of non-monetary outputs (such as data, knowledge, and technology) and, in the future, monetary benefits. The BBNJ Agreement's architecture, particularly the CHM and the CBTMT Committee, reflects a commitment to addressing systemic disparities in scientific and technological capacity. Article 14(3) establishes mandatory non-monetary benefit-sharing obligations, including the sharing of data and research results. This provision introduces an important redistributive mechanism within the treaty framework. Access to raw sequence data, however, represents only one layer of participation in marine genetic research. Scientific capability depends on computational infrastructure, specialised training, data-processing capacity and access to enabling technologies. The distributive concern addressed here relates to this second-order dimension of capability, which data-sharing obligations alone cannot equalise across jurisdictions. A structural difficulty stems from the absence of explicit intellectual property provisions in the BBNJ Agreement. TRIPS obligations continue to govern the recognition and enforcement of patents, copyrights, and trade secrets, irrespective of the commons-based origin of genetic material or the distributive logic reflected in Article 7.

The conflict becomes particularly acute when one considers upstream technologies. Sequencing platforms, data storage systems, and bioinformatics pipelines essential to accessing and interpreting MGRs are routinely protected by patents or proprietary licensing models. Their exclusivity consolidates control over the very starting points of the research process. Because these technologies are prerequisites for participating in marine science, their enclosure creates cumulative barriers for states lacking in infrastructure, funding, and scientific networks. Even when biological samples are made available, the tools necessary to unlock scientific value remain inaccessible. The result is a bifurcated system: access to the ocean genome is formally open but substantively restricted through technological and proprietary bottlenecks (Blasiak et al., 2020).

It bears noting that several bioinformatic tools central to marine genetic research, including widely used protein-structure prediction systems and sequence-analysis platforms, do operate under open-source licences and contribute to expanding technical accessibility. Open-source availability, however, is only one component of the broader innovation ecosystem (Gottlieb et al., 2025). Effective participation in MGR and DSI research depends on access to high-performance computing capacity, large-scale data storage, sustained research funding, and specialised scientific expertise. The patterns of concentration at issue here concern aggregate control of enabling infrastructures and institutional resources, not proprietary software alone. This structural dimension frames the distributive implications examined in this section.

Our analysis situates patents within the doctrinal architecture of international IP law and recognises the legal criteria governing their grant. The inquiry concerns the distributive implications arising when enabling technologies essential to marine genetic research remain concentrated in a limited number of jurisdictions. Control over sequencing platforms, data infrastructures and related technologies influences effective access to MGRs and associated DSI, thereby shaping the conditions under which benefit-sharing obligations under the BBNJ Agreement operate (Dunshirn and Zhivkoplias, 2024). The constitutional question we address concerns the interaction between proprietary entitlements and commons-based commitments within the treaty framework.

The deeper constitutional issue is not whether IP incentivises innovation, a premise largely accepted even among its critics, but whether IP's underlying logic is compatible with the distributive and stewardship-based commitments of CHH. IP and CHH reflect distinct normative commitments that generate structural tensions in MGR governance (Salavitch, 2025). IP frameworks assume that exclusive control over knowledge incentivises innovation and that benefits will diffuse through market mechanisms. CHH frameworks assume that resources derived from global commons generate obligations of collective stewardship and equitable distribution. These are not administrative differences; they reflect competing visions of legal ordering: one privileges efficiency and private appropriation as pathways to social benefit; the other privileges fairness, ecological responsibility and direct distributive mechanisms (Xu & Jin, 2025). The BBNJ Agreement seeks to bridge this divide, but its tools, particularly benefit-sharing, risk remaining secondary if upstream control points remain shielded from redistributive obligations.

3.3 Digital sequence information as a test of institutional design

DSI is where the normative conflict between proprietary innovation and equity finds its sharpest expression. By decoupling value from material samples, DSI enables users to appropriate genetic information without engaging with access-and-benefit-sharing (ABS) frameworks designed around physical specimens. This informationalisation of biodiversity carries profound legal consequences. Although physical access to samples in ABNJ may occur in clandestine ways and presents significant enforcement challenges, it remains geographically and materially anchored in ways that render it, at least in principle, observable and traceable. Digital access, by contrast, is diffuse, rapid and often opaque, allowing sequences to circulate across jurisdictions without any corresponding point of collection or notification. Public repositories such as GenBank facilitate open data sharing, yet nothing prevents entities from downloading sequences, integrating them into proprietary datasets, synthesising them *in vitro*, and securing patents over resulting discoveries, all without disclosure of the source ecosystem or any benefit-sharing obligations (Oldham et al., 2023). Oldham et al. (2025) describe this phenomenon as 'post-access appropriation', highlighting its distributive implications. The absence of physical access requirements allows actors to circumvent governance tools designed around material collection. DSI accordingly becomes a critical test of the BBNJ Agreement's institutional robustness. Even though the treaty does not provide an explicit definition of DSI, several provisions, including Articles 1(10), 11, 12, 14, 44 and 51, establish a legal architecture within which informational components of MGRs can be linked to notification, transparency and benefit-sharing obligations, subject to coherent institutional interpretation. The effectiveness of this approach depends primarily on two governance mechanisms: the CHM and the CBTMT Committee.

For the CHM, DSI raises foundational questions concerning how informational use can be rendered traceable within benefit-sharing systems, how utilisation can be linked to points of collection in ABNJ, and how downstream innovation can be connected to obligations of disclosure and redistribution. Therefore, metadata standardisation, mandatory disclosures in data repositories, and integration with global patent databases become essential legal tools. These are not merely tools of scientific collaboration; they operationalise the visibility without which equitable redistribution cannot function. For the CBTMT Committee, DSI underscores the need to strengthen digital and computational capacity across developing states. Without access to sequencing tools, data infrastructures, and bioinformatics training, benefit-sharing remains aspirational. DSI thus pressures the CBTMT Committee to move beyond traditional technology transfer paradigms and into the terrain of digital sovereignty and infrastructure-building. DSI thus operates as an institutional test case for the BBNJ Agreement, extending its governance challenges from biological material to the digital knowledge infrastructures that increasingly structure the marine bioeconomy (Oldham et al., 2023, 2025).

DSI, in short, crystallises the structural misalignment at the core of MGR governance. If the BBNJ Agreement cannot regulate intangible informational outputs, its equity commitments risk becoming symbolic. If, on the other hand, its institutions succeed in linking DSI use to benefit-sharing obligations, the BBNJ Agreement could reshape how international law governs the digital dimensions of the global commons. The stakes are high. DSI determines whether CHH remains a constitutional principle with operative force or a normative aspiration overshadowed by proprietary regimes.

4 Institutional interfaces for equity

Resolving the structural tension between innovation-driven proprietary regimes and the distributive commitments of CHH

requires institutional architectures capable of mediating power asymmetries, securing transparency, and opening avenues for equitable participation in scientific knowledge production. The BBNJ Agreement acknowledges this challenge by establishing two governance bodies, the CHM and the CBTMT Committee, that we argue should be understood as constitutional infrastructures rather than merely procedural instruments. The two mechanisms occupy distinct yet interlinked roles in redressing structural inequities in access to MGRs/DSI. Their legitimacy turns on whether they can operationalise CHH not as rhetoric but as a functional constraint on proprietary enclosure, ensuring that scientific and technological flows derived from ABNJ remain tied to collective benefit. We analyse below how these two mechanisms can perform such constitutional functions and identify the institutional design choices that will determine whether the BBNJ Agreement fulfils its promise of equity. The following subsections analyse each mechanism in turn, examining their constitutional functions and identifying design choices that determine their effectiveness in embedding equity into the BBNJ framework.

4.1 The clearing-house mechanism

The CHM established under Article 51 forms the informational backbone of the BBNJ Agreement. Although formally described in procedural terms, the CHM's institutional significance goes well beyond that of a conventional repository. As Gaebel et al. (2025) show, the CHM constitutes the connective architecture through which the BBNJ Agreement's four pillars can be rendered interoperable, enabling the circulation of information, technology and obligations across an otherwise fragmented governance landscape. It is not a passive database but an enabling interface whose design determines whether the regime's distributive commitments, including those anchored in CHH, can be operationalised in practice. This aligns with the theoretical account offered by Schütz Veiga and Marcos (2025), who describe the CHM as a constitutional information node: an institutional mechanism that shapes how scientific value is created, shared and linked to legal responsibilities.

Central to this role is the production of visibility across the MGR–DSI value chain. Marine genetic research has historically suffered from fragmented reporting pathways, proprietary sequencing environments and significant opacity in downstream utilisation. Humphries et al. (2025) demonstrate that many governance failures of earlier ABS frameworks arose not from normative gaps but from infrastructural invisibility: states simply could not see where samples, sequences and knowledge travelled. Visibility, then, is not merely a technical attribute but a distributive condition. Through interoperable metadata standards, persistent identifiers and open data architectures, the CHM can render informational flows legible for all users, thereby enabling Articles 14 and 44 to function as intended. The CHM does not itself verify compliance, but it establishes the informational preconditions on which equitable governance depends.

The CHM also carries a significant coordination function. Article 51(3) establishes it as a platform for matching needs and offers, for technology transfer, training, scientific cooperation, and institutional support. As Gaebel et al. (2025) emphasise, effective coordination under the CHM extends beyond the bulletin-board logic characteristic of earlier UNCLOS-era clearing-houses, which tended to privilege actors already possessing digital literacy and institutional capacity. Effective coordination requires differentiated design: multilingual interfaces, regionally tailored functionalities, and user-specific tools for SIDS, IPLCs, early-career researchers, national focal points and regional organisations. Schütz Veiga and Marcos (2025) highlight that without such differentiation, the CHM risks entrenching the epistemic and technological hierarchies that already structure global science. The CHM also constitutes the institutional locus for disclosure of origin, encompassing not only material samples but also DSI and technological applications derived from them. This requires harmonisation with the WIPO Treaty on IP, Genetic Resources and Associated Traditional Knowledge (GRATK), which mandates disclosure obligations in patent filings. Integrating GRATK-based disclosure obligations into the CHM's operational requirements would support institutional traceability, linking commercial utilisation to benefit-sharing obligations (Wendland, 2025). Such an approach sits comfortably within the redistributive logic of CHH and would curb the 'post-access appropriation' of ABNJ-derived sequences that currently characterise marine biotechnology markets.

A subtler but no less consequential function is epistemic integration. Digital infrastructures distribute epistemic authority unequally: actors with access to sequencing platforms, cloud infrastructure and bioinformatic pipelines shape not only the pace but also the content of scientific discovery. Massimi (2024) and Vadrot et al. (2022) demonstrate that unless explicitly designed to counteract these patterns, digital infrastructures amplify epistemic hierarchies, marginalising Global South knowledge practices and constraining the representativeness of global marine science. Schütz Veiga and Marcos (2025) extend this insight into the BBNJ context, arguing that the design of the CHM can incorporate epistemic pluralism through inclusive taxonomies, regionally meaningful metadata, open technical documentation and design choices that accommodate diverse knowledge systems. This is not ancillary work: it affects the accuracy, legitimacy and distributive integrity of global marine research. The CHM can function as an epistemic equaliser when structured as a platform that not only disseminates data but also broadens participation in scientific knowledge production. This means moving beyond traditional north–south assumptions about data capacity and recognising that informational infrastructures can entrench or dismantle inequities depending on their governance. Vadrot et al. (2022) and Massimi (2024) analyse epistemic justice and highlight the risk that poorly designed data infrastructures can reproduce the marginalisation of Global South knowledge systems. For this reason, the CHM's institutional design should incorporate explicit principles promoting interoperability, multilingual accessibility, open technical documentation and decentralised data contributions. The CHM should not replicate elite-controlled repository models but function as a commons-based infrastructure aligned with the distributive obligations of CHH.

The CHM also plays a role in temporal alignment, a dimension that institutional analyses tend to overlook. Digital sequencing, data

circulation and analytical innovation evolve at a speed that far outpaces multilateral decision-making. Schütz Veiga and Marcos (2025) argue that the normative coherence and operational relevance of the BBNJ regime depend in part on the CHM operating as a synchronising mechanism, structuring the timing of submissions, capacity requests, scientific outputs and implementation reviews. Temporal alignment between these processes supports institutional responsiveness and reduces the risk of regulatory lag vis-à-vis scientific practice, with implications for both effectiveness and equity. Within the treaty architecture, we identify three interrelated constitutional roles for the CHM. First, it restores visibility to how MGRs/DSI circulate and are used. Second, it provides a legal framework for linking utilisation to benefit-sharing, thereby giving operational effect to Articles 14 and 44. Third, it operates as an equity-oriented knowledge infrastructure that incorporates diverse epistemic communities and mitigates the capture of proprietary data. Together, these functions make the CHM an institutional vehicle for tethering scientific innovation to the public interest, a necessary corrective to the structural asymmetries produced by global IP systems.

A final point concerns the CHM's contribution to linking informational value to collective obligations. While the mechanism does not perform oversight or verification, it can provide the architecture through which benefit-sharing triggers become legible, especially in relation to non-monetary benefits. Gaebel et al. (2025) stress that it is the visibility of utilisation, not policing, that enables the distributive logic of CHH to materialise. By integrating information on research activities, non-monetary contributions, and capacity-building efforts, the CHM can help ensure that the circulation of scientific value remains tied to obligations of fairness rather than disappearing into proprietary or inaccessible channels. Considered as a whole, these dimensions, visibility, coordination, epistemic integration, temporal alignment and value–obligation linkage position the CHM not as a technical tool but as a foundational institutional interface. The CHM enables the BBNJ regime to function as a coherent governance system and provides the informational scaffolding needed to operationalise CHH's distributive commitments. Without it, the equity ambitions of the Agreement risk remaining aspirational.

Table 1 synthesises the institutional functions of the CHM and the CBTMT Committee, clarifying how each mechanism contributes to governance outcomes, the operationalisation of CHH, and equity within the BBNJ framework.

4.2 The capacity-building and the transfer of marine technology committee

The CBTMT Committee, established under Article 46, plays a complementary but equally central role in the BBNJ Agreement's institutional architecture. Its mandate goes beyond facilitating training or technical assistance; it is designed as a governance mechanism capable of reducing the structural disparities that shape global participation in marine science. Harden-Davies and Schütz Veiga (2025) emphasise that effective capacity-building requires moving beyond voluntary assistance and towards sustained, needs-driven and accountable institutional interventions. This view echoes the approach embedded in UNCLOS Articles 266–268, which frame technology transfer as a legal duty grounded in international cooperation rather than benevolence.

The CBTMT Committee's mandate encompasses both capacity-building and the transfer of marine technology, the latter being not an adjunct to capacity-building but one of its most effective modalities. Technology transfer, when implemented as sustained, accountable cooperation rather than episodic assistance, creates the material and institutional conditions necessary for states to develop endogenous scientific capability. Sequencing platforms, data infrastructures and bioinformatics tools are capacity-building in the strongest sense: they enable participation, interpretation and innovation. We therefore treat technology transfer as a core mechanism through which CHH's distributive obligations operate.

A more concrete understanding of the CBTMT Committee's mandate also follows from a careful reading of the BBNJ Agreement's definition of "marine technology". This structure is not merely conceptual; it delineates the practical scope of the CBTMT Committee's interventions. Although presented as an open-ended list, the definition contains a tripartite structure that is directly relevant to implementation (Schütz Veiga forthcoming). First, it distinguishes between types of technology, encompassing both equipment and informational components, reflecting an understanding of capacity-building that extends beyond hardware to include manuals, standards, methodologies, data architectures and other epistemic resources. Recent scholarship on the design of the BBNJ benefit-sharing regime has similarly emphasised the importance of aligning different functional categories of marine technology with differentiated transfer modalities, underscoring the operational implications of this distinction (Yu et al., 2025). Equipment alone rarely generates sustainable

TABLE 1 Institutional functions of the CHM and the CBTMT committee under the BBNJ agreement.

Institution	Core function	Governance outcomes	CHH operationalisation	Equity outcomes
Clearing-House Mechanism (CHM)	Visibility; metadata standards; interoperability; disclosure; utilisation–obligation linkage	Restores traceability across the MGR–DSI value chain; reduces informational enclosure; supports transparency and compliance	Links utilisation to collective benefit; embeds transparency obligations; reduces informational asymmetries	Ensures origin linkage; enables tracking of DSI use; strengthens data governance in digital research environments
Capacity-Building and Transfer of Marine Technology (CBTMT) Committee	Technology transfer; institutional strengthening; scientific and legal capacity; digital infrastructure development	Builds endogenous capability; reduces dependency on proprietary platforms; enables effective participation in MGR/DSI research and governance	Implements differentiated obligations; distributes enabling technologies; advances long-term capability equity and collective stewardship	Expands DSI analysis capacity; supports regional data hubs; mitigates concentration of computational resources

capability without these complementary elements. Secondly, it organises technology into functional categories, ranging from explanatory and analytical tools to software, facilities and residual forms of knowledge, including context-specific methods that may derive from traditional or community-based practice. This broader understanding aligns with recent analyses of synergies between the BBNJ Agreement and the Kunming–Montreal Global Biodiversity Framework, which emphasise the need to treat marine technology as an ecosystem of interdependent knowledge resources rather than as discrete artefacts (Schütz Veiga et al., 2024). Finally, the definition is anchored by a conditional clause requiring that all technologies be "related to the conservation and sustainable use of marine biological diversity", which transforms it from a descriptive inventory into an operational tool (Schütz Veiga, forthcoming). Interpreted together, these elements provide the CBTMT Committee with a practical framework for prioritising requests, assessing absorptive capacity and aligning technology transfer with the distributive logic of CHH.

This broader understanding of technology transfer has direct implications for how capacity-building is interpreted in the MGR/DSI context. Under Part V, capacity-building operates across legal, technological, infrastructural and epistemic dimensions. Within this framework, the mandate of the CBTMT Committee extends to long-term institution-building in addition to technical training initiatives. This includes supporting states in developing sequencing capabilities, bioinformatics infrastructures, open-source analytical tools, and legal literacy in intellectual property and benefit-sharing. Without such interventions, developing states risk remaining dependent on proprietary platforms and external scientific networks, reinforcing the very asymmetries the BBNJ Agreement seeks to remediate.

The CBTMT Committee's mandate intersects directly with DSI governance. As marine science becomes increasingly data-driven, equity in access to computational resources becomes as critical as access to physical samples. Capacity-building accordingly demands the development of cloud-based computing systems, interoperable data standards and regionally distributed analytical hubs that prevent a handful of elite institutions from dominating data extraction and concentrating informational value (Blasiak et al., 2020; Dunshirn and Zhivkoplias, 2024). In this regard, the CBTMT Committee operates as a vector of digital sovereignty, supporting the development of endogenous capacity to store, process and interpret DSI (Harden-Davies and Schütz Veiga, 2025).

The CBTMT Committee works in close coordination with the CHM within what we describe as an interdependent governance ecosystem. The two institutions function through reciprocal linkages rather than in parallel silos. Within this framework, the CBTMT Committee supports states in developing the capacity to use and contribute to the CHM effectively, while the CHM generates the information base that enables targeted capacity-building interventions. This feedback loop transforms capacity-building from a generic activity into a dynamic process of institutional learning. In practical terms, it requires the development of joint work programmes, shared performance metrics and cross-institutional governance protocols linking data visibility, technology transfer and benefit-sharing. Such institutional integration reflects insights from Ostrom's robustness and polycentric governance framework as applied to the BBNJ Agreement, particularly the need for clearly defined roles and communication channels between institutions (Dalaker, 2025).

A further constitutional function lies in the CBTMT Committee's capacity to embed differentiated obligations. CHH's distributive logic requires not symmetrical but equitable contributions and responsibilities, consistent with scholarship emphasising that CHH embeds differentiated obligations grounded in capacity, equity and collective stewardship (Mickelson, 2019). The Committee's mandate encompasses developing operational criteria for differentiated obligations grounded in scientific capacity, financial resources, ecological exposure and historical patterns of exclusion from marine biotechnology. Such criteria provide a structured basis for prioritisation in technology transfer, for the allocation of financial support, and for the monitoring of compliance. Differentiation also prevents the burden of implementation from falling disproportionately on states least equipped to bear it, thereby preserving the legitimacy and feasibility of the BBNJ regime.

Finally, Annexe II of the BBNJ Agreement clarifies that capacity-building includes the development and strengthening of legal and institutional frameworks, confirming that these elements form an integral component of the Committee's mandate (Harden-Davies and Schütz Veiga, 2025). This dimension includes support for states in navigating IP negotiations, understanding licensing frameworks, asserting benefit-sharing claims and engaging in treaty interpretation processes, consistent with the forms of assistance identified in Annexe II, including subparagraph (d). Legal capacity is itself a form of scientific capacity: without it, states cannot shape the governance of marine genetic resources in accordance with their interests or with the principles of CHH. Empowering states to participate in norm creation and institutional development is what will determine whether the BBNJ Agreement evolves as a genuinely inclusive governance regime.

5 Legal and policy solutions: rebalancing innovation and stewardship

The constitutional tension between proprietary innovation regimes and the collective obligations of CHH calls for a reconfiguration of the legal and institutional infrastructures that govern MGRs/DSI. As the preceding analysis has shown, the IP framework, with its emphasis on exclusivity and market-driven incentives, remains structurally misaligned with the distributive logic underlying the BBNJ Agreement. Benefit-sharing mechanisms are necessary but insufficient unless underpinned by deeper reforms that address the upstream structures of technological control, data access, and epistemic authority. We outline below a set of interlinked strategies to align innovation governance with CHH and the equity objectives of the BBNJ regime.

5.1 Adaptive public-interest licensing

Licensing sits at the operational intersection of IP exclusivity and public-interest objectives (Dreyfuss and Rodríguez-Garavito, 2014; Chiarolla, 2014). In the context of MGRs and DSI originating from ABNJ, licensing represents one of the primary mechanisms through which states and institutions can influence the terms under which scientific knowledge and technology circulate. Adaptive public-interest licensing offers a flexible, context-sensitive way of aligning proprietary incentives with distributive commitments without undermining innovation (Kapczynski, 2017; Abbott and Reichman, 2007). The central premise is that IP rights created through interaction with the ocean commons carry public-regarding obligations. These obligations can include humanitarian-use clauses, open-access provisions for non-commercial research, geographically differentiated sublicensing models, and price or access ceilings for technologies critical to basic scientific participation. Such models do not constitute *ad hoc* deviations from patent orthodoxy. They reflect a broader jurisprudential trajectory in which intellectual property regimes have been recalibrated in response to global public goods challenges, as illustrated by the interpretative turn following the Doha Declaration on TRIPS and Public Health, the institutionalisation of patent pooling mechanisms such as the Medicines Patent Pool, and differentiated pricing strategies designed to reconcile exclusivity with distributive justice (Sell, 2003; Gathii, 2001; Maskus and Reichman, 2005; Contreras, 2025). Translating these principles into the ABNJ context would mean that scientific tools essential to marine biodiversity research reflect differentiated needs and capacities rather than uniform global pricing structures.

Adaptive licensing aligns with CHH precisely because it embeds reciprocal duties into the exercise of IP rights (Alexander and Peñalver, 2009; Dreyfuss and Rodríguez-Garavito, 2014). On this reframing, licensing is not simply a commercial transaction but a legal modality for governing commons-derived value. If designed appropriately, adaptive licensing conditions can be integrated into the mandatory sharing of non-monetary benefits under Article 14 of the BBNJ Agreement. Furthermore, public research funders, philanthropic foundations, and multilateral science initiatives can condition grant agreements on compliance with adaptive licensing norms, ensuring coherence across global scientific ecosystems. Innovation need not become a zero-sum conflict between exclusivity and access; exclusive rights can instead serve as vehicles for implementing redistributive obligations. Adaptive licensing is, in this sense, a practical mechanism for tethering proprietary tools to the public-interest core of CHH.

5.2 Mandatory disclosure of digital sequence information

Mandatory disclosure obligations concerning origin, provenance, and utilisation of genetic resources and their digital derivatives have been widely advanced in the literature as a key legal mechanism for maintaining a normative link between innovation and the commons (Grosse Ruse-Khan 2010; Wendland 2025; Chiarolla, 2014). Without disclosure, actors can convert publicly accessible DSI into exclusive IP rights without corresponding reciprocal duties, weakening the legal connection between innovation and the commons from which informational value derives. The GRATK Treaty establishes an important normative precedent by requiring disclosure of origin in patent applications, relating to genetic resources, although its scope does not extend comprehensively to DSI (Wendland, 2025; Perron-Welch, 2025). Complementing this development, WIPO Standard ST.26 introduces harmonised technical requirements for sequence listings in patent applications, enhancing standardisation and facilitating potential traceability within the patent system. The BBNJ regime provides a framework within which such disclosure approaches could be considered and subject to coherent institutional interpretation, with a view to their potential relevance to associated DSI. Linking disclosure to the CHM would allow DSI-based inventions to be tracked in real time, facilitating benefit-sharing and supporting compliance monitoring. Such traceability mechanisms are increasingly seen as necessary components of governance for intangible resources.

Mandatory disclosure serves a constitutional function as well. Disclosure anchors proprietary claims within a framework of accountability and transparency, reflecting the distributive commitments embedded in Article 7(b) regarding the CHH and Article 7(d) regarding fair and equitable sharing of benefits. Disclosure underscores the relational character of innovation, recognising that knowledge production is embedded in shared ecological and institutional contexts (Jasanoff, 2004). This reconnection mitigates forms of epistemic disembedding enabled by digital infrastructures, which allow informational value to circulate independently of material origin (Blasiak et al., 2020). There is a strategic dimension too. By requiring entities to provide information regarding the source and intended use of DSI, states can map utilisation patterns and inform benefit-sharing and capacity-building interventions. Disclosure thus operates not only as a transparency mechanism but as a component of data governance consistent with polycentric approaches to institutional design (Ostrom, 2010; Dalaker, 2025).

5.3 Reconceptualising property as stewardship

A more fundamental shift is needed to address the structural misalignment between conventional IP paradigms and the collective obligations inherent in CHH. Property, in its dominant legal formulation, is understood as a right to exclude (Merrill and Smith, 2017), to control, and to derive value from an object or resource (Dagan, 2011). That formulation sits uneasily with the governance architecture established for ABNJ MGRs, where access and utilisation are embedded within obligations of notification, transparency and collective oversight under Article 11 of the BBNJ Agreement, which situates the exercise of rights within a framework of accountability that departs from unilateral models of control. Reconceiving property as stewardship offers both a normative and doctrinal alternative that better reflects the relational and ecological character of MGRs and DSI.

Under a stewardship model, rights over technologies or data derived from ABNJ cannot be separated from obligations to

preserve accessibility, promote knowledge circulation, contribute to shared scientific capability, and support the conservation and sustainable use of marine biological diversity. This draws on relational theories of property, which treat ownership not as an autonomous domain of control but as an institutional position embedded within a web of responsibilities, particularly in the governance of global commons (Cifrodelli, 2024). Stewardship-based models have found application in other fields, including cultural heritage, environmental protection, and indigenous rights, and they resonate strongly with the distributive and intergenerational dimensions of CHH as well as with the ecological objectives embedded in the BBNJ Agreement.

Operationalising stewardship in the BBNJ context means linking IP rights and contractual claims to explicit duties. These duties could include contributions to benefit-sharing funds established under the BBNJ Agreement, potentially drawing on multilateral models such as the Cali Fund under the Global Biodiversity Framework. They may also encompass mandatory capacity-building commitments, support for open data standards, and shared authorship or attribution for research outputs derived from commons-based materials. Such obligations could be codified through treaty provisions, institutional guidelines, or contractual instruments negotiated through the CHM or CBTMT Committee. By making stewardship a legal condition for legitimate proprietary claims, the BBNJ regime can realign market incentives with the ecological and distributive imperatives of the ocean commons (Alexander and Peñalver, 2009). Stewardship reframes property as a mechanism that enhances, rather than constrains, the public good. The implication is that exclusivity is legitimate only insofar as it advances collective benefit, a principle deeply entrenched in CHH but largely absent from contemporary IP doctrine (Merrill and Smith, 2017; Dagan, 2011).

5.4 Codifying CHH in operational clauses

Whether the BBNJ Agreement proves effective depends ultimately on translating CHH from an aspirational principle into enforceable operational obligations. Embedding CHH in this way would ensure that its distributive logic permeates the treaty's core governance structures. For CHH to serve as a constitutional norm capable of shaping innovation governance, its operational significance must emerge through systematic interpretation across benefit-sharing, transparency, technology transfer and compliance provisions. The operational force of CHH depends on its systematic interpretation across Articles 12, 14, 44, 45, 46 and 51 within the existing treaty framework. Read in conjunction with Article 7(b), these provisions already provide a legal basis for integrating distributive considerations into benefit-sharing, transparency, capacity-building and compliance mechanisms. Conference of the Parties practice and institutional guidance can further clarify that benefit-sharing constitutes an integral element of accessing and utilising MGRs and associated DSI. This clarification could occur through COP decisions specifying reporting templates under Article 51, interpretative guidance adopted by the CBTMT Committee, and the incorporation of equity indicators into periodic implementation reviews. Such an approach strengthens the internal coherence of the Agreement without altering its textual architecture. Compliance mechanisms can integrate CHH as an evaluative criterion, framing reporting obligations under the CHM and oversight functions under the CBTMT Committee within the equity and sustainability objectives articulated in Article 7(b). Operationalising CHH also requires integrating equity benchmarks into institutional performance indicators. Such indicators may include, for example, the distribution of technological capacity across regions, representation in scientific collaborations, the frequency and substantive quality of benefit-sharing contributions, and the extent of participation of developing states in standard-setting processes. Embedding CHH in this way anchors its distributive logic within the treaty's governance structures and guards against its marginalisation by more dominant normative regimes.

The CHM can function as a platform for documenting compliance with CHH-based obligations; the CBTMT Committee can operate as the institutional mechanism through which CHH is translated into technological and scientific equity; and the Conference of the Parties can serve as the forum through which CHH-informed institutional practice develops. Whether CHH evolves from a symbolic affirmation into a constitutional principle with regulatory influence will depend on how these institutions develop in practice.

6 Conclusion

The conflict between IP regimes and the distributive commitments embedded in the BBNJ Agreement, including the CHH under Article 7(b), the principle of fair and equitable sharing of benefits under Article 7(d) and the FoHS under Article 7(c), brings into view a deeper legal tension between models of innovation rooted in exclusivity and constitutional norms anchored in stewardship, sustainability and equity. That tension will not be resolved through rhetorical accommodation or procedural transparency alone. What is required is a sustained recalibration of doctrines, institutions, and legal expectations so that proprietary rights operate consistently with the collective commitments outlined in the BBNJ Agreement.

The BBNJ Agreement marks a significant moment in the law of the sea, a point at which foundational principles of ocean governance are being rearticulated and institutionally specified. Through Articles 7, 14, 44, and 46, the BBNJ Agreement provides a normative and operational foundation for embedding CHH into binding legal obligations. Realising that potential means reimagining innovation as a legal relation conditioned on access, traceability, and equitable redistribution. The CHM is central to this transformation. Its constitutional function lies in operating as an infrastructure of transparency and accountability, not a passive repository. Origin disclosure, metadata standards, and benefit-sharing linkages are structural conditions that shape the legitimacy of governance in digital commons contexts. Without institutions capable of making informational flows visible and linking them to redistributive obligations, the ocean commons risks remaining formally open while benefits concentrate within

proprietary systems controlled by a handful of jurisdictions and corporate actors.

The institutional design challenges we have identified extend beyond the BBNJ Agreement itself. They raise broader questions about how international law can govern resources that are at once ecological, informational, and economic. DSI exemplifies the complexity: it is neither purely biological nor entirely digital, neither fully tangible nor wholly intangible. Governing DSI requires legal frameworks capable of navigating this liminality and of recognising value in information while preventing its complete detachment from the material and territorial origins that give it meaning under international law. We have advanced a model of tethered innovation: a governance paradigm in which exclusive rights may exist, but only insofar as they remain legally connected to the commons from which they derive. In this model, value extracted from shared biodiversity is not privatised in isolation; it is reinvested in the collective good through enforceable benefit-sharing mechanisms, capacity-building programs, and technology transfer obligations. Tethering treats patents, licences and proprietary claims over MGRs/DSI as legally connected to corresponding duties, including disclosure of origin, benefit-sharing, enabling access for non-commercial research and supporting scientific capacity in regions historically excluded from marine biotechnology development.

The legal strategies proposed here, adaptive licensing, mandatory disclosure, property as stewardship, and the codification of CHH, are not utopian aspirations but pragmatic interventions grounded in existing legal principles and institutional capacities. They build on precedents in public health, agricultural biodiversity, and environmental law, adapting them to the distinctive challenges of marine genetic resources in ABNJ. What sets the BBNJ context apart is the absence of a territorial sovereign to assert provider rights, making institutional mechanisms like the CHM and the CBTMT Committee even more critical as proxies for collective governance. Their success, however, depends on political will, adequate funding, and sustained engagement from both developed and developing states. The history of multilateral environmental agreements is a reminder that, without robust implementation frameworks, even well-designed treaty provisions can remain aspirational. The BBNJ Agreement entered into force on 17 January 2026. But this milestone marks only the beginning; the BBNJ Agreement's constitutional potential will be realised (or not) through the choices made during the operationalisation of its institutions.

We conclude that maintaining the ocean genome as legally open while its benefits remain structurally enclosed generates tension with the distributive commitments of the BBNJ regime. Equity in MGR governance is a core principle of the BBNJ Agreement, expressly articulated in Article 7(d), and it functions as a constitutional condition for the regime's legitimacy. Integrating CHH into innovation governance through binding obligations, transparent processes and accountable institutions will shape the extent to which the BBNJ Agreement operates as a legal framework capable of supporting ecological sustainability and equitable benefit-sharing across generations.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

Author contributions

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