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# Chapter 8

## Scientists and the Sovereigns: The Distributive Justice Implications of Digital Sequence Information Governance Under the Convention on Biological Diversity



Bob Kreiken and Adam McCarthy

**Abstract** This chapter presents an insight into current negotiations of the UN Convention on Biological Diversity (CBD) regarding the digitalization of genetic resources, from an ethics of technology perspective. The chapter gives an overview of the transition towards data-centric biological research and open science, and its implications for Access and Benefit-Sharing (ABS) policies, which consist of mechanisms that ensure fair access to genetic resources and the fair and equitable benefit-sharing from their utilization in research and development. Here, we examine value conflicts at the knowledge-governance interface, conceptualizing the CBD negotiations as a site that can be analyzed to provide a better understanding of the relationship between science, technology, and innovation policies, values, and distributive justice. In particular, we suggest that values regarding utilitarian notions of open science clash with sovereignty claims over so-called Digital Sequence Information (DSI) on genetic resources. We then apply a distributive justice lens to current debates about the modalities of a benefit-sharing system for DSI, illustrating how different normative approaches to distributive justice and criteria for the fair allocation of benefits underlie states' and stakeholders' political positions. The analysis concludes by discussing the need to consider the unequal scientific capabilities in the production of knowledge and calls for deeper reflection on value divergence in international Science, Technology, and Innovation policy-making processes.

**Keywords** Distributive justice · Open science · Biodiversity · Technology and innovation governance · Data values

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## 8.1 Introduction

At first glance, Nature appears untouched by contemporary digital society. Yet, we continuously generate vast amounts of data from it, from the canopy above to the microbes below, mainly for conservation but also for a range of other uses. Here, we focus on genetic sequence data that are produced by scientists to advance our understanding of and ability to utilize genetic diversity. Technological advances in data-driven biological Science, Technology, and Innovation (STI), such as the decreasing cost of sequencing technologies, have made the molecular scale, concerning but not limited to genetic sequences, proteins, and metabolites, increasingly accessible to the biosciences, which constitute disciplines concerned with the biological aspects of humans, plants, and animals. These data serve as input to fields like biodiversity genomics, conservation genetics, biotechnological research, and synthetic biology (Carbonell et al., 2019; Dixon et al., 2020; Leonelli, 2016). This “digital revolution” in the biosciences is supported by genetic sequence databases which provide scientists and companies with open access to data, a fundamentally important resource used to inform and perform observations, compare genetic traits across species, conduct experiments, and produce innovations.

Because new technologies in unequal societies tend to disproportionately benefit those with the resources to exploit them (Woodhouse & Sarewitz, 2007), it is important to reflect on how this ongoing and accelerating STI development affects society. Distributive justice is a useful lens to explore how benefits, opportunities, risks, and burdens arising from technological transformations are distributed in society, and we propose that digitalization in the biosciences is a useful case to examine in this context. This perspective states that the “datafication” of nature carries distributive effects, such as differential capacities to control and make use of data and benefit from its outcomes (Geary & Bubela, 2019; Pritchard et al., 2022). Because distributive justice is also concerned with the redistribution of scientific agency, these considerations are not only pertinent to the economic outputs of STI production but also to STI processes as sites of knowledge production. This relates to how benefits from STIs are shared in society and which STIs are pursued. In this vein, insights from the Science and Technology Studies field reveal that both knowledge generation and its outcomes are influenced by the norms and values of the society that produces them (Jasanoff, 2004). This points to the importance of examining STIs beyond their technical aspects and focusing on the socio-economic, cultural, and political contexts in which they exist. As a result, approaches like Ethical Legal and Social Implications (ELSI) and Responsible Research and Innovation have been applied to explore the broader implications of STI, including recently for biodiversity sequencing technologies (Laird & Wynberg, 2016; Sherkow et al., 2022). Thereby, we can raise critical questions such as “Who decides what STI is pursued” and “Who benefits from their use in conservation” (Arts et al., 2015; Heeks et al., 2014).

At the same time, distributive aspects of technologies are shaped by Science, Technology, and Innovation Policy (STIP), which plays a key role in influencing the “directionality” of STI. This influence arises from constraints on scientific

activities, such as prohibitions on certain types of research, or funding decisions made in alignment with policy objectives (recently articulated through mission-oriented innovation policy, for example) (Gupta & Falkner, 2006; Kishi, 2020; Mazzucato, 2018). Furthermore, publicly funded programs for capacity-building and incentives or obligations for technology transfer often aim to broaden access to the benefits of STI and to include marginalized groups in its design and production. However, the impact of STIP on the distribution of the outcomes of STI and agency in data-driven research is less explored, particularly at an international level. Therefore, we argue that STIP processes are a key site to explore how different values associated with STI manifest and play out and that a distributive justice lens is useful to illuminate and discuss these values in more detail.

In this chapter, we focus on attempts to govern the complex issues raised by the bioscience digital revolution, such as the right to consent of Indigenous peoples about access to and use of their traditional knowledge and genetic resources on their lands, compensation of biodiverse developing states as “data providers”, and a growing global technological divide. We take the negotiations of the Convention on Biological Diversity (CBD) on Digital Sequence Information as a case study of an international STIP process that seeks to advance distributive justice by addressing global disparities in the capacities to generate, access, and utilize genetic sequence data in the biosciences. Digital Sequence Information (DSI) is an undefined policy term that broadly refers to genetic sequence data but can be interpreted to encompass associated information and metadata, and other types of biochemical data. The CBD negotiations over DSI can be characterized as a site of science for policy and policy for science, as negotiators require knowledge inputs from the scientific community and scientific practice is also affected by the regulation of DSI. The analysis is informed by literature on ABS, DSI, and distributive justice in STIP, reading of policy documents, and in-person observation of the DSI negotiations, including the negotiations of the open-ended working group on DSI in Geneva in March 2022, the 15th Conference of the Parties (COP15) in Montreal in December 2022, and of the open-ended working group on DSI in Geneva in November 2023. We begin the chapter with a discussion on competing values over genetic sequence data, tracing these back to the turn towards the data driven biosciences. Then, we move on to explore how the different policy proposals for the allocation of monetary and non-monetary benefits from the use of DSI are rooted in different approaches to distributive justice. The chapter concludes that explicitly recognizing value conflicts and facilitating discussions where these are foregrounded, may lead to more effective decision-making processes.

## 8.2 Background: The Convention on Biological Diversity

Before we explore the value conflicts and distributive justice dimensions of the negotiations over DSI, it is important to understand the origin and aims of Access and Benefit-Sharing policies under the CBD. The CBD is a framework convention

for biodiversity governance adopted in 1992 at the Rio Earth Summit. Its three objectives are the conservation of biodiversity, its sustainable use, and fair access to genetic resources and the fair and equitable sharing of the benefits arising from their utilization, in short, Access and Benefit-Sharing (ABS) (UNCED, 1992). By incorporating ABS as an objective, the CBD established a new legal regime for the governance of genetic resources by bringing them under the sovereignty of states. This meant that companies and scientists as “users” of genetic resources were obliged to work with governments and Indigenous Peoples and Local Communities (IPLCs) as “providers” to obtain their Prior and Informed Consent (PIC) and set Mutually Agreed Terms (MAT) regarding the conditions of access to their genetic resources and benefit-sharing resulting from their use. Although the function of this system has been criticized based on its failure to generate a large amount of benefits (Michiels et al., 2021), ABS provides a potential lever for distributive justice in STI based on the sharing of benefits derived from biological STI (Wynberg, 2023). The MAT have also been noted for their potential to produce more equitable co-production of knowledge in international scientific and commercial relationships because they can contain provisions about collaboration, capacity-building technology transfer, and shared authorship of scientific publications or even ownership of intellectual property. In sum, ABS was originally conceived as a win-win policy that would promote biodiversity conservation while reducing inequality in STI through benefit-sharing based on legally certain criteria (Laird et al., 2020; Kate & Laird, 1999).

The rules and norms of ABS were operationalized in the legally binding Nagoya Protocol (SCBD, 2010), which entered into force in 2014. But, as the regulations applied only to the transfer of physical genetic resources, the informational component of genetic resources, accessible through increasingly affordable sequencing technologies and open access genetic sequence databases, created a loophole for users of such “digitized” genetic resources. Because scientific publications that use sequences include an average of 44 from a variety of states, regulating DSI under a bilateral system like the Nagoya Protocol was considered impractical by many stakeholders (Scholz et al., 2021). Therefore, efforts to regulate DSI under the CBD culminated in a decision at COP15 in Montreal in 2022 to establish a multilateral benefit-sharing mechanism for DSI, although some ambiguity remained over a potential “hybrid system” involving some bilateral arrangements for DSI and genetic resources (SCBD, 2022b; Van Vooren, 2022). With this decision, commercial and noncommercial users of DSI from states that are Party to the CBD will likely have varying duties for financial compensation, technology transfer, scientific cooperation, and capacity-building.

The way policies are designed to meet competing demands could have significant implications for the distributional aspects of biological STI. Although Parties to the CBD have heeded the call of companies and scientists to maintain open access to DSI and “*not hinder*” biological STI, integrating processes for equitable co-production of knowledge in existing scientific infrastructures, while at the same time strengthening rights to benefit-sharing from DSI undoubtedly involves trade-offs (SCBD, 2022a, 2022b). This dilemma, which will be discussed in more detail,

is summarized in the often-used phrase to govern data “*as open as possible, as closed as necessary*” (European Union, 2019; Klünker & Richter, 2022).

### 8.3 Scientists and the Sovereigns

#### 8.3.1 *The Scientific Globalization of the Gene*

The open access model of the biosciences is a culmination of decades of value-based decisions. In the 1960s, biologists first began using computers to decipher and digitize DNA sequences, a development that fundamentally reshaped biological STI (Hagen, 2011). By the 1980s, research institutes worldwide established major databases, which later converged into national and regional databases. The USA, Europe, and Japan began standardizing data formats to facilitate data sharing, leading eventually to the formation of the International Nucleotide Sequence Database Collaboration (INSDC) in 1987. Some years later, when the international community was working towards sequencing and assembling the human genome, the Bermuda Principles were adopted which called for the pre-publication of sequence data following its generation. Hilgartner (2017), in his analysis of the Human Genome Project, suggests that this shift in the control of knowledge, driven by the mass proliferation of data, made the previous regime of publishing sequence data in journals untenable due to fears of data being “scooped” before publication and led to the emergence of open access norms. This highlights how, alongside arguments about the societal benefits of open access, bioscientists’ norms, practices, and ownership claims shifted towards openness in concert with the digital transformation of STI.

This international regime based on open access to digitalized biological information involved the construction of genetic sequence data as “transnational digital objects” with an *abstractable*, *sharable*, and *mobile* character (Stevens, 2018). The facilitation of international “data journeys”, such as is the case in the use of DSI, further involves the decontextualization and standardization of a sequence from the context of the genetic resource it was generated from, like a living being, field station, or laboratory, to enable its recontextualization in the specific research setting where the sequence is accessed and utilized (Leonelli, 2016, p. 30).

An illustrative example of this is the Earth Biogenome Project, which took inspiration from the Human Genome Project and aims to generate genome sequences for all Earth’s eukaryotes with the collaboration of regional and national biogenome projects (Lewin et al., 2018). Doezema (2023) uses this project as a case study to explore how the global character of genetic sequence data is paired with the construction of biodiversity as a “global object” in biodiversity sequencing efforts of global concern that transcends cultural, ethnic, national, geopolitical, economic, and technological differences between states. The construction by the scientific community of biological sequence data as *global* resources to conserve biodiversity

as a *global* object is important because it normalizes STIPs that prioritize the scientific and evidential value of DSI. This “scientific data value” refers to the attention and care scientific institutions give to ensuring sequence data can support knowledge claims (Leonelli, 2016).

Although the Earth Biogenome Project provides one example, the institutionalization of scientific data values for validating knowledge claims is well established in the open science movement which seeks to make research including data, samples, articles, and technologies more accessible. The foremost principles in open science are the FAIR data standards, meaning data is Findable, Accessible, Interoperable, and Reusable to increase scientific output and facilitate the replication of studies. The FAIR data standards have been successful in articulating an ideal for international scientific collaboration and for automating database integration. Additionally, they have gained increasing political traction, with promotion by both the OECD and UNESCO (OECD, 2020; UNESCO, 2023).

However, proposals for unlimited openness have been critiqued for failing to address existing inequalities related to the differential abilities to comply with and benefit from open data policies (Leonelli, 2018). The implementation of the FAIR data standards in research institutions involves significant human and technological resources that low- and middle-income countries may not have (Bezuidenhout, 2020). Additionally, there are arguments that these proposals neglect the rights and interests of groups in society, such as those related to privacy and ownership (Tosie, 2019). In the context of the DSI negotiations, the CARE principles for Indigenous Data Governance, which stand for Collective Benefit, Authority to Control, Responsibility, and Ethics, form a notable addition to the FAIR principles. The CARE data principles aim for “*value-based relationships that position data approaches within Indigenous cultures and knowledge systems to the benefit of Indigenous Peoples* (Castellano, 2004; Anderson et al., 2003). *This shift ultimately promotes equitable participation*” (Carroll et al., 2021). Data standard setting as a site of STI policy therefore involves questions of distributive justice, along with a diversity of associated values, illustrating the need for further examination and discussion of the values underpinning data standards and the open science movement.

Despite these issues, several policy briefs, position statements, and publications suggest that there is general agreement among biological scientists worldwide that the open sharing of data should continue for the sake of scientific progress and conservation (Prathapan et al., 2018). In particular, in recent policy briefs, members of the DSI Scientific Network and the International Chamber of Commerce call for a simple multilateral benefit-sharing system for DSI that ensures legal certainty and harmonization of ABS policies of various UN fora while aligning with open access norms in research and innovation (Halewood et al., 2023; Michiels et al., 2021; Scholz et al., 2022). The partial uptake of this argumentation from the Geneva negotiations into the later COP15 decision, outlined in language that any decision on DSI should “(e) *Not hinder research and innovation;* (f) *Be consistent with open access to data*” suggests that the scientific data value has been emphatically and successfully argued (SCBD, 2022a, 2022b). However, we identify a potential clash between these criteria and norms and values of sovereignty, outlined explicitly in

the criterion “(i) *Take into account the rights of indigenous peoples and local communities, including with respect to the traditional knowledge associated with genetic resources that they hold;*”, but also implicitly via the potential extension of the ABS regulations to DSI use. This conflict is the subject of the next section.

### 8.3.2 *Data Sovereignty as a Competing Set of Values*

It could be argued that COP *decision 15/9* implicitly recognizes that the sovereignty of states over genetic resources will extend to DSI on those resources (although some countries like Brazil and South Africa already had national ABS legislation in place for DSI (Bagley et al., 2020)). This decision will likely have significant implications for the data-driven biological STI regime, not only in terms of data accessibility and standards but also in terms of professional responsibility to share benefits with states and IPLCs. However, the terms of the multilateral benefit-sharing system are yet to be determined, and we propose that clashes between scientific data values and data sovereignty values form significant, unresolved fault lines in the debate that should be made more explicit.

While the regulation of a key resource for biological STI under an environmental treaty may seem misplaced, states and IPLCs hold data sovereignty over DSI as a key principle, reflected in their written submissions and position statements. Data sovereignty is an emergent, multidimensional concept that is mobilized by individuals and societies to denote rights, control, and power over data (Von Scherenberg et al., 2024). The concept promotes values like transparency, inclusion, representation, deliberation, beneficence, and justice in how data are collected and used (Hummel et al., 2021). In addition, digital sovereignty, mostly applied in relation to Big Data and privacy, describes the efforts of governments to develop national technological identities, responding to the increasing power of multinational technology companies and concentration of digital control through state capitalism (Couture & Toupin, 2019). The DSI negotiations should be considered in this wider context of data geopolitics and science diplomacy.

Technological constructs like DSI can shape, challenge, and reinforce sovereignty over genetic resources (Timmers, 2022), necessitating an exploration of the role and meaning of sovereignty within the CBD as it relates to DSI. We do this based on Berry’s (2022) distinction between *de jure* and *de facto* sovereignty over genetic resources. The *de jure* conception holds that the highest international legal order ought to be followed. That means that sovereignty is derived from the obligations that follow from the CBD’s founding text and its consequent legally binding COP decisions. However, others argue that this idealistic conception ignores the political dimensions underpinning interactions between actors, including states. From this perspective, sovereignty is constituted by the power to decide and enforce laws, meaning the actor or state that exercises control over genetic resources has sovereignty. This *de facto* interpretation of sovereignty is particularly important to

determining sovereignty over viruses, migratory species and species, and traditional knowledge found across international and community borders (Berry, 2022).

The effects of the “dematerialization” of genetic resources through DSI on these conceptions of sovereignty are so far unclear. However, we can ascertain at least that honoring data sovereignty is likely to clash with notions of open access based on scientific data values, and combined with uncertainties about assigning sovereignty and responsibility, these form unresolved issues in the DSI debate. Firstly, even though the COP15 decision may implicitly recognize sovereignty over DSI due to the extension of the ABS regime, there is not yet a binding instrument that defines the specific rights and obligations of Parties concerning DSI under the CBD. Secondly, the determination of sovereignty is challenging because the decisions over DSI are dispersed over its lifecycle. Should we recognize as sovereign the state of the data’s origin, where the database is located, or where the data are reproduced and utilized? From this perspective, multiple actors constantly exert their influence over DSI and its derivatives across various locations<sup>1</sup> (Klünker & Richter, 2022). Conversely, an actor lacking control over infrastructures to store and utilize DSI cannot assert *de facto* sovereignty, despite *de jure* rights.

This complexity is often used to justify the defense of open access, but states and IPLCs are unlikely to “drop” their data sovereignty claims for the sake of STI. In fact, data sovereignty in relation to DSI and the biosciences is increasingly reflected in regional and national bioeconomy strategies. For example, the valorization of biodiversity is key to the nation-building process underlying the Colombian bioeconomy strategy (Aparicio, 2022). Likewise, Indigenous data sovereignty is pursued to retain control over data and prevent misuse, misrepresentation, and unacknowledged use of Indigenous-held genetic resources and traditional knowledge (McCartney et al., 2022). This is based on the argument that imposing open access obligations on IPLCs without additional protections risks undermining their specific rights and values associated with the data (McCartney et al., 2022).

In this debate, the obligation to obtain free, prior, and informed consent (PIC) before acquiring DSI and the methods that increase the visibility of IPLCs in data infrastructures may provide a pathway for equitable data-driven biological STI. However, Prior Informed Consent (PIC) seems to be marginalized in the DSI debate compared to its strong articulation in the Nagoya Protocol, due to arguments about the challenges of tracking and tracing DSI, as well as the complexities related to sovereignty across both species and data lifecycles. This can be contrasted with “bottom-up” initiatives, such as Traditional Labels, and discussions about the importance of Indigenous provenance metadata. Such metadata may enable communities to assert their rights over digitized genetic resources and increase their visibility whether a multilateral system explicitly grants sovereignty over them or not (Golan et al., 2022).

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<sup>1</sup>In the context of discussions on property and contractual rights on data, a *de facto* property right of the data producer has been discussed in legal literature, for example in Eckardt and Kerber (2024).

Furthermore, different assertions of data sovereignty are not aligned per se and can lead to further clashes. A telling example is that national genomics initiatives aimed at leveraging human genetic diversity for STIs as public goods have previously led to the inequitable dispossession of Indigenous peoples' DNA (Benjamin, 2009). The importance of data in national and IPLC agendas differs significantly: while nations may view DSI as a resource input for economic development based on bioeconomy strategies, many IPLCs describe genetic resources from relational perspectives, considering them a sacred part of Mother Earth and allowing their use based on values of reciprocity (Espinosa, 2014; Kreiken & Arts, 2024). Therefore, the issue of sovereignty in relation to DSI presents a complex and contested area, with different values underlying each position having implications for benefit-sharing modalities.

#### 8.4 Distributive Justice in Biological STI

Revisiting the data governance dilemma of “*open as possible, closed as necessary*”, we find a complex and potentially competing set of demands on the multilateral mechanism for DSI. This section outlines how this value diversity relates to approaches to distributive justice in STI. This chapter does not aim to simplify or resolve the complexity of sovereignty concerning DSI. Instead, it highlights the need to recognize and discuss these issues within the debate. Drawing from previous analyses of competing demands in STIP, when such demands are incommensurable, it is usually the most powerful actors whose demands are met (Parker & Crona, 2012). This gives a distributive justice lens further relevance for analyzing power dynamics. This section is based on the analysis of policy options put forward in the document “Synthesis of views pursuant to decision 15/9” (SCBD, 2023) alongside developments at CBD negotiations over DSI in Geneva, November 2023.

A first avenue for distributive justice is the variety of allocation criteria for the benefits generated from the multilateral mechanism. These will be analyzed using De Jonge's (2011) distinction between the principles of *desert*, *equity*, and *need*. *Desert* holds that actors that contribute to biodiversity conservation and the generation of DSI deserve compensation in accordance with their relative contribution. The principle of *need* demands that benefits accrue to those who need them most, for example, states with higher biodiversity richness, in line with the aims of the CBD. *Equity*, then, accounts for morally relevant differences between actors, such as development status, meaning that low- and middle-income countries with shortcomings in conservation and scientific budgets would be prioritized.

These three principles are reflected with regard to one major issue in the negotiations, namely the link between access and utilization to monetary and nonmonetary benefits being achieved through tracking and tracing of Parties and IPLC's DSI. This option, however, would involve mass collection of data for database managers and

extra administrative burdens to users of DSI.<sup>2</sup> Such time, cost, and regulatory constraints, could arguably outweigh generated benefits and should be considered for a fair distribution of burdens and benefits (Collins et al., 2020). Another option is that benefits are allocated based on available information on the geographic origin of the sequences or underlying genetic resources in the complete database.

The above options reflect *desert*-based redistribution of benefits proportional to a state's share of DSI in the database. However, several Parties argue that this disbursement unfairly affects regions with fewer capacities to generate DSI, specifically identified by Scholz et al. (2021) as Latin America, Africa, and Eastern Europe. Other proposals, which do not link DSI back to its origin, emphasize the principles of *need* and *equity*, for example by allocating benefits to low- and middle-income countries and IPLCs with financial, technological, scientific, and self-identified needs. Thus, following need- and equity-based reasoning, states with low generation of DSI should instead be made beneficiaries. Such multilateral solutions, while technologically and regulatorily speaking are more pragmatic, counterintuitively erode data sovereignty over DSI because actors will not be able to control how DSI from their jurisdiction is being used in STI, yet receive benefits from its use. Moving towards a single multilateral system for both DSI and genetic resources (an option preferred by many users of DSI), also means that mechanisms under the Nagoya Protocol that currently enhance equity in research and development, such as PIC and MAT, potentially become obsolete without replacement. While access to DSI and its utilization may become separated for practical reasons, such as efficiency, current proposals do not detail how mechanisms for equity, such as PIC and MAT are reimaged within the multilateral system. Another proposal suggests that benefits should be enhanced for Parties opting into the multilateral mechanism. This argument suggests that if many states opt into the multilateral system, the last ones that 'cling' to national legislation will receive less scientific interest (SCBD, 2023). Hence, by putting DSI on the agenda of the CBD and asserting data sovereignty over it, states may have conversely introduced a stressor to their sovereignty over their genetic resources, highlighting how technological changes in the can biosciences reshape sovereignty through control over key resources for STI (Timmers, 2022).

Another reason why this loss of control over DSI's use in STI is relevant is that the current pathways for DSI narrow possibilities for the redistribution of scientific agency. We discuss this point by distinguishing between commutative and distributive justice in ABS rationales (Korthals & De Jonge, 2009). Whereas commutative justice governs fair compensation in exchanges *downstream* of the STI pipeline, distributive justice entails discussions over STI priorities *upstream* so the needs of low- and middle-income countries and IPLCs are recognized and integrated into STIP priorities. Currently, we find that ABS remains in the commutative justice paradigm because most negotiations focus more on the modalities of a

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<sup>2</sup>In adjacent ABS discussions over DSI on marine genetic resources held under the High Seas Treaty, Langlet and Dunshirn (2023) have discussed the strengths and weaknesses of several policy options for traceability.

benefit-sharing system (*Who gets What*) for DSI rather than the needs that the system and users of DSI must address (*the Why*).

With the maintenance of open access in the multilateral system, the so-called “decoupling” of access from benefit-sharing, benefit-sharing is only effectuated when benefits have materialized, for example in publications and patents. However, a key unresolved issue of the multilateral system is that it raises the impression that users of DSI fulfill their moral benefit-sharing duties if the databases they use are compliant with the new CBD rules. It is questionable whether this fairness in exchange of DSI actually meets the aforementioned needs or whether they would support the other aims of the CBD (Sirakaya, 2021). In this vein, Laird et al. (2020) argue that stimulation of equitable research processes in biological STI could achieve more than another dysfunctional ABS mechanism, their critique suggesting a failure of the commutative paradigm of justice. This is echoed by Gaffney et al. (2020) who state: “*Greater equity in use of genetic sequence data will not come from ABS schemes but through greater cooperation and capacity building.*” These statements point to the need for scientists and companies to proactively take responsibility and engage stakeholders in the direction, design, and production of benefits and not face such questions when the research has already been conducted.

Therefore, the ideal of fair and equitable benefit-sharing from DSI necessitates a move away from a commutative to a distributive approach to justice. Distributive justice is not a unitary concept and harbors varying interpretations, though we limit our discussion to a few of them. In the submission statements on DSI, we broadly identify utilitarian and communitarian approaches to equity in STIP (Cozzens, 2007). Utilitarianism recognizes STIPs as fair when they produce the highest societal well-being with the support of the market. Inequalities are not considered morally wrong if the maximum utility situation demands this. Communitarianism, on the other hand, supports policies that build community bonds and values social responsibilities in STI.

Utilitarian arguments against the current ABS system are increasing, challenging its original conception as a win-win due to concerns about efficiency and effectiveness. Although there are no definitive figures on the benefits generated under the Nagoya Protocol, the regulatory and implementation costs involved with ABS possibly outweigh any financial benefits generated. There is recognition that the multilateral benefit-sharing system must avoid this situation (SCBD, 2022b). The utilitarian claims are supported by the argument that the direct impact of ABS on conservation is uncertain, while it indirectly hinders the progress of biodiversity research (Neumann et al., 2018). This has led to calls for reflection on the purposes of the ABS system, its desired outcomes, and whether it can effectively produce them (Wynberg, 2023). Utilitarian arguments, underpinned by scientific data values, point to the societal value of STI derived from open and unrestricted access to DSI. Rather than systemic inequalities, the users of DSI point towards capacity gaps as the key cause of the global STI divide. According to this reasoning, DSI policies should not restrict open science but rather support scientific capacity-building, technology transfer, and international collaboration that will help with “*leveling the DSI playing field*” (Scholz et al., 2021).

The provision of technological and scientific capacity according to a “catch-up” innovation approach, however, risks overlooking a key challenge (Cirera & Maloney, 2017). While utilitarianism assumes other redistributive mechanisms operating outside STIPs ensure the least well-off also benefit, there would be no such redistributive mechanisms from the use of DSI if allocation is conditional and based on notions of *desert* rather than *need* or *equity*, because countries already unable to generate DSI would be excluded from benefits (Cozzens, 2007). Furthermore, non-monetary benefits from open science, such as knowledge products and new technologies, have only minimally “trickled down” to the Global South, as was highlighted by the unequal access to COVID-19 vaccines (Reidpath & Allotey, 2019). This perspective suggests that overcoming technological divides involves not only providing access to technologies and information and strengthening STI capacities but also building the capabilities of the least advantaged for DSI and its associated technologies meaningfully, reflecting the concept of Inclusive Innovation (Heeks et al., 2014; Himma, 2007). Fieldwork in laboratory settings suggests that low-resourced scientists, even those with access to data face challenges that relate to personal, financial, infrastructural, and institutional constraints to generating, curating, sharing, and using data (Bezuidenhout et al., 2017). A similar issue is found in North-South capacity-building projects that focus on developing the technical competencies of scientists without strengthening the political and socio-economic structures that sustain scientific research (Mormina, 2019). Utilitarian ideas about the simple transfer of technologies and technical expertise to low- and middle-income countries overlook the learning process, the local situatedness of STI, and the need for strengthening institutional and policy capacities (Shen & Williams, 2005). Moreover, STI-oriented policy proposals for the allocation of benefits for projects on a “competitive” basis (SCBD, 2023) raise questions about who will receive funding and whose epistemic norms are promoted. Overall, as utilitarian approaches to DSI are suggested, policymakers and stakeholders should consider how policies will meaningfully strengthen individual and societal capabilities to benefit from DSI.

If the scientific community aims to advance equity in DSI use independently of sovereign states, it must move beyond focusing solely on the regulatory hurdles posed by ABS. A communitarian approach suggests that DSI users might embrace the spirit and principles of ABS and apply these in their own unique research and technological context. That is particularly important considering new technological developments that could outpace still-to-be-established DSI regulations, for example, the use of artificial intelligence in sequence predictions and self-driving synthetic biology labs (Holland et al., 2024). The “datafication” of Nature, in combination with such techniques and the predominance of scientific data values, might also make biodiversity issues to users of DSI less visible and decrease their concern for in-situ genetic diversity.

In communitarianism, the focus shifts towards how STI is done rather than on its outcomes, and thus closer to the *upstream* conceptualization of distributive justice that Korthals and De Jonge (2009) conceptualized, and aligning with notions of Responsible Research and Innovation (Stilgoe et al., 2013). Despite the lack of

participatory processes for DSI users under a multilateral benefit-sharing system, users can learn from new organizations that proactively pursue benefit-sharing. One example is Base Camp Research, a company that is building a biological dataset for AI and setting up partnerships with local researchers and communities to valorize their biodiversity, though this model does not preserve open access. Another organization, Wise Ancestors, promotes co-production in biotechnological STI by mediating Western and Indigenous knowledge systems, strengthening conservation leadership by and data sovereignty for IPLCs. Adopting benefit-sharing responsibilities as part of professional practice extends beyond DSI users to other stakeholders in the STI ecosystem, such as journals, funding agencies, and patent offices, which play major roles in driving ethical conduct and fostering Responsible Research and Innovation in the biosciences. Take, for example, the journal *Molecular Ecology* which revised its data accessibility statement to invite authors to list any type of nonmonetary benefit that were generated and shared in the research (Marden et al., 2021). These emerging avenues address criticisms of the ABS system and offer potential models for communitarian relationships in biological STI. However, it remains to be seen how these might be integrated into a practical multilateral mechanism. Opening the conversation about fairness and equity in biological STI, while examining the values that underpin positions is therefore of paramount importance.

## 8.5 Discussion

Biological STI finds itself in a technological acceleration, most recently with the emergence of artificial intelligence-driven bioscience and synthetic biology (Holland et al., 2024). This chapter highlights that policy responses to technological change are driven by different values, and such changes can either challenge or reinforce the data sovereignty of states and IPLCs. In this context, the principle of benefit-sharing for DSI seems to involve the task of incorporating additional values, such as sovereignty and notions of distributive justice, alongside scientific data values. While some proposals may promote a utilitarian vision based on the scientific value of DSI, others show signs of evolving ideas about benefit-sharing from DSI in a communitarian sense without impeding STI. These biases may be caused by inadequate representation of companies and research institutions from low- and middle-income countries at the DSI negotiations, or by the lack of strategic discussions over how ABS policies could function best to advance STI and biodiversity conservation.

Based on this discussion, we advocate that engaged actors recognize and openly discuss the value-laden nature of STIP. In this sense, it is important to acknowledge diverse values and whether they are served when weighing policy options (Stirling, 2010). Additionally, sovereignty over DSI seems to be critical for economic and political aspirations beyond biodiversity conservation and STI, and discussions should be more explicit about trade-offs that may be necessary to support states and

IPLCs to achieve self-determined goals. The place of ABS discussions under the CBD limits the discussion to a cost-benefit analysis for biodiversity conservation, while the procedural rights and recognition and scientific agency that are strengthened by ABS do not lend themselves easily to financial calculation.

Literature on distributive justice and STIP remains limited, especially regarding international STIP instruments like ABS. The international dimension of the DSI negotiations thus invites further research on how international STIPs are related to distributive justice. This article formed an introduction to some value conflicts in the DSI negotiations. Many aspects are left unexplored, such as the relationship between data values and nature values,<sup>3</sup> values of further observer groups, and the conflicts or synergies between values, such as efficiency and equity. Many of the DSI policy outcomes, such as the Geneva principles from March 2022 suggest value conflicts remain implicit in the negotiations, yet are represented in the list of criteria for a multilateral benefit sharing system for DSI. Possible theoretical frameworks to ground further value analyses are responsible and inclusive innovation, twin commons, neogeography in digital systems, and epistemic value theory in relation to the digital divide (Arts et al., 2015; Bruynseels, 2020; Fallis, 2007).

## 8.6 Conclusion

Examining the DSI negotiations as a site of value conflict in STIP reveals how data values in STI and in society relate to one another. Value-based discussions which also recognize different concepts of distributive justice could assist the DSI negotiations at least in understanding values inherent in the relationships with, access to, and utilization of DSI, and in proposals for greater equity in the biosciences.

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<sup>3</sup>The IPBES Values Assessment (2022) contains a comprehensive overview of the variety of values people and groups hold towards nature.

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