Scientific discourses as arguments of authority in legal and political fields.
The case of seed dematerialization and its legal regime

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Abstract

This article-based thesis examines the strategic use of scientific arguments in political and legal spheres. It focuses on debates surrounding Digital Sequence Information (DSI) within the framework of the International Treaty on Plant Genetic Resources for Food and Agriculture, the Convention on Biological Diversity, and other Access and Benefit-Sharing (ABS) instruments. Due to advances in sequencing technologies, genetic data are increasingly used alongside, or in place of, physical genetic resources for research and industrial purposes. This use contributes to the bypassing of existing ABS obligations, without consensus on whether such uses of DSI fall within the scope of ABS instruments.

Within this hybrid context, characterized by concerns over biopiracy, gene editing, and the patenting of genetic resources, the thesis analyzes how scientific arguments are mobilized in these debates. It examines the epistocratic use of science by states in negotiations on DSI, particularly regarding the integration of DSI into ABS mechanisms and in relation to the definitions of "genetic resources" and "genetic material." It also explores how science is used to frame the ontological questions raised by DSI, including the determination of their terminology, scope, and the types of knowledge considered legitimate, thereby contributing to epistemic injustices toward Indigenous knowledge systems. The thesis then investigates how scientific perspectives shape the interpretation of international law by analyzing the ontological assumptions underlying a conception of "modern science" presented as objective and universal.

Situated at the intersection of international law, philosophy of law, philosophy of science, and posthuman approaches, this thesis examines how this "modern science," drawing on a dualistic framework, produces normative "ontological cuts" between physical plants and their immaterial components, and between nature and culture. Finally, the thesis advances a relational and cosmopolitical approach to international law. It argues that international law should not be interpreted solely through supposedly universal, Western, and anthropocentric frameworks, but can instead be understood as a space of ontological diplomacy, open to reinterpretation in light of the ontological and epistemological claims at stake within these human–seed relationships.

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List of Papers

Table 1. List of papers included in the PhD thesis, and their publication status.

No.	Paper
1	WALCKIERS P., "Les articulations des régimes de vérité et des modes d'existence. Une approche foucaldienne pour analyser les rapports entre science et droit," *Revue interdisciplinaire d'études juridiques*, 2023, vol. 91, no. 2, pp. 195-220.
2	WALCKIERS P., « The "Rights of Relations" Between Human and Seeds: An Ecological, Ontological, and Epistemological Approach to the Legal Property Regime Complex of Seeds », *Les Carnets du Centre de Philosophie du Droit*, 2024, no. 183.
3	WALCKIERS P., "Risque, confiance et autorité. Quelles utilisations des sciences dans la jurisprudence de l'Union européenne et dans l'application du principe de précaution ?" *Revue de la faculté de droit de l'Université de Liège*, 2024, no. 1, pp. 55-95.
4	WALCKIERS P., "Conflicting Scientific Narratives at the Convention on Biological Diversity and Other Fora: Analysis and Contradiction in the Discussions on Dematerialization of (Plant) Genetic Resources," *Journal of Environmental Law & Policy*, June 1, 2024, vol. 04, no. 1, pp. 22-53.
5	WALCKIERS P., "La science et l'ontologie dualiste en droit : le droit naturel et le positivisme juridique face à l'argument épistocratique," *Revue interdisciplinaire d'études juridiques*, 2024, vol. 94, no. 2, pp. 27-58.
6	WALCKIERS P., "Les systèmes « techniques » alimentaires et l'approche relationnelle comme outil de repolitisation," *Éthique publique. Revue internationale d'éthique sociétale et gouvernementale*, Éditions Nota bene, December 31, 2024, vol. 26, no. 2.
7	WALCKIERS P., "Scientific and Political Narratives: Discursive Strategies in EU Agrifood Policies and Legislation," *Research Paper in Law - College of Europe*, 2025, no. 1, pp. 1-31.
8	WALCKIERS P., "L'approche relationnelle et le droit des relations dans le droit de l'environnement. exploration ontologique, épistémologique et constructions juridiques," *Revue Juridique de l'Environnement*, 2025, pp. 131-146.
9	**WALCKIERS** P., FRISON, C., AUBRY, S., "Dematerialization of Genetic Resources: Interpreting the Treaty on Plant Genetic Resources for Food and Agriculture," *European Journal of International Law* [under review].
10	WALCKIERS P., « Science. Une définition inclusive », in M.S. DE CLIPPELE, D. MISONE, S. BOURGEOIS-GIRONDE (dir.) *Dictionnaire droit de la nature*, Paris, Presses Universitaires de France, 2026 [accepted for publication].
11	WALCKIERS P., « Posthuman and Relational Approaches in Law. Bringing cuts and relational continuities in legal research » *Interconnections: journal of posthumanism* [accepted for publication]
12	KAHEHTOKTHA BRANT J., **WALCKIERS** P., ALEXIS A., "La semence, la séquence et l'esprit : penser la dématérialisation des plantes au prisme d'une approche cosmopolitique du droit et des savoirs," *Louvain Law Review*, 2026 [accepted for publication].

13	WALCKIERS, P., "Intellectual property rights and discrimination between knowledge systems," *International Journal of the Commons* [under review].

Table 2. List of papers that are not part of the PhD project but are associated with it.

No.	Paper
I	**WALCKIERS** P., FRISON C., AUBRY S., "A roadmap to equity in pandemic preparedness, prevention and response," *Journal of Global Health*, 2024, vol. 14, p. 03031.
II	WALCKIERS P., « The "Rights of Relations" Between Human and Seeds: An Ecological, Ontological, and Epistemological Approach to the Legal Property Regime Complex of Seeds » in SAGAERT V. et al. (dir.), *Property Law Reform, Sustainability and the Commons*, Property Law Series, Brussels, Larcier-Intersentia, 2024, pp. 255-275.
III	WALCKIERS P., "Ignorance et argument scientifique, le cas de la dématérialisation des ressources (phyto)génétiques," *Cahiers Droit, Sciences, & Technologies*, 2025, vol. 19, pp. 125-136.
IV	WALCKIERS P., "The European Green Deal and Agri-Food Policies: Revisiting Technical/Scientific Narratives Through a Relational Approach," (dir. B. MARTINEZ ROMERA), *Natolin Nests Series, Warsaw*, 2026 [accepted for publication].
V	AUBRY S., **WALCKIERS** P., FRISON C., "Keep talking while everything gets sequenced: Is global governance of Genetic Resources keeping pace with digitization?," *Journal of Global Health Law*, 2026 [accepted for publication].
VI	MOCANU D., **WALCKIERS** P., "Des objets aux sujets de droit et au-delà. Querelles méthodologiques autour des approches graduelles et relationnelles du statut juridique de l'intelligence artificielle," *Droit et philosophie*, 2026 [accepted for publication].
VII	ALEXIS A., **WALCKIERS** P., KOUTOUKI, K., FRISON, C., "Epistemic degradation: The role of modern Law and Science in othering and transforming Indigenous Knowledge into 'Beliefs'," *Transnational Environmental Law* [Under review].
VIII	FRISON, C. *et al.*, « Policy Paper from EcoLAWgy at the Eleventh Session of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA), agenda item 9.2 on the Enhancement of the MLS », *SSRN Paper*, 2025.
IX	WALCKIERS P., "Les méthodes posthumaines et relationnelles en droit : imaginaire critique et alternative au droit dualiste," *Louvain Law Review*, 2026 [accepted for publication].

Figures and Tables

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List of Acronyms

ABS	Access and Benefit-Sharing
AHTEG	Ad Hoc Technical Expert Group on Digital Sequence Information on Genetic Resources (CBD)
BBNJ	Agreement on the Conservation and Sustainable Use of Marine Biological Diversity of Areas beyond National Jurisdiction
CBD	Convention on Biological Diversity

CGRFA	Commission on Genetic Resources for Food and Agriculture (FAO)
CJEU	Court of Justice of the European Union
COP	Conference of the Parties (CBD)
DSI	Digital Sequence Information
DUS	Distinctness, Uniformity, and Stability
EFSA	European Food Safety Authority
FAO	Food and Agriculture Organization of the United Nations
GB	Governing Body (ITPGRFA)
GMO	Genetically Modified Organism
GRATK	WIPO Treaty on Genetic Resources and Associated Traditional Knowledge
GSD	Genetic Sequence Data
GURT	Genetic Use Restriction Technologies
ICESCR	International Covenant on Economic, Social and Cultural Rights
ICJ	International Court of Justice
IKS	Indigenous Knowledge Systems
IPR	Intellectual Property Rights
ITPGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
JRC	Joint Research Centre (European Commission)
KSSLC	Kenhteke Seed Sanctuary & Learning Centre (or the Seed Sanctuary)
MAT	Mutually Agreed Terms
MEP	Member of the European Parlement
MLS	Multilateral System (of Access and Benefit-Sharing under the ITPGRFA)
NGT	New Genomic Techniques
NPF	Narrative Policy Framework
PABS	Pathogen Access and Benefit-Sharing (Pandemic Agreement)
PGRFA	Plant Genetic Resources for Food and Agriculture
PIC	Prior Informed Consent
RH	Research Hypothesis
RO	Research Objective
RQ	Research Question
SDGs	Sustainable Development Goals
SMTA	Standard Material Transfer Agreement
STS	Science and Technology Studies
TRIPS	Agreement on Trade-Related Aspects of Intellectual Property Rights
UDHR	Universal Declaration of Human Rights
UNDRIP	United Nations Declaration on the Rights of Indigenous Peoples
UNDROP	United Nations Declaration on the Rights of Peasants and Other People Working in Rural Areas
UPOV	International Convention for the Protection of New Varieties of Plants
WG-ABS	Working Group on Access and Benefit-Sharing (CBD)
WHO	World Health Organization
WIPO	World Intellectual Property Organization

Introduction

1. Adopted in 2001, the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA, or the Treaty) aims to ensure the conservation and sustainable use of plant genetic resources for food and agriculture (PGRFA). It also aims to facilitate access to certain PGRFA through the establishment of a fair and equitable system of access and benefit-sharing (ABS). The ABS system operates in conjunction with the 1992 Convention on Biological Diversity (CBD), which recognizes States' sovereign rights over their natural resources. On this basis, access to these resources and the sharing of benefits may be negotiated on a bilateral basis (Morgera et al. 2014). The ITPGRFA builds on the principle of States' sovereign rights while reversing its logic. By virtue of their sovereign rights over their genetic resources, States decide to pool certain PGRFA listed in Annex I, given their importance for food security, through a Multilateral System (MLS) with a Benefit-Sharing Fund (Frison 2018). The Treaty also recognizes Farmers' Rights and, through its Multilateral System, aims to prevent the misappropriation of PGRFA.

2. Yet, nearly 25 years after its adoption, these initial objectives of justice and equity do not appear to have been achieved: seeds have been made freely accessible for breeding and agricultural innovation, but contributions from States and breeding industries are insufficient and uneven, non-monetary contributions unequally shared (Aoki 2009; Rabitz 2017; Frison 2018; Tsioumani 2018). Acknowledging that this ABS system does not operate optimally, the Treaty's Governing Body initiated in 2013 a revision process of the MLS (Tvedt 2025).[1] After a first deadlock in 2019, before being relaunched at the Governing Body meeting in Rome in 2022; its eleventh session of the Governing Body, held in Lima in 2025, once again failed to reach consensus on the proposed revisions (Tsioumani et al. 2025). This renewed impasse illustrates the contentious issues addressed by the Governing Body in the context of its eleventh session: the revision of the SMTA and payment structure, the extension of the scope covered by the ITPGRFA, and the issue addressed in detail here, the dematerialization of PGRFA. These difficulties are also reinforced by power imbalances and injustices within the negotiation process itself.[2]

[1] Established under Article 19 of the ITPGRFA, the Governing Body is the Treaty's supreme authority. Composed of all Contracting Parties, it promotes the full implementation of the Treaty, notably through policy guidance and general decisions. Ordinary sessions are generally held biennially. They include, as observers: intergovernmental organizations, international agricultural research centers, Indigenous and farmers' organizations, as well as private sector, civil society, and academic actors.

[2] Together with members of the EcoLAWgy research team, I observed these power imbalances through participant observation at the Governing Body meetings (GB10 and GB11). These tensions were particularly visible during GB11, when the plenary was unable to engage in a substantive discussion of the Chair's final compromise, as key

3. Indeed, a recurring site of contestation, following nearly a decade of formal inclusion on negotiation agendas, is the dematerialization of genetic resources and its implications for the Treaty. The dematerialization of genetic resources may be understood, schematically, as "the information and knowledge content of genetic material [that could be] extracted, processed and exchanged in its own right" detached from physical PGRFA (FAO 2013; Welch et al. 2017; Frison 2018; Aubry et al. 2022). It fundamentally affects the logic of ABS instruments. In the 1980s and 1990s, ABS instruments were primarily designed to facilitate access to "physical" genetic resources; their immaterial dimension, however, has always been inherent to their operation.[3] Today, genetic sequencing has become faster, cheaper, and more economically accessible, and the bioeconomy increasingly relies on sequence data instead of, or in addition to, physical genetic resources. For instance, in 2018, scientists in Canada were able to chemically synthesize the horsepox virus (HPXV) using only digitized genetic sequence information (Rourke et al. 2020; Jefferson 2023). Advances in sequencing technologies increasingly make it possible to exchange dematerialized genetic resources in the form of data, without complying with access and benefit-sharing obligations (Bagley 2022).

4. The dematerialization of genetic resources is discussed under the CBD through the placeholder term "Digital Sequence Information" (DSI), although alternative terminologies have also been advanced, such as Genetic Sequence Data (GSD).[4] The terminology is also linked to questions of scope, as DSI may potentially cover a broader range of so-called "omics" data. It can include, *sensu stricto*, DNA/RNA sequence data, but, *sensu largo*, can extend to proteins and metabolites, and to phenotypic data, structural data, metadata, or even traditional knowledge (Houssen et al. 2020; Paper V). In addition, DSI is not limited to biodiversity conservation and ABS, but is also related to global health and intellectual property rights (IPR). Indeed, DSI is discussed under the ITPGRFA, the CBD and its Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity (Nagoya Protocol), and the Agreement on the Conservation and Sustainable Use of Marine Biological Diversity of Areas beyond National Jurisdiction (BBNJ 2022). It also extends to the World Health Organization (WHO), through the Pandemic Influenza Preparedness Framework (PIP 2011) and the Pandemic Agreement

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negotiations had taken place behind closed doors or involved only a limited number of regional representatives, without systematic translation (Frison 2018; Tsioumani et al. 2025).

[3] Indeed, the commercial value of genetic resources largely resides in the intangible information they carry. This is reflected, for example, in the central importance attached to the sharing of passport data and characterization information associated with genetic resources, which enables breeders and researchers to make effective use of them (Paper 9).

[4] GSD are discussed alongside DSI within the ITPGRFA. GSD are primarily used in the Pandemic Agreement and the PIP Framework and defined as the "order of nucleotides found in a molecule of DNA or RNA" (PIP, Art. 4.2).

(2025), as well as to World Intellectual Property Organization (WIPO) Treaty on Genetic Resources and Associated Traditional Knowledge (GRATK 2024).

5. Several contestations cut across these instruments, including whether DSI should be included within the scope of the Treaty, within ABS mechanisms, and the measures that should be taken to prevent the use of DSI from becoming a way to circumvent the system (Bond and Scott 2020; Hampton 2023). These discussions also involve the erosion of state sovereign rights over their genetic resources once they are sequenced and published in data repositories located outside national territories, the growing digital divide between countries as sequencing technologies expand, the loss of relational ties to seeds in processes of dematerialization, and the marginalization of Indigenous Knowledge Systems (IKS) in these negotiations (Aubry et al. 2022; Paper V). These disagreements remain significant, despite recent decisions adopted at the fifteenth and sixteenth Conferences of the Parties (COP) to the CBD moving towards the establishment of a multilateral benefit-sharing mechanism for DSI. The practical modalities of this mechanism remain under negotiation, and current discussions point towards a system based primarily on voluntary contributions (Rabitz and Tsioumani 2025). DSI then re-emerged as one of the main sources of deep disagreement at the eleventh meeting of the Governing Body of the ITPGRFA in Lima and partly explains the failure to reach consensus on the reform of the MLS.

6. In this thesis, I understand DSI as a "hybrid" issue (Latour 1993; 2004), as it goes well beyond purely technical aspects and is also taken up by heterogeneous actors with divergent interests and obligations, depending on their axiological, ontological, and epistemological frameworks. Indeed, DSI is not addressed in the same way in the discourses of States from the so-called Global North and Global South,[5] scientists, industrial actors, farmers, and Indigenous peoples (Rourke 2022; Alexis 2023; Kreiken and Arts 2024). For example, countries that benefit from the unregulated use of DSI for their research sectors and for biotechnological industries may support the maintenance of DSI in open access without ABS obligations. They can rely on a supposed interest of the scientific community, treated as a monolithic block, allegedly sharing an interest in using DSI without administrative burden or benefit-sharing (Aubry 2019; Frison and Tsioumani 2022). By contrast, Parties from where genetic resources originate before being sequenced argue that these data are indeed used in ways comparable to physical genetic resources and that their use should therefore be subject to ABS (Bond and Scott 2020).

[5] Although I recognize that this dichotomy is not always clear-cut, as megadiverse countries may also rely heavily on sequence data, while Northern countries already hold genetic resources in gene banks that they sequence without involving Global South countries.

7. In this vein, the use of DSI aggravates imbalances of rights within this seed property "regime complex" (Raustiala and Victor 2004; Frison 2018). Indigenous and local farming communities, often marginalized in these forums, denounce acts of digital biopiracy: genetic information is sequenced without their consent, then uploaded and made freely accessible, becoming the source of new innovations and gene-edited plants that are subsequently protected by patents or plant breeders' rights (Nehring 2022; Tordjman 2021). While these dematerialized seed data remain de facto freely accessible, intellectual property mechanisms restrict the exchange and use of seeds among farmers, thereby disrupting the social and cultural relations that connect farming communities to their seeds and contributing to biodiversity erosion through a "tragedy of the anticommons" dynamic (Heller 1998; Howard 2015; Frison 2018). Therefore, DSI can be understood as the subject of contestations, but ones that are embedded in multiple levels of conflict, with underlying ontological controversies and deep-rooted conflicts (Frison and Tsioumani 2022, 129; Madden and McQuinn 2014; Kloppenburg 2004). These debates are notably shaped by a heavy historical legacy of genetic resource governance marked by colonization and dispossession, as well as by the historical disregard for Indigenous knowledge, agricultural techniques, and relationships to seeds (Figure 1, see *infra* § 26).

8. Approaching these questions from a public international law perspective, a contested question repeatedly identified in the literature is whether the ITPGRFA, and its definitions of PGRFA and "genetic material," should be limited to physical elements, or whether these definitions should be interpreted holistically to cover genetic resources in both their tangible and intangible dimensions. While these definitions can indeed be interpreted holistically to include DSI, as argued here and on the basis of existing literature (Frison 2018; Bendimred and Frison 2022; Frison and Tsioumani 2022; Morgera 2016; Schei and Tvedt 2010; Silvestri and Roig-Cerdeño 2025), this thesis focuses more specifically on the role and uses of scientific arguments in these debates. Bringing together legal technique, the philosophy of law, and the philosophy of science within the continuity of the "ontological turn" (Escobar 2018) and posthuman theories (Braidotti 2019), the thesis addresses the strategic ways in which science is used to influence negotiations, to guide policymaking processes, to frame the ontology of DSI, and to interpret these legal definitions.

9. An initial research angle has theorized the use of scientific argumentation as an external authority in debates on DSI. Without diminishing the importance of scientific contributions in political and legal contexts, the aim is to limit the ways in which scientific messages (that could be marked by uncertainties, conflicts of interest, and, more broadly, reflecting situated viewpoints) are transformed into authoritative truth discourses that delimit political and legal reasoning. Such argumentation, in which science is presented as a neutral, external, and objective argument of truth, echoes a dualist ontology and the associated "great divides" between objective science and subjective politics, nature and culture, and facts and values (Latour 1993; 2004; Descola 2014; Stengers 2015). It is on this separation between science and

politics that scientific arguments can take the form of objectivity and neutrality and impose on subjective political debates. This argumentative form, grounded in a dualist ontology, is also examined through its epistocratic expressions, as well as through the concepts of "power/knowledge", articulations of "regimes of truth," and distinct "modes of existence" that must not be conflated to avoid category errors (Foucault 2014; Latour 2013).

10. Following this theoretical framework, the articles composing this thesis also expose the visible and empirical manifestations of these "scientific/technical narratives" mobilized in the argumentation of political and legal actors. In these narratives, science is not approached as a practice of reference, humility, and the co-construction of provisional knowledge, but rather as a guide for determining the right policy to adopt, accompanied by claims of neutrality, rationality and expertise (Viala 2024; Mouffe 2016). The different articles of the thesis discuss these cases of "technical/scientific narratives," for example when States from the Global North defended political positions and legal interpretations aligned with their political agendas, they argued that DSI are not scientifically considered to be genetic resources (Paper 4). Likewise, when the New Genomic Techniques (NGT) Regulation was presented by the European Commission as corresponding to the "biological reality of these techniques," and when the Commission claimed to make policies that are "science based," guided by independent experts who have no political interests, or when the opposition uses scientific arguments to criticize this same proposal (Papers 7, VI).

11. The investigation of science as an epistocratic and dualist argument is complemented by an analysis of the definitions of "modern science" and by critiques developed within feminist, decolonial, and, more broadly, posthuman critical theories (Braidotti 2019; Haraway 2015; Stengers 1993; 2022). Posthuman critical theories are conceived as a space of convergence between generations of critique, addressing both Western humanism, particularly from feminist and decolonial perspectives that challenge the discriminations and hierarchies it produces among humans, and anthropocentrism, which isolates "Man" as detached from and superior to non-humans, positioned as master and possessor of nature (Braidotti 2019; Jones 2023). These theories denounce the alleged universality and objectivity of modern science, which is universal only in the sense defined by Western traditions and operates through the exclusion of forms of knowledge and representation that do not conform to positivist frameworks (Braidotti, 2019). Indeed, this alleged objectivity understood as a "view from nowhere" (Haraway 2015), operates through ruptures and forms of "thinning of the world," setting aside lived experience, as well as fields of values, cultures, embodied experiences, doubt, and other epistemologies (Stengers and Debaise 2023).

12. Following these conceptual contributions, I enriched the initial research angle with two related questions. On the one hand, an examination of how the discourses of modern science produce "ontological cuts" (between nature and culture, between science and politics, and between facts and values) that can become normative. On the other hand, epistemic injustice, with the systemic disqualification of other epistemologies, particularly Indigenous knowledge systems. First, by mobilizing posthuman theories to move across successive generations of critical scholarship and concepts (Braidotti 2019; 2022; Jones 2023; Arvidsson and Jones 2024), the thesis examines the processes through which legal positivism and Western science operate through "ontological cuts," such as those between object and subject of law, humans and non-humans, and the tangible and the intangible. Barad (2007) takes up this concept by drawing on the notion of individuation (Simondon 2005) and of becoming (Deleuze and Guattari 1980), through which she considers that there are no things or subjects that exist as ready-made and isolated entities, but rather through processes of individuation and becoming; that is, through the construction of knowledge, discourses, and categorizations that form "ontological cuts" (Arvidsson 2024).

13. Through this analytical framework, the thesis analyzes how these "ontological cuts" acquire implicit normative force and how they are strategically mobilized in legal and political debates. For example, arguments drawn from Western sciences often incorporate Cartesian dualist assumptions, thereby reinforcing a physicalist approach to genetic resources (Oguamanam 2022), in which seeds are treated as "universal store of genes," detached from their cultural, spiritual, and relational dimensions (Bonneuil 2019). As discussed in this thesis, these "ontological cuts" are not fixed; rather, they are deployed in varying ways according to the interests at stake. Indeed, certain States seek to produce such "cuts" in the context of ABS regimes, whether physicalist, distinguishing physical plants from intangible elements such as DSI, or naturalist, separating plants understood as raw material or genetic pools from their cultural and spiritual relations to humans. By contrast, these separations operate differently in the field of property law, which tends to establish continuities between the tangible and the intangible "where capital wants it to go" (Käll 2022, 60; Sherman 2024).

14. Beyond their critical potential to expose what is problematic and open to deconstruction, as is common to many critical theories, posthuman theories also possess a creative dimension (Arvidsson 2024). By relying on this constructive component, this thesis adopts a relational approach to seeds, law, politics, and knowledge. Rather than remaining confined to the ontological deadlock of modern sciences, which may a priori constrain certain ontological claims, the thesis seeks to explore, imagine, and defend a plurality of ontologies and virtuous relations between humans and non-humans, whether existing, marginalized, unexplored, or potential. In this vein, the thesis develops the notion of the "rights of relations" between humans and non-humans and applies it to a relational approach to law, to politics understood as *praxis* rather than *technē*, and to a relational and inclusive conception of science. Applied to a holistic

conception of seeds, this approach acknowledges continuities between the material and the immaterial, nature and culture, and situates seeds within relational webs linking humans, non-humans, ancestors, animals, techniques, and technologies. While such wholistic dimension of seeds is not new to many Indigenous epistemologies (Battiste and Henderson 2000; Absolon 2010; Kimmerer 2015; Taiaiake Alfred 2023; Swiderska and Argumedo 2022), this thesis draws on it to support an inclusive interpretation of the ITPGRFA.

15. Then, examining questions of epistemic injustice, this relational approach is also transposed to argue for an inclusive definition of science. In this thesis, I therefore examine the debates on DSI, the types of knowledge considered legitimate to guide the interpretation of international law and denounce the persistent hegemony of Western science, to the exclusion and devaluation of other epistemologies (Grosfoguel 2007; Tuhiwai Smith 2012; Oguamanam 2006; 2022). Drawing on this literature on epistemic injustices and on concrete examples in the fields of DSI, IPR, and biotechnologies, the thesis describes how these phenomena of epistemic degradation arise, for example, when Western science is presented as the sole authority capable of defining the reality of an "Only One World," to the detriment of Indigenous epistemologies, which are relegated to mere cultural representations of that world (Ingold 2021; Viveiros De Castro 2009; Wattez 2024). Such dynamics are also evident when Indigenous knowledge is reduced to what is translatable into Western scientific frameworks, at the expense of their own ontological contexts. Then, and more concretely, in practices of biopiracy and biocolonialism, where knowledge that are nevertheless essential to discovery are appropriated and recognized as "innovation" only once translated into the language of intellectual property law (Shiva 2016; Whitt 2009). This critique also extends to the protection of IKS under the category of "traditional knowledge," whether as knowledge to be preserved or passively protected against misappropriation (Ewens 2000; Oguamanam 2006; Frison 2018), and which leaves "modern science" as the sole legitimate form of knowledge to interpret international law.

16. Engaging with this critique, this thesis calls for a braiding of knowledge systems when science is used to interpret international law applicable to genetic resources, their definitions, ontologies, and "actual or potential values." While such initiatives of braiding of knowledge have already been explored on epistemological and ethical grounds (Kimmerer 2015; Snively and Williams 2018), this thesis adds a legal dimension by drawing on a "cosmopolitical approach" to international law (Gutwirth 2004; Stengers and de Sutter 2004). In doing so, it seeks to address at the roots the universalist ambitions of international law, to argue that it should not be interpreted solely through Western ontology presented as universal (Borrows 2019; Stengers 2018). Instead, international law could be seen as a flexible space open to ontological diplomacy. In this sense, its legacies would not function as heteronomous constraints, but as a framework within which reinterpretation can take place, considering the various ontological claims and languages of justice. This cosmopolitical argument is grounded both in elements of general international law, such as the broader framework of human rights

and the human right to science, and in specific instruments such as the ITPGRFA and the CBD, and their references to the "social and/or economic value" of genetic resources. It also draws on a recent COP decision noting that "in some world views, all natural genetic information belongs to Mother Earth" (CBD/COP/DEC/16/2).

17. Finally, it is through this attempt at cosmopolitical interpretation that the thesis concludes its final article with a moment of listening in Indigenous voices (Moreno Cely et al. 2021; Spivak and Harasym 1990), understood as a vital and situated knowledge that define the "actual or potential" value of genetic resources as wholistic: both material and spiritual beings, through which sustainable relations with humans, ancestors, and non-humans are maintained. After setting out the methodology and adopting a transparent and explicit reflexive stance regarding my own modes of knowledge production, the thesis is structured around two main components. First, it develops a theoretical framework addressing the utilization and implications of scientific arguments in political and legal spheres. Second, it applies this theoretical framework to analyze the role of science within discussions on the dematerialization of genetic resources under the ITPGRFA and other ABS instruments.

Methodological Framework

18. Given that the PhD thesis is defended based on a collection of articles (Tables 1 and 2), the purpose of the present manuscript is to synthesize these research findings by making explicit the overarching ideas that cut across the individual contributions. This exercise also provides an opportunity to make explicit a reflexive process regarding my knowledge production, the evolution of my thinking, my methodology, and my research practices. This manuscript therefore begins by engaging with the interdisciplinary scientific and political literature upon which the thesis draws, as well as with discussions on the dematerialization of genetic resources and the relationship between law and science. It then outlines the research objectives, the initial research questions and their evolution, as well as the reflexive stance and evolving methodologies adopted throughout the study. Anticipating this reflexive standpoint, the recognition of my own positionality is important.

19. In this sense, this research was conducted from legal and philosophical perspectives, within a university in the Global North, and from the position of a white man from a Catholic, socioeconomically privileged background. I am also situated within a context in which Western philosophical frameworks, as well as their epistemological and ontological perspectives, are dominant, taught within official education systems, and often presented as universal and

objective. I therefore acknowledge blind spots and limitations, which, particularly in Indigenous contexts, have led me to question some of my epistemological frameworks and to modify certain approaches. This positionality also influences my role as a researcher: it is not for me to define what ontology is for Indigenous communities, but rather to deconstruct the hegemony of Western scientific and legal systems, or to develop arguments for an ontological diplomacy. Related opportunities also influenced the conduct of the research.[6] Supervision by Prof. Christine Frison notably provided privileged access to the field through participation in Governing Body meetings. It also enabled, through Prof. Konstantia Koutouki, engagement with work related to Indigenous contexts. In this sense, this thesis assumes a position of situated knowledge. It does not aim to produce objective, detached, or purified knowledge from its object of study. Rather, the constraints, difficulties, privileges, opportunities, obstacles, and encounters shaping the research process are treated as essential markers in the evolution of this knowledge (see *infra*, §§ 45-59).

Positioning within the Existing Literature

20. This thesis is structured in two parts: a theoretical framework and a case study on DSI. Together, they seek to bring different strands of literature into dialogue. The first part develops a theoretical framework examining the roles and functions of scientific arguments in politics and law, with particular attention to their dualist dimensions, epistocratic dynamics, "ontological cuts," and epistemic injustices. The second part takes up this theoretical framework and applies it to the debates on the dematerialization of genetic resources within the ABS regime complex. I begin by addressing the literature on DSI as the starting point of my reflections.

Digital Sequence Information and the ABS Regime Complex

21. Following a utilitarian logic, seeds are defined as "genetic resources" under international law (Girard 2019; Bonneuil 2019). These plant genetic resources are part of a "regime complex" (Raustiala and Victor 2004), given the plurality of international legal instruments that jointly regulate this domain, sometimes pursuing divergent objectives. Tensions notably arise between intellectual property rights, biodiversity conservation, equitable

[6] Another example: French as a native language also facilitated contact with farming communities and with delegates from French-speaking countries during Governing Body meetings, where, despite the availability of interpretation, English remains the official working language. Conversely, not speaking Spanish also limited contact.

benefit-sharing, and sanitary or market access regulations (Oberthür and Pożarowska 2013; Rabitz 2018). This thesis focuses more specifically on the ITPGRFA, while adopting an integrated analysis of other instruments related to ABS, including the CBD and its Nagoya Protocol, as well as, more indirectly, the WHO PIP Framework, the Pandemic Agreement, and the BBNJ Agreement. The analysis also encompasses intellectual property law instruments, notably the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) and the International Convention for the Protection of New Varieties of Plants (UPOV), as well as the recent WIPO Treaty on GRATK.

22. Several key principles are shared across ABS instruments. These notably include the sustainable use of genetic resources (CBD; Nagoya Protocol; ITPGRFA, Art. 1); the protection of traditional knowledge (CBD, Art. 8(j); ITPGRFA, Art. 9); and the recognition of State sovereignty over natural resources (CBD, Art. 15), on the basis of which systems of access to genetic resources and the monetary and non-monetary sharing of benefits arising from their utilization are established (Strobeyko 2025; Berry 2022). Covering all genetic resources,[7] the CBD establishes a bilateral system of ABS, under which access to genetic resources is conditioned upon prior informed consent (PIC) and mutually agreed terms (MAT) on benefit-sharing (Tvedt and Young 2007). These mechanisms are further specified and implemented in the Nagoya Protocol on Access and Benefit-sharing. Together, these ABS instruments thus seek to protect biodiversity and natural resources by embedding them within an underlying commercial logic: the idea that biodiversity can generate commercial value is presented as an incentive for States to conserve it (Tsioumani 2020; Bagley 2022).

23. The ITPGRFA is a specialized ABS instrument related to seeds, whose objective is to establish a Multilateral System to facilitate access to, and the sharing of benefits arising from the use of PGRFA. This system operates through a Standard Material Transfer Agreement (SMTA), a private-law contract between providers and recipients of PGRFA, under which benefits are channeled to a global Benefit-Sharing Fund. The MLS covers 64 crop species listed in Annex I of the Treaty, which together represent approximately 80 per cent of human consumption (Frison 2018; Tvedt 2021). The ITPGRFA is also widely recognized in the literature for its contribution to the recognition of Farmers' Rights. It includes the protection of traditional knowledge, the right to benefit-sharing, and the right to participate in decision-making related to PGRFA, as well as more indirect rights to save, reuse, exchange, and reproduce farmers' seeds (Frison 2018). Nevertheless, the implementation of these rights is left to national governments, and they may come into conflict or tension with other intellectual

[7] It was nevertheless later agreed that human genetic resources fall outside the scope of the CBD (Lawson et al. 2019; Paper I).

property instruments within a broader seed property "regime complex" (Raustiala and Victor 2004).

24. This research builds on the analyses of Frison (2018) regarding imbalances of rights within this seed property regime complex. In this sense, the international legal landscape applicable to seeds, genetic resources, and biotechnologies is marked by a form of "hyperownership" (Safrin 2004). This manifests through IP-oriented instruments that favor the appropriation and commodification of seeds, and is further reinforced by the development of technological tools facilitating seed appropriation, including Genetic Use Restriction Technologies (GURTs), as well as by legal concepts of appropriation such as the UPOV criteria of Distinctness, Uniformity, and Stability (DUS) for plant breeders' rights. As denounced by Frison (2018), this predominance of intellectual property rights limits the rights of farmers, local, and Indigenous communities, and restricts the use of seeds as a "Commons" (Halewood 2013; Dedeurwaerdere 2012; Sievers-Glotzbach and Christinck 2021). Indeed, while the ITPGRFA leaves the implementation of Farmers' Rights to the discretion of States, these are further constrained by other IPR instruments that are legally binding and disadvantageous to farmers. In practice, and despite a farmers' privilege under UPOV, Farmers' Rights to save, exchange, or sell traditional seeds are not properly recognized under international law and can be constrained through IPR (Paper 2, 6-26).

25. Added to this power imbalance is the unfulfilled promise of benefit-sharing systems, and the challenges posed by the dematerialization of genetic resources (Lawson et al. 2019; Aubry et al. 2022). In this sense, this research builds on the literature identifying the structural fragilities of the MLS and other ABS mechanisms, their limited capacity to meet equity objectives, and, more broadly, critiques questioning their utilitarian paradigm in which biodiversity is conserved primarily for its economic value. This research focuses more specifically on the ways in which these ABS systems are further destabilized by the phenomenon of dematerialization. As sequencing technologies are discussed as a "digital loophole" within ABS systems (Hampton 2023; Bagley 2022), the question arises as to whether ABS obligations should extend to genetic resources in their intangible form, that is, whether they should apply to DSI.

26. As discussed in the introduction, debates on DSI give rise to several levels of conflict, raising political, legal, ontological, and epistemological controversies regarding the very nature of what constitutes a genetic resource (Figure 1; Frison and Tsioumani 2022; Rabitz and Tsioumani 2025; Alexis 2023). Among these contested issues, one is addressed in legal terms,

namely whether DSI fall within the scope of the definitions of PGRFA[8] and genetic material[9] (Frison and Tsioumani 2022; Rabitz and Tsioumani 2025; Alexis 2023). On this question, Parties that do not share the same interests in regulating the use of DSI therefore diverge in their interpretation of these instruments and of the policy measures to be adopted. This results in contested legal positions between, on the one hand, States from the Global North and their research institutions or companies using DSI, which consider that these definitions cannot extend to the intangible elements of genetic resources, and, on the other hand, States whose genetic resources are the source material prior to sequencing, which argue that DSI should be integrated into the ABS system (Lawson et al. 2019; Bagley 2022).

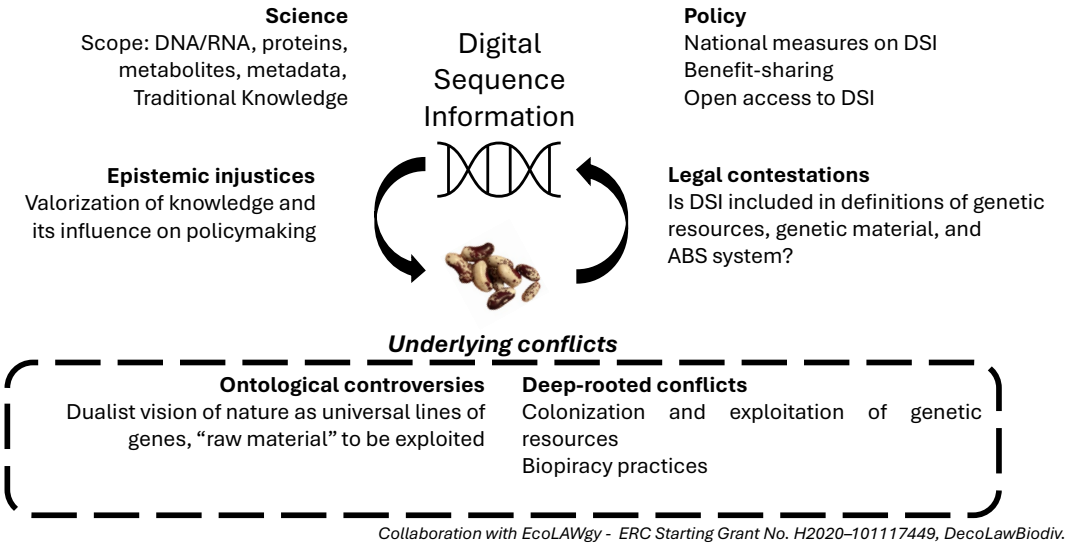


Figure 1. Underlying levels of conflict in DSI.

Several "levels of conflict" can be identified in debates on DSI (ERC Starting Grant No. H2020–101117449, DecoLawBiodiv). In addition to the political elements discussed in Governing Body meetings, legal contestations can be observed regarding whether DSI should be included in the ABS system. These contestations are embedded in deep-rooted conflicts and ontological controversies. The figure also distinguishes "epistemic" from "political" conflicts within a dualist ontological framework, which ultimately converge in underlying conflicts.

[8] Defined as "any genetic material of plant origin of actual or potential value for food and agriculture" (ITPGRFA, Art 2).

[9] Defined as "any material of plant origin, including reproductive and vegetative propagating material, containing functional units of heredity" (ITPGRFA, Art 2).

27. Therefore, in addition to the analyses of policy developments on DSI and this form of "law in the making" (Alexis 2023), this thesis draws on the current rules of international law to support an interpretation of the ITPGRFA that encompasses both physical PGRFA and their intangible dimensions, thus DSI. Such an interpretation aligns with existing scholarship relying on the interpretative methods of the Vienna Convention on the Law of Treaties (Corten et al. 2006; Corten 2017; Linderfalk 2007; Kolb 2007; Chanaki 2013; Lo 2018; Portier 2022; Lekkas et al. 2023), as well as with the literature mobilizing these methods to argue that DSI should be included within the scope of the ITPGRFA (Frison 2018; Aubry et al. 2022; Schei and Tvedt 2010; Silvestri and Roig-Cerdeño 2025; Bendimred and Frison 2022; Contra: Spranger 2017). This research complements existing literature by focusing specifically on the role and use of scientific arguments in these political debates and in exercises of legal interpretation.

Law, Philosophy of Science, and Ontological Questions

28. This thesis draws on interdisciplinary literature combining legal-technical scholarship, the philosophy of law, the philosophy of science, and critical posthuman theories. To properly identify the argumentative uses of science in debates on DSI, the thesis integrates, for example, perspectives from Science and Technology Studies (STS), and their applications to biotechnology and biological data (Leonelli 2016; Jasanoff 2012; 2016), as well as on analyses of knowledge–power dynamics (Foucault 2012; Haraway 2015). It also draws more broadly on political theories addressing the role of expertise (Castoriadis 1987; 1991; Mouffe 1993; 2016), risk governance (Beck 1992), and epistocratic tendencies in political reasoning leading to a "democracy without politics" (Estlund 2003; Landemore 2013; Viala 2024; Oleart 2023). In this sense, science may echo the pitfalls of the "best argument" in deliberative discussions (Habermas 1996; Castoriadis 2005; Steiner 2012). Accordingly, the thesis is also situated in relation to a broader body of literature addressing the role of "truth" and "facts" in politics and law (Zanni 2023; Tiercelin 2023), including idealist traditions centered on the figure of the philosopher-king (Platon 1966; Viala 2022).

29. In analyzing these interferences between science, politics, and law, a central concept mobilized is that of ontological dualism embedded in the "Modern Constitution." This ontological dualism is characterized by a series of separations between science and politics (Latour 2004; Stengers 1993), between nature and culture (Descola 2014), as well as in law with the *summa divisio* between object and subject, persons and things (Supiot 2017; Perrot 2022; de Clippele 2023). Linking this literature with political theory and the philosophy of law, this thesis defends the idea that epistocratic arguments are associated with this dualism (Paper

5). This reliance operates either through the attribution of formal authority when science becomes a source of legal authority (Amselek 1994), or as an informal yet indisputable "background" within Kelsenian positivism (Kelsen 1967; Viala 2011). This echoes, in ways, the ideas of Law as an "other world" (Hermitte 1999), a distinct regime of truth (Foucault 2014) or "mode of existence" (Latour 2013; Souriau 2009).

30. However, these regimes of truth are articulated within a "modern" interdisciplinary programme well-ordered, which may give rise to situations of domination or to the effacement of ontological claims. This is notably the case when modern science and legal positivism mutually reinforce one another, for example, when Western science is treated as the sole pathway to truth and the exclusive source of patentable innovation (Whitt 2009). Through these "ontological cuts," they also conceptualize nature and seeds as separate, exploitable, and appropriable entities (Whatmore 2002; Sunder 2007; Shiva 2016). Such approaches to law and science are by no means universal and stand in contrast to many Indigenous ontologies and epistemologies, which, according to a large strand of the literature, are generally characterized by holistic relationships with the environment and with seeds, linking social, spiritual, and cultural dimensions (Davidson-Hunt et al. 2005; Oguamanam 2006; Absolon 2010; Swiderska and Argumedo 2022). Being critical of the normative nature of these "ontological cuts" that separate the material and immaterial dimensions of seeds, the thesis defends a relational continuity between the physical seed and its intangible elements (Figure 2).

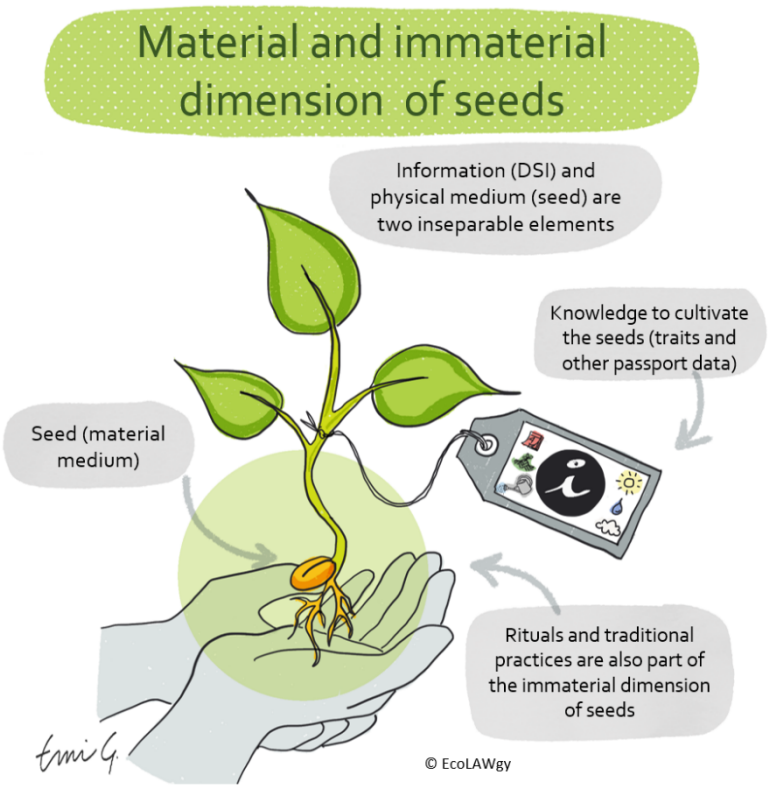


Figure 2. Material and immaterial dimensions of PGRFA (Paper 9).

Seeds are not limited to their physical dimension, but also carry knowledge, practices, and values that are passed down through generations (Frison and Gobbo 2020).

31. This conception of knowledge as external and objective is also challenged by theories of knowledge as constructed *in action*, as well as by feminist and decolonial theories, which emphasize that all knowledge claims are situated within material, embodied, relational, and axiological contexts (Harding 2008; 2011; 2016; Grosfoguel 2007; Haraway 1988; 1984; 2013; 2016). With the aim of mobilizing these bodies of literature, which ultimately nourish one another, this thesis grounds its critical inquiry into the articulations between "modern" law and science in the notions of the "pluriverse," (Escobar 2020) "cosmopolitics" (Stengers 2018) and "ontological turn" (de la Cadena and Blaser 2018). Within these theoretical frameworks, three interdependent claims can be identified. First, realities are enacted through practice. Second, these practices vary, implying the existence of multiple realities. Third, realities are not isolated but entangled, giving rise to an "ontology of multiplicity" (Paper 12). These claims are also connected to questions of epistemic injustice and to decolonial approaches to knowledge (Quijano 2007; de Sousa Santos 2014; Tuhiwai Smith 2012) and decolonial approach to (international) law (Nesiah 2003; 2018; Oguamanam 2006; Borrows 2019; Anghie et al. 2025). Finally, this body of literature is further articulated through posthuman theory (Braidotti 2019; Barad 2005; Marchesini 2023) and posthuman approaches to law (Arvidsson and Jones 2024; Jones 2023; Käll 2017; 2022; Boulot et al. 2021; Boulot and Sterlin 2022).

32. Although distinct, these theoretical frameworks can be placed in dialogue, in particular to challenge claims of universality, neutrality, objectivity, and detachment inherent in modern scientific and legal discourses (Arvidsson and Jones 2024). In this respect, the aim is not to integrate marginalized discourses into dominant epistemic systems, nor to examine how international law might passively accommodate this "traditional knowledge." Rather, it is to call into question the hegemony of Western science as the only legitimate form of knowledge (Tuhiwai Smith 2012), in order to rethink, in a more inclusive manner, international law applicable to seeds. This implies listening to and amplifying Indigenous voices and knowledge systems within their own axiological and ontological frameworks (Moreno Cely et al. 2021). Building on these theoretical foundations, the next section sets out the research objectives and questions that guide this thesis.

Research Objectives

33. The initial design of this doctoral project was guided by three main research objectives, which have been progressively refined and enriched throughout the course of the thesis. The first and initial research objective was to clarify the limits of using scientific arguments in political and legal debates, to prevent their abusive instrumentalization for political or legal purposes. In this vein, the thesis examines how such arguments both reinforce a dualist ontology and create an epistocratic risk, in which situated and value-laden knowledge can be presented as neutral and objective, and then claim authority over political and legal reasoning (Latour 1993).

34. At the same time, this objective is also attentive to the dangers of reductive approaches to science, which promote a vision of knowledge limited to the methods of modern science, thereby excluding other epistemologies. Nevertheless, in the face of the rise of "post-truth" politics and authoritarianism, an equilibrium must be found to defend an "enlightened" vision of democracy that integrates the insights of scientific argumentation, while relying on an inclusive definition of science: one that does not exclude non-Western knowledge systems and does not delimit public deliberation (Papers 10, 13, VII). Therefore, a relational approach to law, politics, and science is proposed, in which the political is defined as *praxis* rather than *technē*, and thus cannot be disqualified a priori by the reductionist discourse of modern science (Paper 6).

35. Situating itself within debates on the dematerialization of genetic resources, the second initial research objective sought to defend an interpretation of the ITPGRFA that includes DSI within its scope, in order to uphold the Treaty's objective of a fair and equitable system of access and benefit-sharing. This interpretation is first developed through the "classical" methods of international law interpretation set out in the Vienna Convention (Vienna Convention, Art. 31). This second research objective thus consists in pursuing interpretation through textual, contextual, and teleological methods, used in a complementary manner in order to arrive at the most coherent interpretation (Kolb 2007; Corten 2017; Linderfalk 2007). Applied to State declarations and positions on DSI, this objective leads to the critique of the way in which reliance on ambiguities in the term "material" is used to associate PGRFA solely with tangible elements and, in a pragmatic manner, to reach a physicalist interpretation of PGRFA, while ignoring not only the nuances of the text, but also the context and the object and purpose of the Treaty. This line of inquiry is further enriched by posthuman theories and approaches to international law (Arvidsson and Jones 2024; Käll 2022; Sherman 2024). Building on these theories, which emphasize the force of matter, PGRFA is conceived not as inert material, but as having agency and as being embedded within relational continuities and broader socio-cultural dimensions. These posthuman approaches also make it possible to criticize the inconsistencies of physicalist arguments within ABS instruments, whereas, in the field of IPR, continuities between the tangible and the intangible are established (Paper 9).

36. In addition, this objective was expanded to include a broader analysis of how scientific arguments are used in political debates and legal interpretations related to the dematerialization of genetic resources. It therefore examines "modern science" as a political and legal discourse, in which scientific perspectives shape the interpretation of concepts such as "genetic material" or "genetic resources" in a physical manner, even in contexts where scientific interpretation is formally detached from legal interpretation (Paper 12). Given the risk of interpreting the ITPGRFA exclusively through Western scientific ontologies rooted in naturalist worldviews (Mills 2016; Borrows 2019), this research also aims to justify (through positivist legal arguments and cosmopolitical approaches to law) the necessity of holistic interpretations of the Treaty that include diverse Indigenous ontologies and epistemologies.

37. Finally, following the debates on the types of data included in definitions of DSI, a third objective was initially to argue for the "recognition and protection of Indigenous epistemologies under the ITPGRFA comparable to that afforded to DSI." As my thinking evolved, this objective was redirected toward defending a broader valorization and protection of Indigenous Knowledge Systems that should not be confined to the technicalities of DSI debates, nor subsumed within market-based ABS mechanisms. Such approaches risk reducing the cultural, political, and ontological dimensions of Indigenous knowledge by protecting it only insofar as it contributes once it has been "translated" into a Western ontological framework (Paper VII). In this sense, this amended research objective considers that, within the category of "traditional knowledge," these forms of knowledge are only indirectly protected under IPR. Above all, this category of "traditional knowledge" makes it possible to leave "Western science" intact, and therefore these forms of knowledge are not considered, for example, for informing debates on DSI, for interpreting the principles of justice behind ABS obligations, or the value of genetic resources. Taking up these questions through the tools of law, this thesis sought to valorize IKS within a cosmopolitical approach, drawing on references to the human right to science and the principle of non-discrimination to argue for an inclusive definition of science (Papers 10, 13).

38. These three research objectives have the potential for significant societal impact within a sustainability-oriented vision combining the Sustainable Development Goals (SDGs) and their dimensions of Planet, People, Prosperity, and Participatory Governance. More generally, the project is situated within the continuity of approaches to the environmentally and socially sustainable management of agricultural practices (Planet, People, Prosperity, Participation; SDGs 1, 2, 6, 8–10, 12–15), the inclusion of local populations and the recognition of their knowledge systems (People, Participation; SDGs 5, 10), a common approach to genetic resources and the fair and equitable sharing of benefits arising from their use (Prosperity, Planet; SDGs 1, 4–5, 8, 10), as well as the adequate consideration of social issues within technical domains (People, Participation; SDG 16). More specifically, one of the project's objectives is

related to social justice and epistemic recognition in international negotiations on seeds in the context of the dematerialization of genetic resources. An objective of transparency underlies the critique of the rhetorical use of scientific arguments to justify political positions, by helping to reveal the power dynamics concealed behind claims of scientific neutrality and objectivity. Finally, the project aims to contribute to the strengthening of Indigenous peoples' rights by integrating their perspectives and recognizing their knowledge related to genetic resources.

Research Questions

39. Although specific Research Questions (RQ) are addressed separately in the individual papers, the following overarching research questions can be identified. The first theoretical question asks: *What are the roles, functions, and risks associated with the use of scientific arguments as arguments in politics and law (RQ1)?* These questions are primarily examined through critical posthuman perspectives, focusing on the uses of "modern" science in their epistocratic dimensions and on the "ontological cuts" by which they produce dichotomies between nature and culture, science and politics, facts and values, and the tangible and the intangible.

40. The second research question is linked to the dematerialization of genetic resources: *What are the uses of scientific arguments in the political and legal implications of the dematerialization of seeds under the ITPGRFA (RQ2a)?* From this overarching question, several more specific sub-questions are derived: *How are scientific arguments strategically mobilized by States and stakeholders in these debates (RQ2b)? What ontological assumptions accompany such arguments when they are used to define a "genetic resource" or "genetic material" (RQ2c)? Is it possible, based on legal technique, to interpret the ITPGRFA and its definitions of "genetic resources" and "genetic material" in a holistic manner to incorporate dematerialized seeds (RQ2d)? What would be the contribution of posthuman and relational approaches to international law to such legal interpretations (RQ2e)?*

41. Finally, the third set of research questions applies decolonial epistemological approaches and inclusive definitions of science to the protection of Indigenous epistemologies. These questions ask: *How can Indigenous Knowledge Systems be recognized and valorized within international frameworks such as the ITPGRFA, in connection with debates on DSI (RQ3a)?* Then, *how can legal tools (through a cosmopolitical approach to international law, the human right to science and the principle of non-discrimination) contribute to the recognition of an inclusive definition of science, in which these knowledge systems are valued in their social, political, and ontological dimensions (RQ3b)?* Finally, *what contributions could*

these knowledge systems make to the interpretation of the ITPGRFA and its definitions of genetic resources and genetic material (RQ3c)?

Research Hypotheses

42. The initial research hypotheses were that, first, whether in general or specifically in relation to the dematerialization of seeds, the actors involved in political and legal debates strategically use scientific arguments to justify decisions and interpretations that suit them (RH1). This hypothesis rests on several risks associated with the use of scientific arguments, as identified in the theoretical framework: the reductionism of modern science, which "thins" the world (Stengers and Debaise 2023); the fact that such discourses may present themselves as neutral and objective while imposing specific worldviews and "ontological cuts" that are not shared across other onto-epistemological frameworks (Latour 2017; Braidotti 2019; Borrows 2019); and, finally, the epistocratic tendency to limit political and legal power by committing category mistakes, conflating one mode of existence (science) with another (law or politics) (Latour 2009; 2013; Viala 2022).

43. Analyzing the use of science in debates on DSI, I argue that Western science plays implicit yet normative roles in these debates (RH2a) and is strategically mobilized by States to advance restrictive interpretations of the Treaty that confine PGRFA to their physical entities (RH2b). However, beyond claims of neutrality or objectivity, I hypothesize that scientific arguments also carry a specific ontological background, including distinctions that shape Treaty interpretation in a physicalist manner (separating tangible and intangible elements) or in a naturalist manner (excluding cultural and relational dimensions), thereby privileging a focus on DNA sequences alone (RH2c). Furthermore, I argue that an inclusive interpretation of the ITPGRFA incorporating DSI is the most convincing from a strictly legal standpoint (RH2d), especially when reinforced by posthuman and relational approaches, which analyze PGRFA as matters of property and rights while emphasizing the continuity between the material and immaterial dimensions of seeds (RH2e).

44. Finally, the combination of posthuman theories and the legal analysis of the ITPGRFA also led me to consider that the Treaty should allow for the inclusion of other worldviews and epistemologies in its interpretation (RH3a). This hypothesis initially stemmed from a research objective that considered that traditional knowledge could benefit from legal protection similar to that afforded to DSI. As my research posture evolved, I chose to move away from an analysis of IKS solely through a techno-centric lens related to DSI, the passive notion of "traditional knowledge," or market-oriented ABS mechanisms, and instead to focus on ways of valorizing

these knowledge systems within their own onto-epistemological frameworks. One avenue I pursued in this direction was the proposal of an inclusive and pluralistic definition of science, based on legal arguments such as the human right to science and the principle of non-discrimination, as well as a cosmopolitical approach to international law (RH3b). Once legitimately recognized, these IKS could, I hypothesize, help guide a holistic interpretation of seeds, integrating them within a relational continuum linking their social, political, epistemological, and ontological dimensions (RH3c). Having referred to these periods of change and evolution in hypotheses, methods, and research objectives, the following section makes these shifts explicit through a series of reflexive moments.

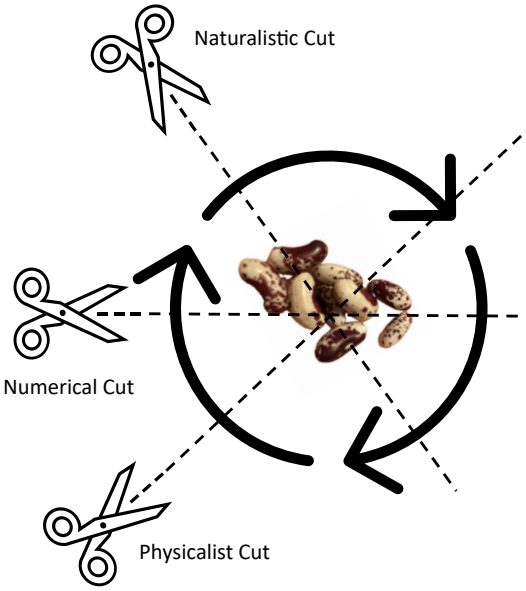
Methodological Approaches and Reflexive Perspectives

45. This thesis adopts an interdisciplinary methodology, using legal technique, legal theory, political theory, and the philosophy of law and science, as well as decolonial, feminist, and posthuman theories. The articulation of these different perspectives underpins the elaboration of the theoretical framework presented in the first part of the thesis. In this first part, for example, the philosophy of law and science is articulated around the concepts of "ontological dualism" and epistocracy, regimes of truth, practices, and modes of existence. These concepts are deployed to examine how scientific arguments may acquire the status of external, neutral, and objective truth, and thus become indisputable in political and legal spheres (Papers 3 and 5). It is also based on critical posthuman, feminist, and decolonial theories that this thesis questions the claimed objectivity and externality of modern science, analyzes its utilization in law (Paper 11), and develops a relational approach to law, politics, and knowledge (Papers 2, 6, 8, 11, 12).

46. This interdisciplinary theoretical framework was subsequently applied to analyze the use of scientific arguments in the context of the dematerialization of genetic resources. Over the course of the research, it was extended to additional objects of analysis, including debates on biotechnology and gene editing, in relation to the EU NGT Regulation, as well as on IPR (Papers 3, 7, and 13). For this purpose, the theoretical framework was combined with legal methodology (Kestemont 2018) and, depending on the specific articles and research question: positivist legal technique and theory (Kelsen 1967; Corten 2017), theories of global law (Benyekhlef 2016; Frydman 2017; Favre 2022), international relations theory and regime complexes (Oberthür and Pożarowska 2013; Kreuder-Sonnen et al. 2025; Tallberg and Zürn 2019), legal pluralism and Indigenous law (Merry 1988; Lajoie et al. 1998; Davies 2017; Borrows 2019; Borrows et al. 2019), and, finally, posthuman and relational approaches to law (Arvidsson 2024).

47. Over the course of my research, posthuman theories took on a more important role, as they present several advantages. As detailed in Paper 11, this is notably the case insofar as they open spaces of dialogue between disciplines, concepts, and critical theoretical generations, including STS, decolonial, Indigenous, feminist, and ontological approaches (Jones 2023; Jones and Arvidsson 2024). This thesis subsequently drew on these approaches for their analytical tools, such as onto-epistemology, intra-action, and actor-network theory, as well as for their figurative tools, such as the posthuman and the cyborg, and for their creative and prescriptive potential, as illustrated, for example, by the proposal of a "right of relations" (Papers 2, 8). More transversally, this thesis also draws on the conceptual tool of "ontological cuts," according to which things, objects, and subjects are not isolated and ready-made elements, but the result of processes of "cuts" and individuation (Barad 2007; Arvidsson 2024).

48. From this perspective, this thesis analyzes the ways in which scientific and legal discourses rely on "ontological cuts," which may be exclusionary, while also showing that other forms of "cuts" are possible. This analytical angle reveals that law and science themselves produce these ontological cuts, and that such "cuts" may vary or even be contradictory depending on the interests at stake (Paper 11). In this sense, attention to "ontological cuts" makes it possible to see, in debates on DSI, how scientific and legal discourses allow States to "physically" divide genetic resources into tangible and intangible elements, or to draw "naturalistic" distinctions between allegedly universal lines of genes and the cultural and spiritual elements associated with seeds. By contrast, in the case of Genetically Modified Organisms (GMOs), NGT, or IPR, other forms of "ontological cuts" can be observed, such as those drawn between "essential biological processes" and "NGT products that could occur naturally or be produced by conventional breeding" (Kim et al. 2023). Confronted with developments in NGTs, the Court of Justice of the European Union (CJEU) opted for a "temporal" cut, interpreting that the exemption from GMO obligations applies only to the techniques traditionally used at the time of the directive and which have a long safety record (CJEU 2018; Gutwirth and Van Dijk 2020). Figure 3 illustrates, with respect to PGRFA, these multiple potential "ontological cuts."



Legal Source	Type of Cut	Explanation
Directive 2001/18	Naturalistic Cut	The directive concerns organisms obtained through non-natural techniques. However, certain genetic modification techniques are exempt from the directive.
CJUE C-528/16	Temporal Cut	Exemptions do not apply to techniques developed after the directive.
NGT Proposal 2023	Numerical Cut (20 nucleotide)	The proposal makes a distinction between Category 1 and Category 2 NGTs based on the number of genetic modifications.
Directive 1998/44	Naturalistic Cut	Exclusion of patents for "essentially biological processes."
ITPGRFA	Naturalist Cut	Distinction between raw plants as the "common heritage of humanity" and improved plants protected by intellectual property rights.
ITPGRFA	Physicalist Cut	The distinction is made between physical genetic resources (material) and their information (DSI - immaterial).

Figure 3. Multiple "Ontological cuts" applied to PGRFA (Paper 11).

Several types of "cuts" (naturalistic, physical, temporal) may coexist and produce different normative effects. These "cuts" are not immanent but vary depending on the interests at stake, sometimes leading to "cuts" that appear contradictory. This is the case, for example, when New Genomic Techniques (NGTs) are presented as conventional plants that should be regulated as such, while exceptions to patentability for essentially biological processes are not applied.

49. These combined legal methodologies were used to identify how normative sources are articulated within the seed property regime complex, across ABS instruments, IPR, and Indigenous knowledge, and to propose an inclusive interpretation of the ITPGRFA. The analyses relied on a broad range of legal and institutional materials, including doctrinal analyses, legislation, treaties and their subsequent developments, resolutions, as well as working documents from the European Commission, Joint Research Centre (JRC), Food and Agriculture Organization (FAO), the CBD, ITPGRFA, and other international organizations (WHO, WIPO, etc.), background studies, preparatory works, State submissions, and FAO archival materials. The present research was also complemented by empirical approaches, combining discursive analysis through the Narrative Policy Framework (NPF), participatory observation, interviews, and fieldwork.

50. The analysis of scientific discourses in politics and law also integrated an empirical approach, combining discourse analysis through the NPF and participatory observation applied

to the discourses of States, the European Commission, and Members of the European Parliament on DSI and on NGT regulation (Shanahan et al. 2018). In fact, based on these initial results (NPF analyses of NGT and DSI debates and interviews), I revisited certain hypotheses (H2a–c) to broaden the analysis to more general "scientific/technical narratives," without requiring that they formally position themselves within explicit dualist ontological frameworks. Indeed, although my empirical analyses show that actors use scientific narratives to justify political and legal positions that serve their interests, such references most often remain abstract, unreferenced, and general. As exemplified further below (see *infra* §§ 99–104, 148–153), epistocratic narratives tend to take the form of discourses claiming to be "based on science," or invoking science as a value. This logic is reflected, for example, in claims advocating open access to DSI to reduce obstacles to scientific research. Similarly, in debates over NGT, epistocratic rhetoric has been invoked to support deregulation in the name of scientific progress in the face of climate change. I also identified, through the NPF, rhetorical strategies and inconsistent uses of scientific arguments by States, depending on the interests defended and across different forums and audiences (Papers 4 and 7).

51. Among these empirical elements, several fieldwork activities were particularly relevant, including:

- Participant in meetings of the Governing Body of the ITPGRFA: GB10 (Rome, 2023) and GB11 (Lima, 2025). These meetings constituted a key site of analysis to examine how national delegates mobilize scientific and technical narratives (alongside ethical and economic arguments) to justify their positions during negotiations.
- An ethnographic "Blue Book" traineeship at the European Commission (Legal Service, DG Agriculture, 2022–2023). This five-month traineeship provided insight into the practical, implicit, and internal functioning of EU institutions. This experience contributed to the thesis by offering concrete exposure to legal reasoning practices within institutions, including the expression of doubts in internal discussions (later erased once arguments are "formalized" and "externalized"), as well as the strategic use of scientific arguments in these processes.
- Research in Indigenous contexts, conducted in the framework of a research stay at the University of Montréal (2025) supervised by Prof. Koutouki. This research stay was also marked by moments of reflection and reorientation in line with the decolonial ambitions in my research approaches (see *infra* §§ 55-59).

52. This research was complemented by approximately ten formal interviews and fifteen informal interviews with policymakers, State representatives, members of international organizations, academics, farmers, and individuals and representatives of Indigenous peoples. As discussed later in connection with my reflections on my own methodological approaches, these interviews were not intended to be representative as such (Olivier de Sardan 2018;

Schelings 2021). In fact, some interviews were deliberately exploratory. Others questioned the need for "formal" interviews to be considered epistemologically valid. Finally, and at the request of the interviewees, some interviews became informal to enable a critical role to be assumed, whether in EU and UN forums or in Indigenous contexts. Although this research did not aim to produce representative formal interviews, I nevertheless developed a research protocol, which was submitted to and approved by the ethics committees of UCLouvain and the Université de Montréal for the interviews with Indigenous communities (see the research protocols and interview materials in the annex).

53. The interview approaches differed depending on whether the interviews fell within the "policy" strand or were conducted in Indigenous contexts. For the first strand, the interviews primarily focused on the role of scientific arguments in the regulation of NGT. Interviewees were selected based on their role in these dossiers, including members of the European Commission (DG AGRI, DG SANTE, JRC), members of the European Parliament (MEPs) and their staff, journalists, as well as State representatives. These interviews were mostly formal and conducted using a semi-structured approach, with questions provided in advance. If consented, the interviews were recorded and transcribed; the recordings were deleted once the transcription was finalized, and the transcripts were validated by the interviewees. These interviews provided the empirical material used for analyses based on the NPF. This method was also applied to certain interviews relating to DSI, conducted with State representatives and members of the staff of international organizations, although with more frequent recourse to informal interviews (ITPGRFA, CBD, WHO).

54. Interviews relating to Indigenous communities were conducted as part of the research stay at the Université de Montréal. The research protocol, contact letters, information and consent forms, and the list of questions were subject to prior ethics committee approval before any contact was made. The individuals contacted for these interviews were members or "representatives" of Indigenous communities involved in political actions related to the agricultural sector, the defense of Indigenous knowledge, or the preservation of historical, cultural, or Indigenous linguistic heritage. The interviews were mostly informal, given a distrust toward extractivist practices in interview-based research. The questions were submitted in advance and discussed depending on the interviewees' thematic preferences. They addressed relationships to knowledge, the use of Western sciences as scientific arguments, political and relational issues related to seeds and GMOs, as well as issues relating to intellectual property and the dematerialization of seeds, the defense of Indigenous knowledge, and relationships between seeds, territories, knowledge, and culture. For most interviews, I obtained consent to retain a transcript, which was subsequently sent back for approval; otherwise, no transcript was retained. As discussed below, this led to a more introspective approach to my research practices. In addition, these interviews also provided an opportunity for collaborative work, notably through the joint writing of an article (Paper 12).

55. Therefore, these interviews and fieldwork experiences in Indigenous context constituted significant moments, marked by obstacles, doubts, and periods of trial and error, which influenced my research approach, methodologies, and thinking. More concretely, and from my situated perspective, I observed tensions between scientific research practices, risks of essentialism, and the needs and priorities of the actors involved. I noted, for example, that highly formalized university ethics procedures and PhD regulations (such as restrictions on co-authorship) were not aligned with the priorities of Indigenous communities and were associated with extractive research practices.[10] Following guidance from Prof. Koutouki and through peer learning during this stay (in particular with Alex Alexis and Caecilia Alexandre), I revised my initial approach in order not to impose my own research agenda or predefined topics (such as DSI), but instead to adapt research questions to reflect the priorities of interviewees. I also relied on informal or indirect approaches in order to avoid intrusive research practices. These engagements materialized through "unscientific" visits to Indigenous territories and communities, including participation in artistic events, political events, visits to specialized museums, and visits undertaken as a tourist. These experiences provided opportunities for more informal exchanges and for conducting a field stay involving visits to Indigenous communities, namely Odanak and Wôlinak (Abenaki), Listuguj and Gesgapegiag (Mi'gmaq), and Wendake (Huron-Wendat). I also participated in conferences organized by and with Indigenous actors (e.g., the Kahnawà:ke Seed Conference, the Tasiujaqmiut Sheewetaganapoi Consortium roundtables, and Braiding Knowledge Canada).

56. More fundamentally, fieldwork experiences and contacts with Indigenous communities highlighted the limits of my own frameworks of thought and academic training (law, European studies, and philosophy). I thus associated these moments with the limits of applying Western-centered, "well-ordered and classified" interdisciplinary analysis, which leaves no room for ontological questioning. Accordingly, in line with the objective of valorizing IKS, I experienced an ethical and epistemological discomfort in relying on Western-centered definitions of "science," "law," or "politics."[11] I also experienced discomfort in tracing their relationships exclusively through the history of Western philosophy. In this sense, whereas earlier in my training recourse to philosophy had offered a refreshing way to move beyond a strictly legal or

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[10] Prior to a request submitted as PhD Representative, the UCLouvain Law doctoral regulations prohibited co-authorship in the article-based PhD. While understandable within its own epistemic framework to ensure the individuality of the work, this rule is not aligned with current scientific practices and raises concerns in Indigenous research contexts, as it positions the researcher as the sole producer and holder of knowledge.

[11] I am aware that "modern philosophy" is not one-sided and that it offers many useful tools for theorizing the relationships between law and science, and that posthuman theories also draw on these traditions (in particular continental philosophy). This exercise of decentering this hegemony of thought is therefore a continuous process, in which Indigenous ontologies must be understood and listened to in light of their own philosophical and ontological frameworks.

positivist approach, it could no longer constitute a self-sufficient escape route for listening to Indigenous voices or for understanding the relations and obligations they maintain with non-humans (Stengers and Debaise 2023). At most, I could draw on concepts such as "ontological diplomacies," "cosmopolitics," and the "pluriverse" as entry points into new perspectives, without being constrained by a return to a neatly ordered universalism of modern science.

57. This is why the thesis adopts a situated, partial, and fragile viewpoint on the world and chooses not to provide a linear synthesis retracing the major currents and "grand authors" addressing the relations between science, law and politics. Such an approach would have risked essentializing these concepts, or diverting the analysis toward broader philosophical debates (between facts and values, or on Truth in politics, etc.) that are already well commented upon. In my view, these debates are also dependent on their underlying ontological presuppositions and risk reproducing hierarchies in knowledge-production practices. This choice manifested more concretely in a refusal to engage in an exhaustive exploration of notions of "law," "science," and "politics" in their universalist and objectified dimensions (see *infra* §§ 64-69). Instead, the thesis analyzes moments of interference between science, politics, and law, and focuses on the pragmatic effects of discourses presenting themselves as bearers of external truth in law (Stengers and Debaise 2023).

58. In connection with these challenges, another methodological choice consisted in drawing on the reflexive and creative openings permitted by posthuman approaches to law (Arvidsson 2024). Indeed, posthuman theories also have the advantage of making explicit in the analysis a whole series of experiences that are set aside in positivist frameworks, namely affects, emotions, discomfort, tensions with values, and more generally embodied forms of subjectivity or reflexivity (Arvidsson 2024; Stengers 2013). Therefore, they allow, through this study, for the evolution of my reflections to be made explicit, as well as the obstacles or trajectories that have marked the development of my thinking across the different articles. They further enabled me, with greater serenity, to adopt an indirect and respectful method in Indigenous contexts, allowing my own research questions to be influenced, reformulated, or displaced by my interlocutors. Finally, this freer approach gave renewed meaning to my observations of international negotiations, or my time at the EU Commission.

59. To conclude this reflection on my methodologies and their evolution, I consider that the posthuman approaches, as applied here, offer, at this stage, a useful balance. They make it possible, at once, to include multiple methods, generations of theory, and critiques to better grasp the relationships between law and science in their complexity, while remaining sufficiently creative, open, and reflexive to assume a partial, non-totalizing form of writing, without seeking to offer an exhaustive or objective form of knowledge. They justify why, in

this thesis, recourse to interdisciplinarity does not serve to consolidate arguments within an already well-mapped and ordered modern universe, but rather to fundamentally call into question my own ontological and epistemological frameworks. Against this totalizing "view from nowhere" (Haraway 2013; Arvidsson and Jones 2024, 34), this thesis thus assumes a situated form of thinking, embedded in a social, historical, and material context. The thesis is therefore attentive to my own relationship to knowledge, my blind spots, my intuitions, and my doubts and hopes, in my analyses, explorations, and proposals for relational approaches to law, science, and politics.

Part I. Theoretical Framework: Scientific Arguments in Politics and Law

60. The first part of this study proposes an overarching theoretical framework linking ideas and analyses on the relationships between science, law, and politics (Papers 1, 2, 5, 6, 11). It also includes the analysis of more specific examples, including the analysis of science in the judicial decisions of the CJEU, the NGT regulation, and EU agrifood policy (Papers 3, IV). This theoretical part also has a reflexive and evolutive vocation. Its first chapter examines how the concepts of "law", "science", and "traditional knowledge" are addressed within positivist frameworks, and the implications of these definitions when they "stabilize" ontologies or exclude other normative or epistemological systems. This chapter also details the evolution of my thinking and how these concepts are reworked through posthuman, decolonial, and relational approaches developed in this thesis.

61. This exercise of redefinition is taken up again in Chapter 2 to address the interferences between science and law. In this respect, these definitions are interrelated and intra-act (Barad 2007). For example, when a positivist notion of law is nourished by a specific Western definition of science, they articulate and reinforce each other while excluding other epistemologies and normativities. Their articulation also reinforces an ontological dualism separating nature and culture and imposing a distance between subject and object (Whitt 2009). Throughout the articles, I propose several conceptual tools to analyze these interferences. These include epistocratic arguments, regimes of truth that articulate with one another, and modes of existence that should not be confused (Papers 1, 3, 5). This chapter presents these tools, clarifying their contributions and limits. This theoretical part is also an opportunity to revisit my propositions for a relational approach to law, politics, and science, in connection with a cosmopolitical approach to law (Papers 2, 6, 8, 10–13).

Chapter 1. Rethinking My Notions of Law and Science

62. Addressed in a transversal manner, this thesis focuses on the strategic uses of science to influence political and legal reasoning, with the initial aim of not confusing these two regimes of truth (Paper 1). However, this approach is not sufficient without also questioning the ontology of science and law themselves: the limits and preconceptions that law assigns to science, as well as the types of knowledge that are legitimized by law. This is why this first chapter is devoted to the definitions of "science" and "law" mobilized in this thesis.

Section 1. Rethinking Science through Decolonial, Feminist, and Posthuman Perspectives

63. This section begins by discussing the definition of "modern science," proper to the Western positivist moment. It then examines how modern sciences operate through a series of exclusions and ruptures, affecting indigenous epistemologies which are later taken up in law under the specific category of "traditional knowledge." Acknowledging the risks of essentialism, Eurocentrism, or scientism in these exercises of definition of Western science and traditional knowledge (Battiste and Henderson 2000), this section addresses the ambiguities whereby, although the legal protection of traditional knowledge is often praised for protecting Indigenous epistemologies or cultures, it also allows Western and positivist definitions of science to remain intact. These may then be perceived as the only guide to truth, for example when defining a genetic resource, while traditional knowledge is treated as an element to be protected passively. This is why, guided by the conclusions of Paper 13 following the human right to science and a cosmopolitical approach to law, this section also proposes an "inclusive" definition of sciences.

Subsection 1. Positivist Conceptions of Science

64. As discussed specifically in Papers 3, 6, 10, and 13, references to science, and to the "best" and "most recent" scientific data, are found in a range of international and European legal instruments (Paris Agreement, Art. 4; Pandemic Agreement, Art. 3). However, as noted by Besson (2024), behind these references to a universal science, presented as acultural and ahistorical, lies the risk that international law understands science only through modern

scientific definitions rooted in Western positivist traditions. This is illustrated, for example, by General Comment No. 25 on the human right to science. Indeed, this comment is marked by a disregard for the epistemic contributions of Indigenous knowledge systems, as these are primarily addressed through cultural and intellectual property rights, without being integrated into the framework of the human right to science (Committee on Economic, Social and Cultural Rights 2020; Besson 2024b; 2023).

65. In this thesis, I draw on Stengers (1993, 2022) for a definition of modern science, understood as a set of knowledge about an object and a subject of study, produced according to specific methods associated with a positivist moment of the Vienna Circle, and integrating a series of disqualifications and purifications. This form of science is grounded in ontological postulates and mobilizes methodological tools, including the paradigm of *mathesis universalis* (with the idea of universal criteria for the establishment of knowledge). It also relies on the separation between facts and values, and, consequently, on the requirement of axiological neutrality. Finally, it includes specific experimental settings required to make nature "speak," which can claim neutrality, objectivity, and extra-sociality, through empirical analyses of facts and logical inferences (Gutwirth and Naim-Gesbert 1995; Stengers and Bensaude-Vincent 2003; Stengers 2017).

66. In this vein, a methodological model often cited is that of the laboratory, which operates by purifying experiments of social elements so that phenomena can be constituted as objective and autonomous facts (Latour and Woolgar 1986; Latour 2015). Modern science is also understood as a mechanism of ontological stabilization: scientific practices not only describe but also enact what is taken to be real, granting epistemic and ontological authority to what has been made observable through experimental mediation (Paper VII). "Existents" thus become visible only once they pass through specific rules of laboratory experimentation, and conversely others are rendered invisible (Latour 2000; 2008; Vries 2016). Therefore, this laboratory process sets aside a whole range of experiences, practices, and ontological questions, with the pragmatic effect of a "thinning" of the world (Stengers and Debaise 2023).

67. Then, the objectivity and neutrality of science have been challenged by feminist and decolonial theories, which emphasize the situated and partial nature of knowledge, as well as the interrelations between knowledge discourses and their *loci* of enunciation (Grosfoguel 2007; Tuhiwai Smith 2012; Harding 2011; 2008). This literature critiques the postulate of immanent truths "discovered" through universal, ahistorical, or acultural scientific practices. It points out that knowledge always emerges within concrete socio-political configurations, marked by relations of power and domination, both in the effects of knowledge and in the forms of knowledge that are excluded (Whitt 2009). Further nuances of "modern science" should also

be acknowledged, taking into account the integration of "subaltern" forms of knowledge into dominant paradigms (Boumediene 2022; Sibum 2015), as well as the coexistence of alternative epistemologies within the modern history of science (Ginzburg 1980; Raj et al. 2019).

68. Building on these critical perspectives, this thesis therefore repositions modern science within a positivist paradigm. It analyzes the ways in which it relies on a Western ontology, characterized by "cuts" between nature and culture, objects and subjects. It further examines how, through its discourses and practices, it performatively reproduces these distinctions (Papers 6, 11). In this sense, it is precisely by presenting themselves as neutral and detached from their objects of study that scientists reinforce the divide between themselves and nature. This ontological reinforcement, produced through supposedly neutral and objective discourses of knowledge, contributes in practice to consolidating an extractivist vision of the world. Indeed, modern science claims a "right of reason" over an external, disenchanted, objective, and controllable world, one that can be both protected and exploited (Stengers and Prigogine 1986; Gutwirth and Naim-Gesbert 1995; Blanc 2020).

69. The same process can be observed within the PGRFA regime complex, where science has been used to "objectify" dichotomies such as plants as "raw material" and as the common heritage of humankind versus improved plants that can be protected through IPR (Whatmore 2002; Jasanoff 2012; Jones et al. 2024). A similar logic applies, as discussed later, to the distinction between tangible and intangible genetic resources in relation to DSI (Paper 12). Moreover, by presenting itself as the only valid epistemology, modern science tends to disqualify other ontological questions and knowledge systems. These are reduced to categories such as "traditional knowledge," "cultural sensitivities," or "beliefs," which may be tolerated only as "cultural variations," but within a subordinated framework dominated by the Western ontology of a single, unified nature shared across cultures (Escobar 2020; Paper VII). These questions are discussed in the following subsection.

Subsection 2. Positivist Science and Traditional Knowledge

70. Building on critiques of claimed objectivity, neutrality, and extra-sociality in Western scientific discourses, this thesis also examines the exclusion of other epistemologies, such as Indigenous knowledge systems, which are reductively categorized as "traditional knowledge." Paper VII discussed these asymmetries between knowledge systems, focusing in particular on two interrelated concerns. First, although no single scientific method exists to definitively distinguish between "science" and "non-science," and while Western scientific practices cannot constitute a universal standard of truth (Oguamanam 2006), an epistemic degradation occurs

whereby modern science excludes an entire range of knowledge systems from being recognized as legitimate epistemologies (Tuhiwai Smith 2012). Second, as Whitt (2009, 63) argues, modern science can also be used to devalorize such "traditional knowledge," which may nonetheless later be "translated" into new inventions susceptible to industrial application. This dynamic is illustrated, for instance, by cases of biopiracy and with the recently adopted WIPO Treaty on GRATK, aimed at preventing patents that illegitimately appropriate Indigenous knowledge.

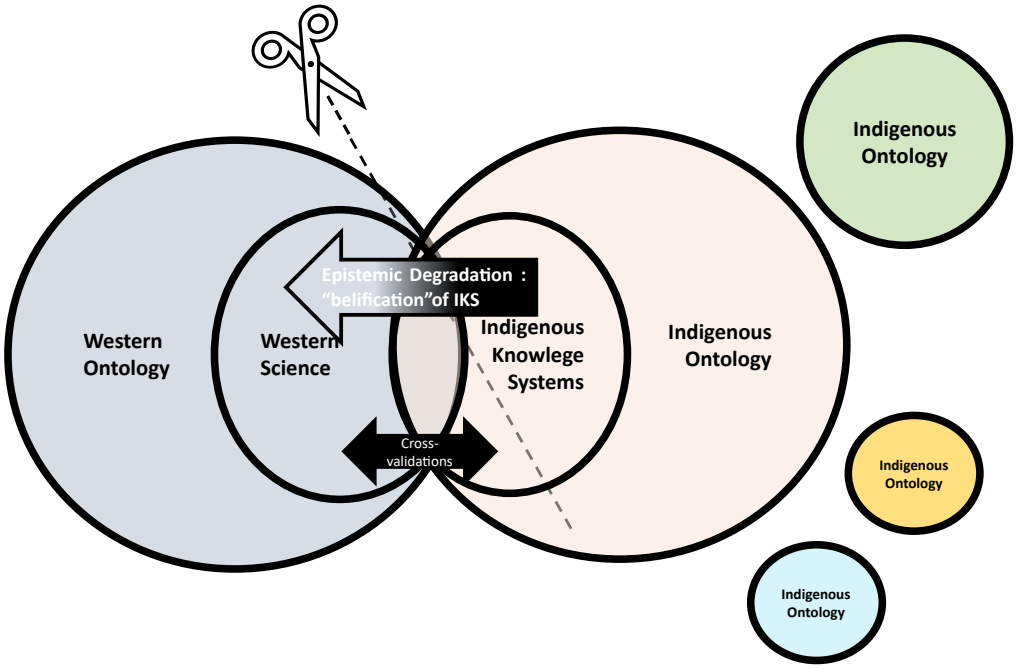

Figure 4. Epistemic Degradation (Paper VII).

The figure represents the epistemic degradation of indigenous ontologies and Knowledge Systems when they engage in dialogue with Western science. Western science, rooted in its ontologies, can interact and seek for validation between knowledge systems, but it can also disintegrate certain elements of knowledge, disregard ontological questions and transforming these knowledges into beliefs.

71. To return to the terminology of Indigenous knowledge systems, and while acknowledging the limits of assembling distinct knowledge systems under a single definition (Battiste and Henderson 2000), the literature nevertheless emphasizes common features. Notably, these systems tend to be relational, circular, holistic, and spiritual. The centrality of community stands out in particular through the intergenerational transmission of knowledge (Oguamanam 2006; Kimmerer 2015). At the institutional level, WIPO (2026) defines traditional knowledge as "knowledge, know-how, skills, and practices that are developed, sustained, and passed on from generation to generation within a community, often forming part of its cultural or spiritual identity."

72. Several instruments within the PGRFA regime complex are particularly relevant to the protection of such knowledge. The CBD recognizes traditional knowledge through Article 8(j), which provides for "respect, preserve and maintain knowledge, innovations and practices of indigenous and local communities." The CBD, as established by the Nagoya Protocol, conditions access to traditional knowledge on PIC and MAT for benefit-sharing. Traditional knowledge related to seeds is also covered as part of Farmers' Rights (ITPGRFA, Art. 9.2). Protection against misappropriation has recently been addressed by the WIPO Treaty on GRATK through mandatory disclosure requirements (Paper 13). Finally, the non-binding Declaration on the Rights of Indigenous Peoples (UNDRIP) recognizes Indigenous peoples' rights to maintain, control, protect, and manage their traditional knowledge and the manifestations of their sciences and technologies, alongside their cultural heritage and expressions. The scope of this recognition is broad, encompassing human and genetic resources, seeds, medicines, knowledge of fauna and flora, oral traditions, literatures, designs, sports and traditional games, as well as visual and performing arts (UNDRIP 2007, Art. 31; Borrows et al. 2019; Girard et al. 2022).

73. These recognitions and protective mechanisms in international law undoubtedly result from a long epistemic and political struggle (Taiaiake Alfred 2008; Tuhiwai Smith 2012), and the adoption of the WIPO GRATK Treaty has rightly been celebrated in this regard (Bagley 2025; Oguamanam 2024a). Nevertheless, Paper 13 also addresses several recurring controversies highlighted in the literature. These include terminological ambiguities surrounding the use of the term "traditional knowledge" and alternative preferred terminologies such as Native sciences, Indigenous knowledge systems, or Indigenous sciences (Shiva 2016; Nijar 2013). It also examines the threats posed by IPR to traditional knowledge, as they are rooted in Western epistemologies and types of innovation that tend to exclude such knowledge through criteria such as novelty, inventive step, and industrial application (TRIPS, Art. 31; Correa 1994; Ewens 2000; Sunder 2007). Similarly, in the field of plant innovations, the DUS criteria of the UPOV Convention exclude farmers' varieties as forms of "common knowledge" (Christinck and Tvedt 2015; Sanderson 2017; Frison 2018).

74. Paper 13 also questions the limits of purely passive or "indirect" protection, which relies on legal tools aimed at preventing the wrongful appropriation of traditional knowledge and "informal innovations."[12] Paradoxically, despite the lack of active protections, acts of (digital)

[12] In his FAO background study, Correa (1994) took up this concept to identify a body of empirical, cumulative knowledge related to PGRFA that is neither codified nor formalized in a patent-like manner, raising the question of the appropriate forms of rewards for the communities that have preserved this knowledge or the associated germplasm.

biopiracy reveal the value of these knowledge systems, albeit only once they have been "translated" into Western scientific or innovation frameworks. Building on this observation, Paper 13 also questions whether it might be more appropriate to broaden the notion of "science" itself to include other epistemologies, rather than creating separate legal categories for "traditional knowledge." Indeed, there is a concern that by consecrating traditional knowledge as a distinct legal category, international law isolates these knowledge systems within a separate sphere, leaving Western science unquestioned. In other words, protecting traditional knowledge "apart" may also reinforce the definitional boundaries of "science" itself as the dominant unquestioned model, or as the sole referent within "science-based" legislative processes. Seeking to mobilize the tools of international law to address these asymmetries, this research also used the human right to science and the principle of non-discrimination through a cosmopolitical approach to law, to advocate for a more inclusive definition of "science."

Subsection 3. Law as a Tool for a Cosmopolitical Approach to Knowledge

75. Considering that the valorization of Indigenous knowledge systems is crucial both epistemically and politically, I draw on the human right to science, the principle of non-discrimination, and a cosmopolitical approach to law to argue for an inclusive definition of science (Papers 6 and 13). Under this inclusive definition, science can be apprehended as a set of collective practices producing reliable knowledge that is consolidated and corrected over time, embedded in the social contexts in which such knowledge is generated, and in the tools, techniques, and discourses that emerge from it (Besson 2024b; Massimi 2014). Following Besson (2024b), this approach seeks to balance the reliability of knowledge, grounded in trust within specific epistemic communities, with attention to the correction of biases, to marginalized knowledge, and to the methodological and metaphysical assumptions underlying dominant epistemic frameworks (Stengers 1993). Through this decentered, minimalist, and inclusive definition of science, Indigenous knowledge systems and the knowledge of agricultural communities are likewise integrated (Besson 2024b).

76. In Paper 13, I argue for this inclusive definition of science through a cosmopolitical argument grounded in the human right to science. I follow Besson's (2024b) attempt to reactivate the participatory dimension of the human right to science, as articulated in Article 27(1) of the Universal Declaration of Human Rights (UDHR) and Article 15 of the International Covenant on Economic, Social and Cultural Rights (ICESCR). Paper 13 took up these arguments related to the human right to science (Besson 2023; 2024a; De Schutter 2011) and linked it to the language of justice associated with the principle of non-discrimination (De Schutter 2010), in order to support this cosmopolitical argument. This argument demands that traditional knowledge be recognized and protected on an equal footing with Western science, without hierarchy in epistemological or ontological terms. Yet, alongside discussions on the acceptance of such an inclusive definition of the sciences, questions remain as to how bridges

and dialogues can be established between different knowledge systems, or even whether such dialogues are possible at all, given their alleged incommensurabilities (Battiste and Henderson 2000; Feit 2017; Schelly et al. 2021).

77. Without resorting to a generalized methodology, and while these issues lie beyond the scope of this thesis, I may nevertheless draw inspiration from existing practices of dialogue and "braiding" between knowledge (Kimmerer 2015; Snively and Williams 2018; BKC 2025), within my own research networks and through the "circle of dialogue of wisdom" (Moreno Cely et al. 2021). Such dialogue requires meaningful listening, a willingness to engage in processes of decolonization of scientific and legal practices, and the valorization of situated knowledge within a pluriverse. In this vein, I have proposed relational approaches to the sciences, emphasizing the value of community-based and holistic knowledge, and recognizing the interdependence of human relations with non-humans, seeds, and territories. Moments of exchange in this sense have been initiated through attentive listening to Indigenous perspectives (see *infra* §§ 209-217), to interpret the definition of PGRFA and genetic material of the ITPGRFA in a cosmopolitical manner. To further develop this legal argument, I now return to the evolution of my ontologies and epistemologies of law.

Section 2. Returning to Law: Where to Begin?

78. Following the same dynamic as the first section, this one discusses the evolution of the ontologies and epistemologies of law across the articles. It continues a reflexive gesture in which interdisciplinarity is conceived in relation to the ontological turn: it is not intended to consolidate a legal argument, but rather to unsettle my own certainties regarding disciplines. When it comes to the evolution of my ontology of law, however, I must acknowledge that this exercise is less clearly framed by my previous research. So far, my publications have addressed law as a mode of existence or as a particular regime of truth (Paper 1), have explored how dualistic arguments claim authority in legal positivism and natural law traditions (Paper 5), and have confronted "law" with critiques from ecological, decolonial, feminist, or posthuman approaches to emphasize that law is not neutral but socially constructed and embedded in relations of power (Kennedy 1987; De Schutter 1992; Paper 11). Yet I nonetheless question whether such critiques risk operating while leaving intact a certain ontology of law itself, including its practices and underlying ontological assumptions.

79. Practical or material arguments may explain this absence: the concern to remain credible within law faculties, or with institutions that produce and apply law has led me to observe a "defensive reflex" aimed at maintaining a stable ontology of what law is. This defensive reflex

is also reflected in a certain epistemology of law that recalls stable boundaries: between law and non-law, or between binding norms and informal codes of conduct. Aware of these limits and mobilizing this study as a space for reflexivity, this section addresses the way in which I approach law and how these notions have evolved throughout my work. This section begins with my initial *a priori* understanding of law (Bergé 2023), namely legal positivism: a law that exists independently within a closed and autonomous system (Subsection 1). Becoming increasingly reluctant to an ontology of law conceived as detached from other spheres, I wanted to rethink it as a mode of existence (Subsection 2), opening the way to a form of legal pluralism and, ultimately, to a relational approach to law (Subsection 3).

Subsection 1. Legal Positivism: Law as an Autonomous System

80. The ontological and epistemological assumptions underpinning several of my papers (3, 5, 7) largely correspond to a positivist conception of law. Without elaborating here, legal positivism can be understood as an application of logical positivism, as developed by the Vienna Circle, to law. It thus shares ontological and methodological affinities with the positivist sciences, notably the separation between is and ought, the commitment to axiological neutrality, and the distinction between describing law *de lege lata* and *de lege ferenda* (Bobbio 1998; Villey 2013; Viala 2010). This separation was ultimately intended to guarantee the possibility of a "science of law" that is pure, that is, free from elements that are not law itself (Paper 5). As an epistemology of law, positivist legal science claims to produce knowledge about law that is objective, neutral, and external to other scientific disciplines, and detached from all extra-legal considerations (moral, political, or social). This scientific attitude is grounded in the principle of *Wertfreiheit* and aligns with Hume's doctrine regarding the impossibility of deriving value judgments from facts (Kelsen 1962; Viala 2011).

81. Within legal positivism, law can be "neutrally" and "objectively" identified as a system of norms existing within its own sphere. It presupposes a Kelsenian ontology of law as a State-centered and hierarchical system of norms, in which each rule derives its validity solely from its conformity with a superior norm, and not from any moral or social consideration (Kelsen 1967; Viala 2010). Therefore, positivism conceives legal ontology through its formal, closed, and autonomous character. Indeed, unlike natural law, positivist legal validity is independent of principles of justice, scientific truth, or social consequences. From this perspective, it becomes possible to apply law in a "mechanical" manner, strictly adhering to the procedures of legal positivism, without explicit reference to the values or social contexts surrounding its application (Gutwirth 2020; 2022). This conception of law as a formal, closed, complete, and self-contained legal system can also be found in other contemporary Western legal traditions (Papers 5, VI). It includes, in particular, Luhmann's conception of law as a specialized social system operating

through self-reference, endowed with its own forms of communication and codes, and capable of adapting to external changes (Luhmann 2004; Clam 2000); ontologies of law as an "other world" (Hermitte 1999) theories of law as an autopoietic system (Teubner 1996; Ost and Kerchove 2000).

82. Much like "modern science," which has "thinned" the world through a series of dichotomies (Debaise and Stengers 2023), legal positivism operates through similar "ontological cuts," notably between subjects and objects of law, between law and non-law (social or moral spheres), and between humans and non-humans (Paper 11). In this sense, legal positivism is grounded in ontological dualism by presupposing an independent, self-contained system that delineates its own domain. At the same time, it actively reinforces these dichotomies by excluding or rendering legally indisputable arguments originating from other spheres (Paper 5). Accordingly, when positivists claim to deal with "law, and nothing but law," they tend to naturalize and objectify their own definition of law. This supposedly epistemological gesture reinforces a single ontology of "what law is," to the detriment of Indigenous normativities (Borrows 2012; Boulot and Sterlin 2022). This positivist logic is also ill-suited to transformations in normative systems that no longer exclusively pass through formal law (Frydman 2017; Tzouvala 2025). Exploring provisional solutions, the following section discusses one possible proposal: conceiving law as a "mode of existence." This approach begins to loosen the constraints imposed by "ontological cuts" and opens a space to consider how different normativities may coexist and interact.

Subsection 2. Law as a Mode of Existence

83. Analyzing the relationship between legal and scientific argument, Paper 1 explored the concepts of "regimes of truth" (Foucault 2014) and "modes of existence" (Souriau 2009; Latour 2013; Stengers 2022). These concepts were used to distinguish law and science as separate regimes of truth that may articulate with one another, or as distinct modes of existence that should not be conflated, at the risk of committing category mistakes. They are also useful for rethinking the ontology of law itself, insofar as law can be understood as a distinct regime of truth or as a mode of existence with its own practices, obligations, and codes of conduct.

84. A regime of truth may be defined as "the corpus of rules and obligations that determine the procedures individuals must follow in order to gain access to truth" (Foucault 2014; Paper 1). From this perspective, each domain (science, law, religion, etc.) operates according to specific constraints and procedures through which it produces its own singular form of truth. To take the example of "modern science," it requires subjects to follow defined frameworks and

precepts to access scientific truth, such as protocols, hypotheses, the discussion of results, mechanisms of arbitration and rectification (Paper 1). Within this framework, truth is thus not conceived as a neutral or universal given, but as the outcome of a socially situated regime of truth. As developed further below, the regimes of truth of law and science may interact, exerting mutual influence and placing pressure on one another (Favre 2022). This is notably the case, when modern science and its dualist ontologies are taken up to interpret the definition of genetic resources in a physicalist manner, or when IPR contribute to epistemic injustices (Paper 1; VII).

85. Paper 1 has also linked regimes of truth with the idea of law as a mode of existence and as a practice. Following the work of Latour, Stengers, and Gutwirth, the analysis through the lens of modes of existence focuses on the internal constraints and regime of enunciation, its rituals, obligations that bind the practitioner to "do law" or "do science" (Paper 1). For Latour, the mode of existence is characterized by: the hiatuses that must be bridged; the continuity produced through associations; the felicity conditions of these translations; the beings that are instituted and traversed; and the transformation of beings-as-other it enables (Latour 2009; 2013; Vries 2016, 163). In *Making of Law*, Latour characterizes the mode of existence of law through its accumulation of procedures and requirements, linking texts and situations to general rules, and to close cases through juridical certainty. Contrary to science, which seeks an evolving truth, the truth of law supposes relativist detachment, as *res judicata* may be taken as true but never confused with truth itself (Latour 2009; de Sutter and Gutwirth 2004; Vries 2016).

86. This approach puts aside legal formalism and pays attention to the obligations constituting the practice of law: its regime of success, the conditions that compel jurists to act, to hesitate, and to respond with creativity to the case (de Sutter and Gutwirth 2004). This is reflected in the cosmopolitical question posed by Stengers, namely what law obliges us to do. Have we properly respected the constraints of rights: do human rights make us "hesitate rightly"? This attention to constraint compels us to consider law in relation to our own ontological commitments, and not only as a set of techniques and codified rules (Stengers and de Sutter 2004; Stengers 2022). Indeed, when jurists respond to external pressures, such as when they have to face politically or economically charged cases, they are never free to do as they please. They remain bound by the practices and mode of existence proper to law (Gutwirth 2004; 2013; 2022). For another example, it is through attention to constraints and practices that Stengers and Gutwirth have also been close to a Deleuzian ontology of law oriented toward becoming. This ontology of law anticipates the potentiality of law before its authentic interpretation and that might lead to a law that is earthly, in becoming, inductive, and topical, rather than fixed, abstract, axiomatic, or deductive (Gutwirth and Stengers 2016; de Sutter 2018).

87. These concepts of regimes of truth and modes of existence are articulated in the second chapter to examine the interferences between law and science. Leaving these questions for later, these concepts have helped me develop an ontology of legal truth that would not be conflated with scientific truth, but also a legal ontology as practice that would not be limited to the formalism of legal positivism. Moreover, they provide an approach more accommodating to ontological politics and diplomacy with an openness to the pluralism of truth. It is thus within this "cosmopolitical" approach to law that I have situated my research and ontologies of law, which has also been informed by Indigenous ontologies and epistemologies of law. This turn to Indigenous and ecological approaches to law is justified by the objective of avoiding the risk of reifying the grand, abstract concepts of "Law" and "Science" in themselves, in a return to a Western-centered philosophy. This is discussed in the following subsection.

Subsection 3. Toward a Relational Ontology of Law

88. The preceding section introduced law as a particular regime of truth, mode of existence, with its practices and constraints. These conceptual tools open the way to a pluralism of truths, ontological politics and diplomacy within a pluriverse. This cosmopolitical approach is also diplomatic and refuses to reduce a priori the claims of "others" to beliefs or cultural sensitivities, as occurs through universalist approaches in international law or through an all-encompassing scientific truth. Rather, it accepts that "we" live in a pluriverse, where the "other" is different but equal, as a bearer of rights, and with whom we must make peace, construct coherence, and take seriously their world, attachments, obligations, and forms of knowledge (Stengers and Debaise 2023; Gutwirth 2004). I sought to adopt this approach in my ontology of law, also drawing on decolonial and posthuman theories, which I associate in this thesis with a relational approach.

89. As introduced in Paper 11, posthuman theories seek to be a space for convergence between theories and critiques of several generations and genealogies toward new conceptual directions. In this sense, posthuman theories aim at the convergence of critiques of Western humanism (dialoguing with feminist, decolonial, Marxist theories) and of anthropocentrism perpetuating forms of domination and exclusion both among humans and in their relations with nonhumans (Braidotti 2019; Jones and Arvidsson 2024). Such critical approaches have also contributed to the ontology of law: the object "law" is produced through discursive acts and struggles for power and legitimacy. It cannot be treated as an autonomous or extra-social sphere, and neither can the science of law claim to provide objective, neutral, or universal knowledge. In this sense, this is why Jones and Arvidsson (2024, 2) use these posthuman theories to extend the critique of international law, which, in its rules, practices, legal reasoning, and science of

law, tends to present itself as universal, objective, to some extent even truth-driven and "scientific" to manage relations between States considered as formally equal.

90. In this thesis, posthuman theories are also taken up to address the "ontological backgrounds" upon which legal thought rests, resonating with the questions in law of the ontological turn (Boulot and Sterlin 2022) , Escobar's pluriverse (2020), Aït-Touati's theater of the worlds (2024), and resonating with Wittgenstein's "background" (1989) and Bergé's *a priori* (2023). The Anishinaabe scholar John Borrows had in this sense considered that the interpretation of treaties rests ultimately on metaphysical ideas of truth, which are not the same between Western and Indigenous ontologies of law (Borrows 2019, 66). Another Anishinaabe legal scholar, Aaron Mills (2016), presents a related argument by distinguishing between rooted and liberal constitutional orders.

91. By "lifeworld," Mills (2016) refers to the ontological, epistemic, and cosmological framework of a community. As Mills argues, every constitutional legal order emerges from a particular life world, that is, a specific ontological understanding of entities (humans, plants, spirits, etc.) and the relations that weave the fabric of the world (Mills 2016). He identifies that liberal constitutionalism (of Western societies) rests on the idea of independent individuals who enter into relations only subsequently, through the political contract. Relations thus take the form of contracts, with the Earth as stage for these relations. By contrast, rooted constitutionalism, which characterizes many Indigenous societies, rests on the idea of interdependence among all beings, human and nonhuman, each member of the political community with the Earth itself as its source and foundation. Therefore, this rooted constitutionalism integrates a relational approach to law in the form of *treaties*: intentionally deepened relations of mutual aid among interdependent entities, with the Earth as their ground (Paper 12).

92. In this sense, this rooted constitutionalism challenges a dualistic ontology of law with the idea of an individual isolated from nonhumans, or of an autonomous sphere of law, and resonates in this sense with posthuman theories and their conceptual tools, figurations or metaphors. Among these, the thesis has mobilized the process of "ontological cuts" to show how the legal categories of subject and object of law are not absolute or universal, but contingent articulations rooted in modern dualisms (Barad 2007; Arvidsson 2024). Integrating the process of "cuts" into the analysis, posthuman theories thus make it possible to envision other ways of making "ontological cuts" according to less discriminatory or even more desirable models (Arvidsson 2024, 40).

93. In other words, positivist "cuts" are not fixed constraints, and law could open itself to alternative constructive solutions to the ontological questions at stake. This capacity to "cut" and "recut" creatively has been useful in this thesis, for example, to imagine ways to better envision the relations between humans and nonhumans that are misrepresented by modern legal frameworks. This creative capacity of posthuman theories is also linked to a moment of suspension: a deliberate "pause" before formulating "mechanical" legal categorization and doctrinal responses. Such suspension seeks to avoid thinning the worlds of excluded experiences or analytical fields (values, empirical experiences, corporeality), practices and constraints, or ontological conflicts (Escobar 2018; Stengers 2018; 2022; Arvidsson 2024, 47). To recapitulate, this pause may also orient legal thinking toward other becomings and enable imagining law through new directions and alternative "cuts," for example to better valorize relations between humans and nonhumans.

94. Following this logic, a part of this thesis defended a relational approach and applied it to law, politics, and science. This approach draws on my early work on "rights of relations," which discussed anthropocentric and ecocentric dialectics in environmental law (Walckiers 2022; Papers 2, 8, 11). This work critically examined the idea that protecting a "nature in itself," detached from humanity, would merely reproduce a naturalist ontology (Descola 2014; Descola and Pignocchi 2022). Similarly, comparative anthropology has shown that the *summa divisio* between objects and subjects of law constitutes a Western category that cannot be assumed to be universal (Swennen 2022; Perrot 2022; de Clippele 2023; Paper VI). In short, other ontologies of the subject and of relations with non-humans (nature, spirits, seeds) exist and should not be ignored a priori (Papers 2, 8). Accordingly, this "relational" approach was proposed to open a space for these ontological debates by taking as points of anchorage the relations between entities, rather than entities taken in isolation or required to be stabilized or fixed to be recognized. In other terms, shifting the focus away from the isolated human or an externalized nature, and from the autonomous subject and the passive object, attention is instead directed toward the relations between these legal entities, and toward how these relations bring them into existence (Barad 2007; Papers 2, 8).

95. Finally, my ontology of law gradually evolved into a holistic one, also echoing a cosmopolitical approach to law (Stengers and de Sutter 2004). Following this holistic ontology, law offers more than a reductionist reading of positivism, more than the mechanical application of precedents, or the exhaustive truth claims of Western sciences. Within this holistic horizon, law may be apprehended as a space in becoming, capable of accommodating other ontologies and other languages of justice, without being limited a priori by already traced doctrinal paths. This cosmopolitical stance is taken up in the next chapter on the interferences between law and science, where I argue that the interpretation of the ITPGRFA cannot be limited to Western sciences, but must also be able to include other knowledge systems to define the actual or potential value of genetic resources.

Chapter 2. Interferences between Law and Science

96. Having presented the evolution of my ontology of law and science in the first chapter, this second chapter introduces the epistemological frameworks used to analyze their interferences. This chapter draws on the work developed in the articles and highlights several examples of the instrumentalization of scientific arguments to influence the law. The first section is devoted to my analysis of scientific narratives through the lens of epistocracy, with examples drawn from specific domains, notably the NGT regulation (examples relating to DSI are taken up in Part II). I then present the application of the theories introduced earlier to these interferences, based on modes of existence and regimes of truth (Section 2), as well as the relational approach (Section 3).

Section 1. The Epistocratic Argument and Its Manifestations

97. A central analytical tool for identifying the interferences between scientific and legal-political discourse is the concept of "epistocracy" (Estlund 2003; Landemore 2013; Viala 2022; 2024). The term epistocracy combines *episteme* (knowledge) and *cratos* (power). It follows a model in which political legitimacy is granted to knowledge holders, who are thus seen as better placed to propose "rational" solutions aimed at the long-term benefit of the political community and detached from any left/right political cleavages (Viala 2024; 2022; Van Bouwel 2024). I return in this section to the dualist roots of the epistocratic argument, discuss its implications, and take up some examples drawn from my articles.

98. For Viala (2022, 2024), the epistocratic argument postulates at its source the existence of immanent ideas (the True, the Good, the Just). Following the Platonic model, "knowledge holders" would be better placed than the ignorant crowd to contemplate these ideas and thus should enjoy political legitimacy (Viala 2024, 29). This idealism is reflected in the claim that truth should guide political choices, and that science would therefore be the ideal method to guide policies that are objective, rational, and neutral, without engaging in "subjective" political debates (Papers 3, 5). This epistocratic logic is, of course, depoliticizing, in that it relies on experts to provide rational decisions, thereby reducing the scope for political choice in a "democracy without politics" (Mouffe 2016). In this context, any political opposition tends to be dismissed as a scientific error or a sign of irrationality (Viala 2022).

99. I analyzed the concrete manifestations of epistocratic discourse through case studies on DSI (Paper 4) and within EU Commission and Parliamentary debates on the NGT regulation (Papers 3 and 7). The analysis of epistocratic discourses within the European Commission was situated within the literature highlighting the hybrid nature of the Commission, with its administrative–political–technical tasks (Bartolini 2005; Mérand 2021), the complementary legitimization strategies of international organizations (Tallberg and Zürn 2019; Cianciara 2021), and the relationships between epistocratic arguments and global law. Favre (2022), on this point, has emphasized that international organizations can rely on epistocratic arguments to advance policies in a "neutral" and "objective" manner in "technical" fields. This literature then adopts a Foucauldian vocabulary to analyze the relations between institutions and organizations, with the idea that the "vocabularies of constraint are cognitive rather than normative" (Koskenniemi 2011). There is indeed the idea that international institutions will produce their own technical knowledge, studies, and reports, aligned with their political agendas, and which may collide with other knowledge from different institutions in this regime complex (Favre 2022).

100. Following an NPF methodology, I analyzed epistocratic arguments through their "scientific/technical narrative." This narrative is composed of several characteristics, notably: privileging norms emanating from independent, competent, and expert-based bodies; justifying policy choices as technically and rationally grounded rather than political; evaluating these policies through technical indicators; emphasizing long-term societal benefits over short-term political interests; and using impersonal language to remove human agency (Pansardi and Tortola 2022; Cianciara 2021). As summarized in Table 3, this ideal type of "technical/scientific narratives" was mobilized in agricultural policies, specifically in relation to the NGT regulation, and situated within the broader context of the European Green Deal, the Farm to Fork Strategy, and the Biodiversity Strategy (Papers 7, IV). The details of the analysis are presented in Paper 7. I observed arguments advocating for the alignment of the European market with new science-based techniques, alongside a neglect of other societal concerns, such as seed ownership and contamination risks. These observations are situated within the framework of NPF analyses, which also examine the Commission's strategic and complementary use of both technical and political narratives depending on the context and the audience (Pansardi and Tortola 2022; Cianciara 2021).

Table 3. Scientific narratives used by the Commission for the NGT Regulation (Paper 7).

The left-hand side of the table presents the NPF methodological categories, while the right-hand side contains excerpts from narratives produced by the Commission, whether drawn from oral statements, working documents submitted to the Parliament, or directly from the NGT proposal.

Scientific narratives	Excerpts from the narratives used by the Commission.
Settings: There are scientific differences between NGT and GMO. NGT are innovative tools designed to meet the objectives of the Green Deal.	"New genomic techniques allow us to do exactly the same [i.e. conventional breeding], but faster and with more precision." "The existing framework […] does not really correspond to the biology of these techniques." (Commission's oral statement 2023). The European Green Deal Farm to Fork Strategy specifically identifies new techniques, including biotechnology, that are safe for consumers and the environment and bring benefits to society as a whole, as a possible tool to increase sustainability of agri-food systems and contribute to guaranteeing food security" (NGT Proposal 2024).
Characters: The commission follows the study from EFSA and JRC. The Commission also undertakes consultation of experts and stakeholders.	"The Commission has relied on EU-level scientific advisory bodies. Safety issues have been thoroughly addressed by the European Food Safety Authority, [and the Commission's Joint Research Centre.]" (European Commission 2023)
Plots: Following the 2018 ruling, Member States asked the Commission to launch a study on NGT. The 2021 study concluded that the GMO framework should be adapted, as NGT products are similar to those obtained through conventional breeding methods, are essential for the agricultural market, and can help address Green Deal objectives.	"The 2021 Commission study concluded that the current rules – mainly the existing GMO legislation - lags behind scientific and technological progress" and this study "considers that the risk assessment of these techniques should be adapted."(NGT Proposal 2024) this proposal is necessary considering the "current challenges in the agri-food system. Climate change and biodiversity loss have put the focus on long-term resilience of the food chain and the need to transition to more sustainable agriculture and food systems." (NGT Proposal 2024) The proposal is also necessary to ensure the competitiveness of the EU market, given that NGT are used in other parts of the world (Commission's oral statement 2023)
Moral of the Story: The NGT regulation reflects independent scientific authorities' conclusions, creating a legal	"Based on EFSA's conclusions, the Commission is proposing that plants that are comparable to conventional plants (according to criteria defined in the proposal) are treated in the same way and not subject to a further risk assessment" (NGT Proposal 2023; European Commission 2023). In the proposal, "there is a

framework aligned with scientific advancements. Its authorization will provide farmers with necessary tools to achieve Green Deal objectives while ensuring EU competitiveness.	verification procedure based on objective criteria. The criteria are based on scientific observation of what has been seen so far in terms of what has been produced by conventional breeding" (Commission's oral statement 2023). "The proposal will create a legal framework so that NGT can support the green transition of the agri-food system. It is designed to meet the demands of farmers for the development and commercialisation of new plant varieties with beneficial characteristics." (European Commission 2023)

101. These "scientific/technical" narratives are also identified during the observations of European parliamentary debates. The Commission's scientific arguments are judged insufficient, particularly with respect to the distinction between category 1 and category 2 NGT products, leading some Members of the European Parliament (MEPs) to call upon alternative scientific data to contest the Commission's position (Papers 7, IV). These observations also lead to a reconsideration of the hypotheses. Although an epistocratic logic can be identified in States' discourses, their anchoring in a dualist ontology is more implicit, as references to science are more general and abstract and are also deployed in other forms. Thus, beyond the epistocratic dimension, narratives of science as a value (the progress of science for the benefit of humanity, science as providing tools to farmers) are identified, as well as narratives of science as a metaphor, with images of genetic scissors, precision, and safety shaping the imaginaries of policymakers who engage with them (Jasanoff 2015; Jarrige 2016).

102. As discussed in Paper 7, these strategic uses of science were also highlighted during my interviews with Commission officials:

> "this proposal assumes that there is a scientific consensus that plants, or at least some NGT, they do not pose more risks than plants obtained through conventional breeding. Arguments such as the 'Green Deal,' farm to fork, and food security (an argument that gained prominence with the war in Ukraine) are then used to assert that these techniques are indispensable for sustainability (and food security). Therefore, a positive narrative is developed to show that opponents are 'anti-science.' We see the Commission's discourse: 'we believe in science. If you are against it then you don't believe in science.' This is a very strong position. The 'necessity' has never been discussed anywhere; it reflects a technological worldview, in my opinion. The issue of competitiveness is not clear, and the idea that 'Europe without GMO has a negative impact on competitiveness' is a narrative, a conviction that is almost religious. We appeal to science with the 2021 study on NGT, but what is not mentioned is that this study was conducted by Commission officials. It also ignores research on modifications to agricultural systems (reintroducing complexity). Science is used rhetorically to separate categories 1 and 2. I would have been more convinced if this distinction had come from an independent scientific body and not developed by colleagues from DG SANTE or JRC." (European Commission, DG AGRI, 2023)

103. The analysis of NGTs was also addressed in Paper 3, which focused on the scientific arguments mobilized in the jurisprudence of the CJEU. Following a review of the literature (de La Serre and Sibony 2008; Brosset 2011; Alemanno 2013; Navel 2023), Paper 3 began by situating scientific arguments and the role of expertise within the judicial landscape. I noted, for example, the margin of appreciation left to Member States in technical cases; the status of the Court, which operates through both external expertise commissioned by the Court and expertise provided by the Parties; and the use of science in the application of the precautionary principle, which articulates science differently by imposing on decision-makers an obligation to prevent risks even in the absence of scientific certainty (Donati 2021). By contrast with legislative work, in which scholars identify a "rationalization of lawmaking" (Alemanno 2013; van Gestel and de Poorter 2016), scientific arguments and external expertise are rarely mobilized by the Court.

104. Several explanations have been advanced to account for this expected yet avoided use of scientific argumentation. Paper 3 discusses formal reasons, including strict admissibility conditions, the risk of procedural delays, and the lack of a clear epistemology of science, in contrast with the Daubert test in the United States (de La Serre and Sibony 2008; van Gestel and de Poorter 2016). It also identifies an institutional reflex to privilege the Court's own knowledge or to refer to its previous decisions. Finally, strategic considerations play a role, as the Court seeks to preserve its prerogatives, or it prioritizes scientific data embedded in EU legal acts, thereby ensuring coherence that is more legislative than scientific. Indeed, the Court primarily uses it to support the choices of the legislator, in line with a presumption of legislative rationality. Then, when the Court does refer to scientific arguments, it tends to accept them in full without engaging with their substance. These observations were further developed through the analysis of the case law on the application of the precautionary principle. In the application of this principle, the Court is more frequently confronted with opposing scientific arguments emanating from the litigants, and it has, at times, manifested moments of distance from them to provide a legal answer to the legal question at hand (Paper 3).

105. Finally, Paper 5 discussed how the epistocratic argument, and its dualist ontology (the separation between science and politics, objectivity and subjectivity), have been mobilized at certain moments throughout the history of legal theory and the philosophy of law. In this sense, this article discussed the ways in which natural law doctrines (ancient, modern, and contemporary) and positivist traditions (sociological or Kelsenian legal positivism) respond to these truth-based scientific arguments. Paper 5 argued that these approaches, given their dualist ontologies, are ill equipped to address epistocratic arguments. In this paper, I argue that natural law presents a normative dualism, in which law is evaluated according to external criteria: principles of justice, reason, or scientific reality. In other words, following the idea that law

must conform to the will of God, to morality, and to reason (Kelsen 1963; Viala 2010), scientific arguments can thus be associated with these objective and external truths. As a result, the scientific argument becomes epistocratic when it bears the seal of objectivity and truth, appealing to a nature that is both immanent and normative (Viala 2024).

106. Within positivist traditions, two types of scientific arguments have been analyzed. On the one hand, sociological positivism extends a form of scientific monism according to which questions of values can be derived from the observation of facts (absorbing the ought into the is). This sociological positivism has the consequence of desubstantializing law and legal activities in favor of what can be observed through the sciences. According to this view, the elaboration of laws is not political but could instead be the subject of rigorous scientific discoveries based on observable social phenomena, thus "assuming that sociology should replace political power and its archaic methods of lawmaking" (Amselek 1994, 9; Viala 2022). On the other hand, Kelsen's legal positivism avoids this "epistocratic trap" insofar as it adheres to axiological neutrality, to Hume's law that one cannot derive an ought from an is, and to the Kantian distinction between practical and theoretical reason. In this sense, politics and law remain subjective activities belonging to the domain of values, and therefore cannot be confused with the domain of facts, of being, or of science (Viala 2011; 2022; 2024).

107. From these precautionary premises, Kelsen's positivism would avoid any normativity of scientific arguments, since legal positivism, as he defines it, isolates pure law from external elements, treating law as an independent sphere, detached from scientific or political considerations (Kelsen 1967; Viala 2011). However, I cannot fully follow this argument, since such an approach reifies the great divide between law, politics, and the supposedly neutral and objective sciences. Moreover, it is precisely through the reification of ontological dualisms, and within broader projects of compartmentalization and articulation of knowledge across positivist disciplines, that scientific arguments claiming neutrality, objectivity, and extra-sociality may at once become indistinguishable within other spheres and nevertheless informally influence legal reasoning (Paper 5). Following the idea that authority does not require formal normativity, if a "neutral" and "objective" truth is recognized outside law and becomes indisputable in legal terms, a factual discourse may then be mobilized within law with a certain rhetorical authority. This argument is further developed through the articulation of "regimes of truth" and "modes of existence," discussed in the following section.

Section 2. Articulation of Truth Regimes Between Law and Science

108. The previous chapters introduced and discussed the concepts of truth regimes and modes of existence to approach the ontology of law and science. By bringing these theoretical frameworks together, I have approached law and science by paying attention to their specific constraining frameworks and precepts, which determine how each subject accesses singular truths, or, in the case of modes of existence, the practices and constraints that must be respected to "do law" or "do science" (Gutwirth 2013). This analytical angle is open to a pluralism of truths. Science and law do not possess any immanent or transcendent truth; rather, they propose constructed and singular truths that coexist within an "ecology of practices" alongside other regimes, and therefore with other truths (Gutwirth and Naim-Gesbert 1995; Stengers 2022). In this section, I revisit how these concepts have been used to analyze the interactions between science and law, and I discuss their usefulness and limits.

109. The analysis of the interferences between law and science was initially undertaken through the lens of truth regimes, from which I was able to map the articulations between these regimes and their normative dimensions. Paper 1 thus analyzed the consequences of such articulations: when truth regimes inter-articulate, they may consolidate and mutually justify one another. These articulations go beyond the mere sum of truth regimes, as they integrate new constraints that are not entirely identifiable when they are theorized in isolation. In this respect, I identify forms of normativity and indisputability produced through these plays of knowledge and mutual references between the legitimacy of positivist law and that of modern science. Examples include, as in Foucault's analyses, the psychiatric institution as a site where psychiatric, legal, and economic truth regimes interact; or the articulation between intellectual property rights and modern sciences within the PGRFA regime complex, which mutually legitimize one another and allow for the devaluation and appropriation of Indigenous knowledge systems (Whatmore 2002; Whitt 2009). As theorized in Paper VII, drawing on these examples in IPR, the articulation of positive rights and Western sciences has the effect of stabilizing ontologies and leads to "epistemic degradation" of IKS (Figure 5).

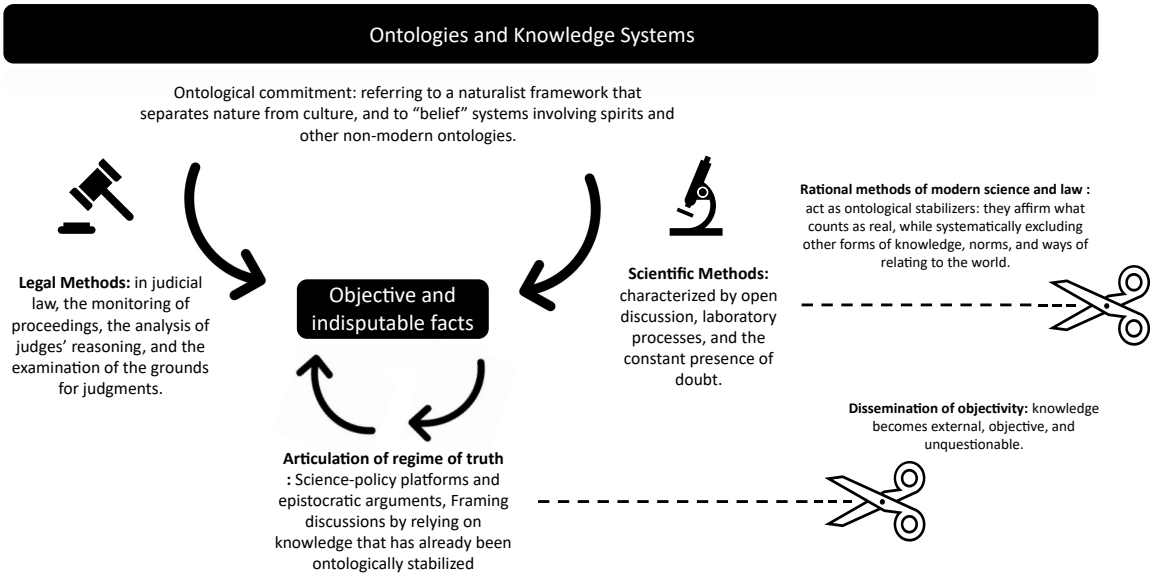

Figure 5. Law and science as ontological stabilizers.

In this figure, Western and scientific methods create interrelated, objective and indisputable facts and norms, grounded in specific (Western) ontologies and epistemic procedures that exclude other ontologies and knowledge systems (Paper VII).

110. Faced with these articulations between truth regimes, Paper 1 proposed some provisional solutions by paying attention to "modes of existence": namely, to argue for respecting each truth regime according to its own logic and felicity conditions, and to avoid category mistakes when one regime is confused with another. This argument postulates that law, like science, constitutes a mode of existence, and that each has its own key of enunciation (language, ethos, felicity conditions), that is, its own mode of veridiction (conditions of success, registers of proof, and forms of discourse). Accordingly, following Latour's idea of taking beings-as-beings and beings-as-others (2013), beings exist by passing through trials specific to modes of existence, their continuity depending on successful passage. An example would be a medicine or a GMO, objects that have several existences depending on the modes involved (scientific, biological, economic), each with its own translations, forms of objectivity, and rules (Harman 2015; Vries 2016; Gutwirth and Van Dijk 2020). Stengers similarly pays attention to the milieu in which disciplines operate, describing it as a common world where diverse practices with their own obligations coexist and interact (Stengers 2022). Therefore, hybrids would thus bear witness to mistranslated situations, in which truth regimes have been mixed (Vries 2016; Latour 2009) and the result of interdependencies between practices and modes of existence (Stengers 2015; 2022).

111. Attention to modes of existence aims to de-hierarchize practices to take attachments and obligations seriously. Accordingly, truth regimes must be recognized within their own regimes of practices, constraints, and felicity conditions, and therefore should not be confused with one another. In this sense, for a being to be successfully translated, it must meet the felicity conditions proper to its own mode of existence. This refusal of any hierarchy between truth regimes has thus allowed me to defend the idea that truth does exist in law (just as it does in science), but that it emerges from a different truth regime (Paper 1). Moreover, attention to modes of existence has enabled me to characterize the epistocratic argument as a "category error:" when rules or principles from one discursive regime are applied in the place of another—in my case, when scientific reasoning is used to replace or to assert authority over legal arguments (Latour 2013; Vries 2016). As Latour points out:

> "Wanting to transport knowledge via the routes of law would be like trying to fax a pizza – and there would be no point in trying to increase the power of the model, it is simply not the right medium. Law, like religion, like politics, deceives those who want to transport information" (Latour 2009, 268).

112. These approaches have the advantage of treating law, science, and politics according to their distinct constraints and conditions of success, which cannot be interchanged or hierarchized. Accordingly, epistocratic forms of reasoning that draw on one regime of truth in place of another amount to a category error. Nevertheless, in this exercise of reflexivity and in the evolution of my thinking throughout the thesis, I wish to add some precautions in my use of these approaches. In mobilizing the concepts of modes of existence and regimes of truth, I do not seek to essentialize a fixed ontology of law and science, at least not in a sense that would lead to a depoliticized legal formalism. Indeed, such essentialism would be inadequate to recognize inequalities, hierarchies, and political tensions among humans and with non-humans (Braidotti 2019; Jones 2023), or the ontological questions at stake within legal practices themselves (for instance, when the rights of nature are taken up as political projects). To put it differently, while I am convinced that these concepts are useful within an "anthropology of the moderns" (Latour 2013), I do not wish to use them in a reifying manner and in their Eurocentric meanings, at the expense of the paths taken within Indigenous systems (Tuhiwai Smith 2012). These questions are largely left open for future research, and the relational approach presented in Section 3 explicitly sketches some ways of responding to these concerns.

Section 3. The Contribution of a Relational Approach to Law and Science

113. This final section addresses the interferences between law and science through a "relational approach," which was progressively developed throughout the papers (Papers 2, 6, 8, 11, 12). As already introduced (see *supra* §§ 88-95), this relational approach was taken up as

an onto-epistemological tool and as a legal argument. The proposed relational approach therefore aims to recognize, qualify, or protect a multiplicity of ontologies, continuities, and relations between humans and non-humans (existing, unexplored, or potential), without being disqualified a priori by dualist frameworks, reductionist modern sciences, or formalist legal positivism. First, this relational approach is used to defend a reading of politics as a *praxis* rather than as a *technē*. Second, it is mobilized in law, either as a legal argument or as a cosmopolitical interpretation.

Subsection 1. A Relational Approach to the Political

114. As discussed in Papers 6 and IV, the political version of the relational approach found its roots in the political thought of Latour, Stengers, Mouffe, and particularly Castoriadis. More specifically, Castoriadis's political theory was useful to associate ontological dualisms and epistocratic arguments with their heteronomous dimensions, insofar as political action is constrained by elements external to the political community. In this sense, when science or references to nature are endowed with epistocratic authority, this reduces the autonomy of the political community in its primary sense: that of giving itself its own norms (Castoriadis 1987; 1991). This concern resonates with the theses of Mouffe (1993) and Latour (2017) on the "return of the political" in the absence of "Nature" as a pacifying arbiter, and on the need to reactivate an approach to politics as a space of diplomacy and agonistic conflict (Papers 6, IV). In this respect, the papers mobilized Castoriadis's critique of heteronomy, according to which democracy should not submit to truths external to it (religion, science, or the market). These papers also relied on creative tools drawn from Castoriadis's thought, such as the valorization of autonomy, imagination, and his definition of politics as a *praxis* (Castoriadis 1987).

115. In this sense, this relational approach to politics can be theorized on autonomy and the self-instituting power of society as the source of political power. As Castoriadis (1987) argues, political institutions are not fixed or immanent but rather result from the radical imagination of the political community. There is a distance between instituting and instituted society, which constitutes a space for new political imaginations (Castoriadis 1987; Van Eynde 2006; Lynteris 2019). Drawing again on Castoriadis's thought, this also entails a critique of expertise in politics and of *all* forms of epistocracy, insofar as he conceives political activity as a *praxis* and not as a *technē*. As taken up in Papers 6 and IV, *praxis* is an activity which, like education or psychanalysis, values the autonomy of subjects and maintains the indissociability of ends and means. There is therefore no abstract knowledge directly applicable to this *praxis*, since knowledge is generated by autonomous subjects emerging from democratic participation and experimentation, and remains always fragmentary and provisional (Castoriadis 1978; 1987; Prat 2007).

116. By contrast, *technē* presupposes an association between goals and appropriate means, a relation of mastery between subject and object, and a fixed mode of operation. In its relation to knowledge and expertise, *technē* relies on the application of a limited, domain-specific know-how to reach a predetermined goal (Castoriadis 1978; 1987; Prat 2007). This contrasts with a conception of politics as praxis, in which political activity cannot be reduced to the application of technical know-how, but instead constitutes a collective and democratic activity in which knowledge is shared and debated among autonomous subjects. Following these distinctions, Castoriadis acknowledges that expertise may have a place in politics, but only as a form of advice rather than as a means of formulating answers, as this exercise remains the sole prerogative of the political community in its autonomy. His position is therefore explicitly wary of epistocratic appeals to authoritative expertise, described as "one of the conditions for the expansion and growing irresponsibility of modern hierarchical bureaucratic apparatuses," since political affairs affect the entire community rather than a technical elite (tr. French; Castoriadis 1986; Delcroix 2006).

117. A final argument supporting this relational approach to the political lies in Castoriadis's warnings against the "madness" of wanting to be wise alone, or of using scientific arguments as arguments of authority (Castoriadis 1986). In this sense, Castoriadis evokes political wisdom as the capacity to weave together different viewpoints within inclusive deliberative processes. This metaphor of weaving together was taken up in Papers 6 and IV, to conceptualize a relational approach to politics grounded in autonomy as the source of a radical political imagination. In this sense, this relational approach to the political would be capable of listening to, confronting, and combining different viewpoints, including the integration of relational ontologies. By integrating these different arguments, I therefore proposed a relational approach with the following definition:

> "the relational approach to politics seeks to emancipate itself from dualism and epistocracy by: i) recognizing a multiplicity of ontologies and links between humans and non-humans (existing, unexplored or potential); ii) valuing the autonomy of the political community viewed holistically; and iii) acknowledging that political questions invoking specific ontologies or links between humans and non-humans cannot be discredited a priori by the application of technical or scientific knowledge" (Papers 6, IV).

118. This relational approach to politics aims to resist epistocratic arguments or "technical/scientific narratives" that are both depoliticizing and that also thin the world of its ontological controversies (Stengers and Debaise 2023). Its objective is this weaving together, even in technical questions such as DSI or NGT, which therefore implies approaching them not as a *technē*, nor as the application of rational and technical policy, but as a cosmopolitical question, in which different political actors must be meaningfully heard, enabling the exchange

of diverse "matters of concern" and deliberation over the choices to be made. The following section takes up this reference to cosmopolitics through a legal argument.

Subsection 2. Relational and Cosmopolitical Approaches to Science and Law

119. Among the papers defended in this thesis, several are articulated around a relational approach to law and the idea of the "rights of relations" (Papers 2, 8, 11). Throughout the research, this relational approach was considered for its epistemic contributions and its legal implications. On the one hand, the epistemological contribution of this relational approach aims to identify, integrate, and legally protect the ontologies and relational continuities that link humans and non-humans, which may be marginalized by positivist reasoning. In connection with its political dimension (Papers 6, IV), this relational approach to law also has a normative dimension. In fact, it seeks to create legal imaginaries that would not be a priori disqualified by positivist or technoscientific reasoning. It postulates that Law thus offers sufficiently stable constructions to give existence to, and to defend, assemblages that are relational and holistic. While this relational approach is primarily meant to be refined through concrete, situated, and local claims, I believe it provides a legal tool for the repoliticization of rights related to nature and technology, offering strategic uses for Indigenous and "naturalist" reclaims (Pignocchi 2019, 80).

120. This relational approach has also been defended as a legal argument, inspired by numerous "relational" developments in legal scholarship and affiliated fields. Paper 11 then took up these relational intuitions, notably to better conceive relations among individuals rather than isolated selves (Nedelsky 2023; 2011; Van Meerbeeck 2020; Arvidsson 2024), to value relations between humans and non-humans that do not operate through domination, to make visible in law hybrid and "troubled" entities or various forms of zoe-techno-assemblages in connection with posthuman approaches to law (Haraway 2016; Jones 2023; Arvidsson 2024), to challenge strict distinctions between subjects and objects of law and to shed light on their gradual or relational continuities between or beyond them (Mocanu 2024; de Clippele 2023), and to take up and explore the ontological questions that emerge from relations between humans and non-humans (Papers 11, VI).

121. Drawing in turn on these different relational manifestations, I previously envisioned the "rights of relations" (Papers 2, 8), later enriched by posthuman theories and their creative openings (Paper 11). In an attempt to propose a new angle in this study, I could also imagine this relational approach to law through the metaphor of ruins. This metaphor is drawn both from the philosophy of art, which conceives ruins as sites of effacement and melancholy as well as

sources of creativity through and within erasure (Schnapp 2020; Wadbled 2020; Descola 2021; Van Eynde 2022). This metaphor of ruins is also mobilized to underline the need for new theoretical and critical imaginaries in response to the ruination of capitalism in the Anthropocene (Luxemburg 2010; Stengers 2015; Stengers et al. 2026; Tsing 2015; Tsing et al. 2017; Grear and Bollier 2020), the effacement of modern certitude in the posthuman condition (Braidotti 2019), the fragmentations of Indigenous knowledge systems due to colonization (Tuhiwai Smith 2012), ruins as shadows and absence in the data sphere (Leonelli et al. 2017; Trauttmansdorff and Hajek 2025; Arvidsson 2025) as well as the ruins of international law (Tzouvala 2025). I therefore use this metaphor of ruins as a non-ideal theory of law to revive the ambivalence of law. It assumes that law is situated between its colonial, naturalist, and extractivist past and present, while at the same time viewing it as having creative potential and flexibility to change or to be reinterpreted to respond to contemporary social, ontological, and ecological questions.

122. By approaching law through both its flexibility (Ost 2012; Doussan 2024) and this form of creative melancholy, I can defend the idea that law may serve as a relay for new ontological mediations and alternative imaginaries. To envision law as a ruin is to see in it traces and fragments from which new interpretations and reconstructions may arise, which can be relational depending on the ontological questions that traverse them. I link this metaphor of ruins to my previous proposals related to the "rights of relations," which, despite not existing positively, may nevertheless draw on reinterpretations of resurgent legal sources or on interstices within positive law (Stengers and Gutwirth 2016). Such sources may include, for instance, the protection of the commons, the reuse of archaic civil law provisions, precolonial legal systems or customs, or human rights principles, as well as the rewriting or reinterpretation of judicial decisions, legal argumentation related to the rights of nature or the crime of ecocide (Paper 2). Assuming these mixtures of legal registers, this relational approach may find support, in the context of debates on DSI, in the insertion of "unstabilized" ontological elements into positive law, as illustrated by the latest COP decision noting that, "in some world views, all natural genetic information belongs to Mother Earth" (CBD/COP/DEC/16/2).

123. This relational perspective, as well as its reappropriation through the metaphor of ruins, also underpins a cosmopolitical interpretation of the ITPGRFA defended later in this thesis. This movement extends the cosmopolitical question that Stengers addresses to law (2022), namely: *what does law oblige us to? Have we "hesitated well" in relation to it?* It therefore suspends readymade answers produced either by the mechanical application of legal reasoning or by the application of scientific knowledge that "thins" the world (Stengers and Debaise 2023; Arvidsson 2024). The approach I defend through this notion of cosmopolitics consists in creating a moment of hesitation for ontological diplomacy. This suspension then makes it possible to explore law as a way of reactivating grounded, inherited, or "ruined" elements of positive law within new politico-legal imaginaries. To articulate these ideas differently, the

thesis may draw on fragments of positive law in order to anticipate new legal constructions that are not those already addressed through the mechanical application of juridical positivism, but new directions that are more accommodating of ontological politics and of relations among humans and with non-humans.

124. Building on this proposal of cosmopolitical interpretation and focusing more specifically on the debates on DSI within the ITPGRFA, Part II of this thesis seeks to overcome the "monoculture" of legal interpretation that treats Western sciences as the sole reference (Shiva 1993). This articulation between Western science and legal positivism implies occupying law according to a specific ontological background, imposing "ontological cuts" between nature and culture, humans and non-humans, the tangible and the intangible. By contrast, while analyzing the ITPGRFA through the conventional methods of international law, I argue that its definitions cannot be restrictively interpreted, nor solely in light of Western sciences and ontologies. The Treaty, its history, and its subsequent evolutions reveal several elements of positive law that push toward the integration of other knowledge systems. This is why I also mobilize this cosmopolitical approach to interpret the ITPGRFA from Indigenous epistemologies (Paper 12). These different arguments are therefore taken up in the second part of the thesis, which returns to the debates on DSI, analyzed considering my different contributions to this theoretical framework.

Part II. Scientific Arguments and the Dematerialization of Genetic Resources

125. This second part of this study analyzes the ways in which scientific arguments are used in the context of the dematerialization of genetic resources. Attention is primarily paid to debates surrounding the ITPGRFA, but also to other instruments within the ABS regime complex (Raustiala and Victor 2004). The first chapter draws on the theoretical framework to analyze the challenges raised by the DSI conundrum, including their conceptual, ontological, legal, and political implications (Alexis 2023). This chapter analyzes, for instance, the role of epistocratic arguments in States' positions in defining what constitutes a genetic resource in ways that serve political interests. This relates to, for example, the framing of the terminology and scope of DSI, and the influences on their integration, or lack thereof, into ABS systems (Paper 4). Building again on my inclusive definition of science and on the relational approach to knowledge, I also criticize the ways in which Western, reductionist, and geneticist approaches to science have been privileged, leading to the marginalization of Indigenous knowledge systems (Oguamanam 2022; Papers 12, VII).

126. Chapter 2 follows a more normative approach. It begins by mobilizing the classical methods of international law in the Vienna Convention to defend an inclusive interpretation of the ITPGRFA. This interpretation considers that the definitions of PGRFA and genetic material should include both tangible and intangible elements and thus be inclusive of DSI. This interpretation is further reinforced by a posthuman approach, which underlines that the ITPGRFA governs PGRFA as matters of property and rights, and which establishes continuities between physical seeds and their intangible elements (Käll 2022; Sherman 2024; Paper 9). Drawing on the conceptual tools of the first part, this chapter also analyzes how scientific knowledge informs this interpretation, and critiques interpretations of the Treaty grounded exclusively in modern sciences and their ontological presuppositions. Finally, I propose a cosmopolitical approach to interpreting the ITPGRFA, considering it as a possible space for ontological diplomacy and as open to interpretation in light of Indigenous epistemologies (Paper 12).

Chapter 1. Digital Sequence Information: Definitions, Controversies, and the Epistemic Role of Science

127. The broader issues raised by the dematerialization of genetic resources for the ITPGRFA and other ABS instruments have already been addressed in the introduction, and recalled across the different papers (Papers 2, 3, 8, 9, 11, 12, I–III, V, and VII). By synthesizing the key conclusions, this first chapter primarily aims to apply the theoretical framework to ontological questions related to dematerialization as a "hybrid" issue (Section 1), to examine how science has been mobilized to stabilize these questions (Section 2), and to analyze how they have subsequently been instrumentalized by States (Section 3).

Section 1. Digital Sequence Information as a Hybrid Issue with Ambiguous Ontologies

128. To grasp the technical, political, and ontological questions surrounding DSI, I choose to approach them as a "hybrid," while also associating them with theoretical vocabularies such as quasi-objects (Serres 1985), beings-as-others (Latour 2013; Merleau-Ponty 2016), the in-between (Oosterling 2003), becoming (Deleuze and Guattari 1980), individuation (Simondon 2005), intra-action (Barad 2007), and wicked problems (Stengers 2015; Servigne et al. 2018). A hybrid is a mixture of elements that are normally separated within dualistic conceptual frameworks, such as humans and non-humans, nature and politics, or object and subject. These objects are blended across registers supposedly distinct from the perspective of modern

constitutions, and that may also be apprehended through other ontologies, with different controversies, constraints, and obligations (Stengers 2015; 2022). In short, these hybrids cannot be classified within the categories of subject and object, combine scientific and technical dimensions, and produce significant social impacts and concerns for heterogeneous actors (Latour 1993; Vermaas et al. 2011; Vries 2016).

129. The dematerialization of genetic resources is thus considered here as a hybrid issue. It mixes a high degree of technicality within political debates, while simultaneously integrating broader ethical, political, and ontological concerns for different actors, including States, industrial and scientific actors, farmers, and Indigenous communities (Alexis 2023). In these discussions, scientists themselves have their own interests, such as the desire to maintain open access to data to advance research. These scientists also have their own networks of representation and have articulated positions regarding the status of these data (DSI Scientific Network 2022; Jefferson 2023; Kreiken and Arts 2024; van Buitenen et al. 2025). However, the DSI conundrum is not only a scientific or technical matter. Ethical questions arise, for example, regarding unrestricted access to sequence data rather than to physical genetic resources as a means of circumventing benefit-sharing obligations (Bond and Scott 2020; Hampton 2023). Such practices may also contribute to digital divides in the use of DSI (Leonelli 2014), further distancing current scientific practices from the initial equity objectives of bioeconomies, as originally envisaged in access and benefit-sharing instruments (Bagley 2022; Aubry et al. 2022; Paper I).

130. Sequencing technologies may also undermine their social, cultural, and spiritual dimensions, and ultimately weaken the relationships between seeds and the territories or communities with which they co-evolve (Ajates 2023). In this regard, farmers' and Indigenous communities have also raised that, such access to DSI may be a source of new gene edited and patented plants, aggravating situations of hyper appropriation of genetic resources and of digital biopiracy (Shah et al. 2021; Nehring 2022). More broadly, I situate these debates on DSI within the continuity of several levels of conflicts, composed of legal contestation (on the status of DSI in relation to ABS frameworks) and, more fundamentally, of underlying ontological controversies and deep-rooted conflicts. In this context, trust has been undermined by histories of colonization, appropriation, and biopiracy of genetic resources (Figure 1; Madden and McQuinn 2014; Frison and Tsioumani 2022).

131. These conflicts manifest more concretely in contested legal positions on the inclusion of DSI within ABS instruments and on the interpretation of the definitions of genetic resources and genetic material (detailed in Papers 9, and 12). Without returning at this stage to the proposed interpretation of these instruments (see *infra* §§ 171-194), and referring to other works

for the most recent policy developments following COP16 and GB11 (see Paper V), Table 4 summarizes the contested views persisting among Global North and Global South States.[13] The arguments are primarily drawn from the ITPGRFA and the CBD, and are echoed in debates within other IPR and global health instruments dealing with genetic resources, without necessarily being coordinated (Bagley 2022; Paper V).

Table 4. Compilation of political and legal arguments (Paper 9).

This table sets out the contested views on the inclusion or exclusion of DSI within the scope of the ITPGRFA and its ABS system. It presents the main arguments, classified according to the methods of treaty in international law (Vienna Convention, Art. 31). Legend: (T = textual methods of interpretation; C = contextual methods; OP = object and purpose). The table also sets out the principal obligations arising from these two views. It is based on Parties' submissions made during the discussions on DSI, in particular the arguments developed under the ITPGRFA and the CBD, as well as on the relevant literature. (Bagley 2022; Aubry 2019; Aubry et al. 2022; Bendimred and Frison 2022; Hampton 2023; Bond and Scott 2020; Lawson et al. 2019; Lawson 2022; Spranger 2017).

Views	**View 1 - Restrictive**	**View 2 – Inclusive**
States and stakeholders	Primarily "Global North" countries. Position explicitly supported by Canada, Australia, US, Japan, European Union. Industry.	Primarily Global South countries. Position explicitly supported by Lebanon, Argentina, Brazil. NGO/farmers' organizations.
Main arguments from States' declarations	PGRFA is of "tangible" material, excluding DSI.[T] DSI does not contain "functional units of heredity" or genes (Italy, Canada, Australia).[T,C] Open access to DSI is a form of non-monetary benefit sharing. ABS should not hinder scientific progress.[OP]	Ambiguity of the term material: does not mean tangible (Argentina).[T] The definition of PGRFA includes DSI (both material and immaterial).[T, OP] Unregulated use of DSI will impact the functioning of the Treaty (Jordan).[OP] States' sovereign rights over PGRFA.[C, OP]
Implications	DSI are **outside** the scope of the ITPGRFA. DSI may be used without the prior consent of countries of origin. The use of DSI does not trigger benefit-sharing obligations under ABS; compensation may instead be	DSI are **within** the scope of the ITPGRFA. The consent of countries of origin is required to generate or publish DSI, and benefit-sharing obligations should arise from their use.

[13] As mentioned in the introduction, I acknowledge that this dichotomy can be nuanced (n 5).

	negotiated outside the Treaty framework. Article 12.3(d) does not apply to DSI derived from PGRFA. Against national legislation restricting access to DSI.	Article 12.3(d) also applies to DSI derived from PGRFA within the Multilateral System, thereby limiting their appropriation. National legislation linking DSI to genetic resources and limiting access to DSI is legitimate.

132. Based on this table, I identify opposite positions among the Parties. On the one hand, there are the positions of Global North countries, which have interests, for their industries and research, in maintaining DSI in open access, and which benefit from the technological capacity to use DSI to improve plant materials for commercial products. These countries pragmatically tend to consider that DSI are not included within ABS frameworks, and that these frameworks apply only to the physical, and not the intangible, components of genetic resources. These countries argue that DSI should not be considered as genetic resources, which must be limited to tangible material, as reflected for instance in Canada's position at COP13 and COP15. Consequently, any inclusion of DSI within ABS systems would, according to this view, require new negotiations, as reflected in the positions of Australia, Canada, the European Union, Japan, South Korea, the United States, and Switzerland at COP15. As critically discussed elsewhere (see *infra*, 177-188; Paper 9), this pragmatic justification based on their interests, and the physicalist interpretation, find their roots in a partial interpretation, relying on the ambiguity of the term "material" without acknowledging the context and the object and purpose of the Treaty, and are reinforced by scientific arguments grounded in Cartesian ontologies.

133. This physicalist position is contested by Global South and gene rich countries, which argue that intangible elements and sequence information derived from genetic resources should be included within ABS frameworks and be subject to the fair sharing of benefits arising from their use (Paper 4). They further contend that, by virtue of the principle of State sovereignty, States should be able to condition sequencing activities and access to DSI. These countries consider that DSI should fall within the scope of ABS rules, and some have already adapted their national frameworks accordingly (Bagley 2022; Bagley et al. 2020; Strobeyko 2025). Following the declarations made at COP14 and COP15, these Parties reaffirm their sovereign rights over genetic resources in both their material and dematerialized forms, as reflected in the positions of Indonesia, Brazil, and the Democratic Republic of the Congo. They express concern over the erosion of ABS mechanisms, as emphasized by Namibia. They also stress, drawing on the examples of Brazil and Argentina, that the definitions of genetic material and genetic resources should not be restricted to tangible elements. These countries also highlight the risks of digital biopiracy and the misappropriation of genetic resources (Bond and Scott 2020; Bagley 2022).

134. As briefly recalled, the DSI conundrum is associated with a hybrid problem, marked by strong political and legal contestations, but also underlying ontological and epistemological controversies. These different levels of conflict manifest themselves in questions presented as purely technical, for example on the types of data covered. It is also in this context that science has served as a form of external guarantor and as a stabilizer of ontologies. Science has thus been used to conceptually stabilize what DSI "really are," while leaving only the "social" or "political" questions of their use and ownership to be debated afterward (Alexis 2023). Building on Alexis's research on DSI as a subject of ontological controversies within the CBD (2023), as well as on my own work on epistocratic arguments regarding DSI within the ITPGRFA (Papers 4 and 9) and subsequent joint research (Papers 12 and VII), the next two sections examine how science has been mobilized as an epistocratic and dualist argument in these debates.

Section 2. Ontological Stabilization of DSI: Competing Epistemological Frameworks

135. The following two sections empirically analyze how science has been mobilized in these debates. Section 3 analyzes more specifically how States' positions rely on scientific arguments, notably to determine the terms and scope of what counts as DSI, or to advocate for alternative terminology such as GSD. Scientific arguments, together with their Cartesian ontological backgrounds, have also been used by States to interpret restrictively, and in line with their political agendas, the definitions of "genetic material" and PGRFA. Before examining these State-driven instrumentalizations, this section begins by contextualizing the science–policy processes on DSI. The role of science is thus discussed both in its capacity to stabilize ontological questions and political debates, and in terms of its epistemic selectivity, insofar as it has excluded traditional knowledge systems.

136. The most striking illustration of how science has been used to delimit the DSI debate, to frame the ontological perspectives at stake, or to exclude Indigenous epistemologies can be found in the momentum surrounding the CBD's studies on DSI (Lawson 2022; Oguamanam 2022). Indeed, negotiations within the CBD led, at the end of COP13, to the establishment of an Ad Hoc Technical Expert Group on Digital Sequence Information on Genetic Resources (AHTEG) and to the commissioning of a study (Bagley 2022). This study aimed to clarify the terminology and concepts related to DSI, as well as to assess their scope and conditions of use in relation to genetic resources under the CBD and the Nagoya Protocol (Laird and Wynberg 2018; or 2018 study). This epistocratic process was renewed in the aftermath of COP14 through

the commissioning of a series of "science based peer reviewed fact finding" studies (CBD/COP/DEC/14/20; Bagley 2022). These studies addressed, respectively, the concept of DSI, relevant terminologies, and the scope of information covered (Houssen et al. 2020; or Study No. 1); databases containing DSI and traceability mechanisms for the implementation of ABS systems in the context of commercial and non commercial uses of DSI (Rohden et al. 2020; or Studies No. 2 and 3); and national ABS measures adopted to regulate DSI (Bagley et al. 2020; or Study No. 4).

137. More policy-oriented studies were also commissioned by Parties and stakeholders, for example by the European Commission (Morgera et al. 2020), Germany (Karger 2018; Spranger 2017), Switzerland (Sollberger 2018). Similar initiatives can be observed within the FAO. Starting with the Commission on Genetic Resources for Food and Agriculture (CGRFA), which, at its sixteenth regular session, initiated a work stream on DSI and requested an exploratory fact-finding scoping study on DSI, including terminology, actors involved, types and extent of uses, and the relevance of DSI for genetic resources for food and agriculture in relation to food security and nutrition (Heinemann et al. 2018; or Background Study 68). The Secretariat of the ITPGRFA also commissioned several studies, including a background study on the Global Information System on PGRFA and genomic information (Manzella 2016), as well as a study by Welch et al. (2017) on the "Potential implications of new synthetic biology and genomic research trajectories for the International Treaty on Plant Genetic Resources for Food and Agriculture." Although these studies are taken up in States' arguments (see *infra* § 156), my analysis focuses on the CBD studies, which thereby offer more material for analysis. These studies were made available following a science-policy process, with the aim of guiding negotiations through external and objective scientific expertise (Bagley 2022; Alexis 2023). They were also discussed more formally by the Parties, through the AHTEG and via peer-review processes.

138. Indeed, to return to CBD studies, the 2018 study and Study No. 1 each addressed terminology related to DSI. Both studies acknowledge that DSI remain widely acknowledged as a placeholder term for which no consensus on a replacement or precise definition currently exists (Laird and Wynberg 2018, 21; Houssen et al. 2020, 10). They also discussed competing terminologies advocated by Parties and observers, including resources in silico, Genetic Sequence Data or Genetic Sequence Information, Genetic Sequences, Nucleotide Sequence Data, Digital Sequence Data, Genetic Resource Sequence Data and Information, Genetic Information, dematerialized genetic resources, in silico utilization, information on nucleic acid sequences, nucleic acid information, and natural information (Laird and Wynberg 2018, 19–20; Lawson 2022, 20). In fact, these differences reflect divergences regarding the types of material being referred to (Laird and Wynberg 2018; Houssen et al. 2020, 33). For example, the term Genetic Sequence Data is more commonly used by the scientific community and refers to a narrower scope of data covered: "order of nucleotides found in a molecule of DNA or RNA"

(PIP Framework, Art. 4.2; Paper 5). This partly explains why some States promote this terminology, while others refer to alternative terminologies, also used in scientific contexts, such as "natural information," which seek either to broaden the scope covered or to establish a more direct link with genetic resources (see in Papers 4, 12, and *infra* §§ 154-158).

139. On the scope of DSI, CBD Study No. 1 grouped DSI into four increasingly inclusive categories on the basis of a curious "proximity" criterion, namely Group 1, limited to DNA and RNA data; Group 2, comprising Group 1 plus proteins; Group 3, comprising Group 2 plus metabolites; and Group 4, comprising Group 3 plus contextual information, including traditional knowledge, ecological interactions, and related data. This proximity criterion, understood as the degree of proximity to the original genetic resource, is based on the idea that certain data, such as DNA and RNA, are "closer" to the genetic resources than environmental information or traditional knowledge. It is also on the basis of this proximity criterion that the study considers traditional knowledge to be "too distant" to be included within traceability mechanisms, and within the scope of ABS (Houssen et al. 2020; Bendimred and Frison 2022; Lawson 2022; Alexis 2023).

140. It is also on the basis of this proximity criterion proposed in Study No. 1 that the report of the Ad Hoc Technical Expert Group ultimately excluded traditional knowledge from the definition of DSI (AHTEG 2020; Bendimred and Frison 2022). The report retained three cumulative groups considered as DSI: Group 1, DNA and RNA; Group 2, Group 1 plus proteins and epigenetic modifications; and Group 3, Group 2 plus metabolites and other macromolecules. Traditional knowledge was not included within these groups and was therefore not considered as DSI (Oguamanam 2022; Bendimred and Frison 2022; Alexis 2023). Drawing on the analyses of Bendimred and Frison (2021), Oguamanam (2022), and Alexis (2023), Papers 4, 8, and 12 argue that this proximity criterion reflects an epistemological choice in favor of a geneticist ontology of plants and their immaterial components, which effectively excludes traditional knowledge.

141. The AHTEG passage and the underlying epistemic criterion illustrate how such epistemic choices produce epistemic injustices regarding which forms of knowledge are recognized and protected. Given that these classifications are justified within a geneticist epistemic framework, they also raise broader epistemological questions about which forms of knowledge are considered relevant to guiding the policy process in defining the scope of DSI itself and the intangible assets of PGRFA (Oguamanam 2022). Consequently, traditional knowledge is simultaneously excluded from the elements to be protected under the broad category of DSI and from the category of "valid" knowledge used to determine which forms of knowledge should be protected. In addition, when compared to Indigenous epistemologies (or

socio-anthropological epistemic choices), this proximity criterion disconnects DSI from its historicity and agency. Indeed, these resources were, prior to any sequencing process, extracted from specific regions and embedded in forms of knowledge "proximate" to local or Indigenous communities (Alexis 2023). This is why Papers 8 and 12 argue that this technicist and geneticist approach to science contributes to the disembodying of seeds from their sociohistorical and ecological contexts. This reading also undermines farmer–seed relations and farmers' knowledge related to seeds, which, as noted by Via Campesina at the GB11 pre-meeting workshop (2025), possess the primary economic, social, and epistemic value that agribusiness actors seek to extract through DSI.

142. Moreover, from an anthropological and STS perspective, it fails to account for the actual proximities between researchers, their tools, and genetic resources in the processes of generating and using sequence data (Alexis 2023). It also ignores the entire process of trial and error in knowledge construction, the material operations involved in sequencing genetic resources, and the rematerialization of data into improved plants (Leonelli 2019a; Nawaz et al. 2021; Ajates 2023). These studies also reproduce the dogma of "unprocessed data" through a distinction between data and information, that performs "ontological cuts" between successive epistemic moments (Houssen et al. 2020; Lawson 2022; Bendimred and Frison 2022). This framing indeed postulates an ontology in which nature is viewed as an immanent and universal stock of genes, in which sequencing is assumed to produce objective data, and in which these data are subsequently treated as information. It echoes Leonelli's argument regarding a data-centric "genetic prism," whereby biological data are treated as "fixed" and "given." This framing fails to recognize the dynamism of genes and the fact that their value is context-dependent and shaped by their relations within specific epistemic frameworks (Leonelli 2015; 2016; 2019b).

143. Subsequently, Oguamanam (2022) denounces how this epistemic choice, rooted in Western scientific ontologies grounded in Cartesian dualism, leads to the systematic exclusion of traditional knowledge from the definition of DSI, from traceability mechanisms, and from the application of ABS systems. This produces epistemic fractures and colonial dynamics, in which holders of traditional knowledge are neither heard in the scientific and ontological definitions of DSI in the context of PGRFA dematerialization, nor are their knowledge systems legitimized, but instead weakened and ignored (Oguamanam 2022). This echoes what Whitt (2009) denounces as "biocolonialism," namely the fact that political decisions impacting indigenous people are legitimized by Western science, presented as objective and universal, while simultaneously devaluing Indigenous knowledge systems, which are later perceived as raw material to be subsequently exploited.

144. This concrete example can be linked with the epistocratic arguments, their dualist ontological background and their normative effects. Despite their claims to objectivity, Western scientific paradigms embed specific worldviews that become normative when applied to plants and their genetic sequences (Paper 12). Following this point, discourses from "modern science" may frame PGRFA through "ontological cuts" that are naturalist, separating cultural, social, and spiritual elements from these "natural" and "unprocessed" resources, and physicalist, distinguishing material elements from immaterial ones, such as DSI or other spiritual and cultural dimensions (Paper 12). To draw some connections, I argue that these arguments, framed within modern science, objectify an onto-epistemological classification in which immaterial data are treated as given or immanent (Leonelli 2019b), conceived as universal stores of genes and pure lines of data (Bonneuil 2019), and abstractly placed in the public domain as freely accessible (Whatmore 2002; Tordjman 2021). This occurs while ignoring other holistic and relational perspectives that recognize the cultural, spiritual, and social dimensions of seeds, as articulated within Indigenous knowledge systems (Sievers-Glotzbach et al. 2021; Ajates 2023).

145. This situation also resembles an articulation of truth regimes between positive law and Western sciences, which self-reference and self-legitimize in their ways of compartmentalizing and ordering the world. This process depoliticizes phenomena such as seed appropriation, leaving little room for ontological questions. In Papers 13 and VII, I previously highlighted that, on the one hand, science has been mobilized to establish objective distinctions between "raw" and "improved" genetic material (Whatmore 2002), while on the other hand intellectual property rights reinforce distinctions between the material and the immaterial, the natural and the patentable, and between plants, microbiological organisms, and isolated genetic sequences, as illustrated by the United States cases Diamond v. Chakrabarty and Myriad (Jasanoff 2012; Nawaz et al. 2021, 5). This circle of self-reference and articulation between these regimes of truth is also found when intellectual property rights protect Western knowledge (deemed capable of industrial application), while Western knowledge, in turn, confers epistemic legitimacy on IPR systems. (Paper 13).

146. As a result, I argue that scientific narratives surrounding the dematerialization of PGRFA cannot be separated from the ways in which this hybrid phenomenon is also shaped by circles of self-reference within other regimes of truth, including intellectual property and the broader bioeconomy (Nawaz et al. 2021; Sievers-Glotzbach et al. 2021). These self-reinforcing loops are also evident in legal interpretations of the (im)material nature of genetic resources. For instance, some States uphold a physicalist view that confines PGRFA to their tangible forms (thus excluding DSI), relying both on a reductionist textual method of interpretation and on a physicalist lens grounded in Western scientific thought (Papers 9, 12). Before turning to these questions from a legal perspective (see Chapter 2), the final section of this chapter presents my empirical research results regarding the discourse analysis of States.

Section 3. States' Epistocratic Narratives in the Governance of DSI

147. Through a transversal analysis of negotiations within some ABS instruments (ITPGRFA, CBD and PIP Framework), Paper 4 examined how scientific arguments were empirically mobilized in States' written and oral statements. As developed in Paper 4, and serving as a basis for discussion in Papers 9 and 12, this study focused on the ways in which scientific arguments are advanced by States, industry actors, and scientific communities to influence debates on DSI. In this section, I begin by identifying the types of scientific narratives mobilized in these debates. While some arguments are articulated within an epistocratic logic, presented under the guise of objectivity or rationality, others rely on more abstract references to science. I then analyze how these State discourses have been concretely mobilized to frame the scope of DSI or to influence legal and political contestations regarding their relation to ABS systems. This mapping of discourses shows that, even if science is not formally established as an authority, it may nevertheless influence political discussions by orienting them within a technocentric loop anchored in a Western-centered epistemic framing and its associated ontological and axiological background.

Subsection 1. Forms of Scientific/Technical Narratives in DSI Debates

148. As already indicated (see *supra* §§ 50, 101), while my initial hypothesis was that States would reinforce their political positions through explicit scientific or dualistic reasoning, references to science proved to be much broader than anticipated. Indeed, without relying explicitly on a dualistic model or on a formal epistocratic rhetoric (Viala 2022), I nevertheless observed forms of "scientific or technical narratives" involving more implicit (but normative) references to an apolitical framing. Drawing on a combination of methods, including the analysis of States' positions, NPF analysis, participant observation at Governing Body meetings, and formal and informal interviews, I identified a gap between formal and informal discourses. On the one hand, States advanced formal legal arguments (such as claims that DSI are not genetic resources or do not fall within the scope of ABS), supported by unreferenced appeals to science. On the other hand, observation and interview materials (in particular, informal interviews of UN Staff and national delegates), in which these rhetorical uses of

science were more openly acknowledged, notably as pragmatic tools to support their interpretation.[14]

149. By broadening my analysis to "technical or scientific narratives," I observed that these implicit roles of epistocracy and ontological dualism were particularly visible in two discursive forms identified in DSI governance, namely "science as a guide" and "science as a goal." In line with an epistocratic rhetoric and wishes for "science-based policy," a first form of scientific narrative presents science as a guide for action : invoked to promote a more "objective," "rational" and "non-political" decision-making process. In this framing, science is presented as a neutral tool to define and understand DSI, or to determine the scope of DSI and which kind of information are "relevant."

> For example, "Belgium emphasizes the importance of adopting a science-based approach when exploring a possible common understanding of the scope, definition and concept of DSI. Belgium would like to underline that a process was set up under CBD decision 14/20 in order to provide such a science-based approach and assist in further clarifying the concept and the scope of DSI in the context of the CBD and its protocols, as well as assist with the identification of possible appropriate terminology. Belgium believes that this process could be useful to FAO in its endeavour to come to an approach to "DSI". Although we believe it is important not to pre-empt the results of this approach, Belgium would like to stress that a definition of DSI should be based on appropriate relevant terminology and clear terms. To identify appropriate and more precise terminology, it can be useful to explore the terms commonly used by the scientific community in the context of genetic research. These terms include, for instance, genetic sequence data, nucleotide sequence data, and genetic sequence" (Belgium, GB8).

150. In this discursive form, two remarks can be made. First, science is invoked rhetorically as part of an epistocratic discourse, rather than through references to specific data or scientific evidence. For instance, when debating the inclusion of DSI within the definition of genetic material, States such as Canada and Japan relied on the Treaty's definition during GB10, asserting that "scientifically" DSI could not be included, without providing further justification (Papers 4, 12; see *infra* §§ 171-194). Linking this observation to my theoretical framework, although references to science were present in many statements and central in some policy argument, they appeared as broad "scientific narratives" rather than as explicit scientific references, in the Latourian sense of [REF] for scientific modes of existence (Latour 2013).

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[14] To inform future research, and drawing on my situated experience at the European Commission, I could link the implicit role of scientific arguments to the black box of institutional truth discourses. In this context, arguments remain contestable within the institution but become stabilized once externalized. In another direction, I could link them to the truth games at play in international negotiations.

151. Second, this scientific or technical narrative as a "guide for action" is also marked by inconsistency and at times by contradictory positions. Like the findings of Paper 7 on the NGT negotiations, Paper 4 showed that science is invoked when it serves to consolidate a political argument, but that this use is not consistent. Political actors who rely on science to defend an argument can easily distance themselves from this epistocratic framing whenever the scientific argument is no longer needed. Moreover, through a comparative analysis of statements from the same States (the United States, Australia, Germany and the EU), Paper 4 demonstrated that these countries supported at the time the inclusion of these data within the ABS mechanism under the PIP Framework, in line with its objectives and with the aim of preventing an erosion of the system (Tables 5 and 6; Paper 4). In contrast, under the CBD and the ITPGRFA, these very same States adopted opposing positions: they rejected the inclusion of DSI within benefit-sharing systems, arguing that such inclusion would hinder scientific research and the open access necessary for scientific progress.

Table 5. Compilation of comments on DSI regarding the relationship with the definition of biological material (Paper 4).

Tables 5 and 6 are detailed in Paper 4. They reproduce States' declarations made at different moments of the negotiations on DSI/GSD within the ITPGRFA, the CBD, and the PIP Framework. In contrast to the principled physicalist arguments advanced within the CBD and the ITPGRFA in relation to ABS systems, the table shows that these same States, at the time, held positions supporting the inclusion of GSD within the PIP Framework.

State	ITPGRFA	CBD	PIP Framework
Australia	Open access to DSI is a form of ABS. DSI should be open access. Should not intervene in scientific progress.	Does not support the inclusion of DSI in ABS regime. DSI should be Open access for scientific innovation.	Welcome GSD management under the PIP framework, with ABS mechanism. GSD should be managed under the PIP framework as not circumvent Benefit sharing.
Germany (and EU for the CBD)	DSI should be open access. Open access to DSI is a form of ABS. Importance of DSI for scientific progress	DSI should be open access. Open access to DSI is a form of ABS. Importance of DSI for scientific progress, human health, environment.	GSD should be included in the ABS of the PIP Framework.
United States of America	Open access to DSI is a form of ABS. DSI should be open access. Should not intervene in scientific progress.	Importance of GSD for scientific research. Sharing of GSD is a form of benefit sharing. Sharing of GSD should not be restricted.	Access to GSD should trigger different types of benefits. *Example*: development of sensitive virus detection methods and the generation of candidate vaccine virus .

Table 6. Compilation of comments on DSI/GSD regarding ABS (Paper 4).

State	ITPGRFA	CBD	PIP Framework
Australia	DSI is not a physical material and not a genetic resource under the ITPGRFA.	DSI is not a physical material and not a genetic resource under the CBD. DSI is not a derivative under the NP. Changing the definition would require renegotiation of the CBD/NP.	GSD should be handled under the PIP Framework [...] to ensure consistency with the principles of Sharing other PIP material. Changing the definition of PIP biological material would require significant amendments and likely complex and timely negotiations. Prefer developing an Annex.
Germany (and EU for the CBD)	DSI is not a physical material and not a genetic resource under the ITPGRFA.	DSI is not a physical material and not a genetic resource under the CBD/nor a derivative under the NP.	GSD should be handled under the PIP Framework. PIP Framework's objective does apply for GSD.
United States of America	DSI is not a physical material and not a genetic resource under the ITPGRFA.	DSI is not a physical material and not a genetic resource under the CBD.	GSD should be handled by the PIP Framework. Future discussion would benefit from the difference between GSD and biological material.

152. In this way, I also identify another narrative where science is conceived as a "goal" and a "value" to be protected, and not hindered by the administrative burdens of ABS. Given DSI's instrumental role in contemporary scientific practice, science is also portrayed in a more idealized manner, as a universal good that should remain unrestricted in the name of scientific progress and for the benefit of humankind (Kreiken and Arts 2024; van Buitenen et al. 2025). This form of discourse has been pragmatically mobilized by States, including Australia, the United States, and Germany, to justify the exclusion of DSI from access and benefit-sharing mechanisms, or to oppose any administrative burden on the grounds that restrictions would hinder scientific progress. Within this logic, open access to DSI is presented not only as a means to advance science but also as a form of non-monetary benefit-sharing (Papers 4, 9 and 12).

153. Such positions also reflect the agendas of scientists themselves, who depend on DSI for their work (Jefferson 2023), and rest on the assumption that scientific advancement benefits "humanity as a whole," while overlooking digital divides, the association between research and industry, and the risks of misappropriation of genetic resources through such innovations (Leonelli 2014; Aubry et al. 2022). Based on these elements, the two following subsections analyze how rhetorical uses of science are taken up in policy discussions, in particular to define

DSI and to interpret ABS instruments' definitions of PGRFA and genetic material in a restrictive manner.

Subsection 2. Framing the Scope of Digital Sequence Information

154. As introduced earlier, the terminology of "DSI," which remains currently used as a placeholder term within the CBD and the BBNJ Agreement (referring to the CBD), has been the subject of intense contestation. To date, alternative terminologies continue to be advanced, such as "GSD," which is jointly used within the ITPGRFA, or used instead of "DSI" in the WHO PIP Framework and the WHO Pandemic Agreement (Lawson 2022; Paper V).

155. In this context, Paper 4 analyzed how States promote alternative terminologies on the basis of specific scientific narratives, and their concrete policy and legal implications. For example, some statements proposed replacing the term "DSI" with GSD, implying a narrower scope, notably by Canada, the European Union and its Member States, Japan, the Republic of Korea, Switzerland, and the United States (COP15; Paper 4). Conversely, other States acknowledged the term "GSD" while also advancing alternative terminology such as "genetic information," "natural information," or "natural heritage," including the African Union Commission, South Africa, Ethiopia, Brazil, and India. This was done either to broaden the scope of elements covered or to establish a conceptual link with physical resources. Indeed, vocabularies such as "genetic information," "genetic heritage," or "information on genetic resources" are also found in the language of national ABS legislation that legally includes DSI within their regulatory frameworks (Bagley et al. 2020; Lawson 2022).

156. In this respect, the choice of terminology is not neutral, as it influences the types of data covered and the alleged continuities or discontinuities with "physical" genetic resources. In my empirical analysis, I observed that Parties mobilized scientific narratives to consolidate their positions and to present them as "based on science" in line with an epistocratic discourse appealing to rationality and objectivity. State statements frequently referred to commissioned studies or to terminology used by the scientific community to justify their terminological choices. This can be observed, for example, in the positions of Germany and Canada, which referred to Background Study No. 68 to state that:

> "'Genetic information' or 'genomic information' is more common in scientific literature, whereas 'DSI' is not commonly used"(Germany GB8).

> "In the background study 68 […] it is mentioned that "DSI" is not a term being used by the scientific community" (Canada, GB8).

157. As exemplified, there is a push for the term "GSD," justified by the argument that it is already used by the scientific community. As I argue in paper 4, the choice of terminology influences several aspects, including broader positions on ABS and the centrality of a techno-centered prism in these debates. Indeed, most States advocating for the term GSD do not wish to link DSI to ABS systems or to include it within the definition of genetic resources. The term GSD also operates as a way of narrowing the scope of DSI, excluding other types of data, information, and traditional knowledge, thereby framing ontological questions. It is in this sense that, even though there are formal separations between law and science, and even though such statements are formally non-binding, these scientific narratives produce rhetorical and even normative effects. Under the banner of objectivity, neutrality, and scientific rationality, they nonetheless frame legal interpretations influence ABS mechanisms, and determine which types of data are covered and protected and which are excluded. This epistocratic use of science is, to some extent, acknowledged in Party submissions themselves. For example, the African Union Commission explicitly states:

> "Our view is that a prolonged focus on terminology is not helpful for obtaining clarity on the concept of 'DSI'. The goal of a focus on terminology is to narrow the scope of applicability of the Nagoya Protocol, and have certain subject matter excluded from it." (African Union Commission, COP15).

158. A similar objective is echoed by the United States, which insists that the definition of DSI should distinguish data from material:

> "GSD are neither genetic material nor a genetic resource. It is essential to maintain a conceptual and definitional distinction between genetic material itself and data associated with that material." (United States, COP15).

Conversely, South Africa advocates the opposite view, advocating to:

> "Work on a definition [of DSI] that explicitly makes reference to the genes or genetic material which constitute a genetic resource." (South Africa, COP15).

In the following sections, I discuss in detail how scientific narratives have been used to influence a physicalist interpretation of the definition of PGRFA and genetic material.

Subsection 3. Scientific Arguments Supporting Narrow Interpretations of Genetic Material in ABS

159. In this final subsection, I return to several examples of State discourses that strategically mobilize scientific narratives in support of their political interests. While recognizing that these statements are not legally binding, and that science is not among the codified methods for interpreting international law (see *infra* §§ 172-176), I nevertheless consider that such scientific arguments carry an implicit authority that contributes to stabilizing the ontologies of DSI or to fixing their legal status.

160. In this respect, Paper 4 observed that scientific arguments were strategically mobilized to reinforce a physicalist interpretation of PGRFA and genetic material. The physicalist argument, defended by States such as Japan, the United States, Canada, and the European Union, considers that the definitions of PGRFA and genetic material should be limited to tangible and physical elements, thereby excluding intangible elements. This view relies primarily on the term "material," which is interpreted as synonymous with tangibility, and is thus used to exclude DSI as intangible. This position can be found, for instance, in the following statement:

> "'DSI' is no physical material and therefore cannot be qualified as a genetic resource" (Germany, GB8).
>
> "Canada has always been of the opinion that access and benefit-sharing under the CBD and under the ITPGRFA, involves genetic resources, which does not include 'digital sequence information'. […] Canada has taken a firm position in many fora (ITPGRFA, CGRFA, CBD, and WHO) that DSI is not equivalent to genetic resources and continue to strongly resist any language that implies an equivalency between "DSI" and "Genetic Resources" (Canada, GB8).
>
> "[PGRFA] means any genetic *material* [and] the use of DSI that is acquired *without* the use of material […] Based on these basic interpretations (i.e. that DSI is not *material*), we believe that handling DSI under the Treaty should be taken with utmost care under the Treaty" (Japan, GB9).
>
> "The United States reiterates our understanding that "DSI" refers to the genetic sequence data (GSD) that describe the order of nucleotides in DNA or RNA in genetic material. We maintain our view that GSD, as information describing material, should not be treated as a genetic resource. […] The United States does not support expanding the scope of existing international access and benefit-sharing (ABS) instruments, designed for material genetic resources, to include GSD." (United States of America., GB9).

161. However, this physicalist stance lies at the heart of legal contestation conflicts between States (Table 4). Some States thus insisted on the interconnection between DSI and their physical genetic resources, which would not exist without those resources and the sequencing processes that generate them (South Africa, Madagascar, Mexico). Others, such as Argentina and Brazil, emphasized that the term "material" should not be confused with "matter," nor does it necessarily mean "tangible." In support of their argument, they referred to the Oxford Dictionary, which defines "material" as "information or ideas used to create a book or other work." For example:

> "According to the Oxford Dictionary, the word "material" can be defined as 'information or ideas for use in creating a book or other work'. On the other hand, the definition of the word "matter" is 'physical substance in general, as distinct from mind and spirit; (In physics) that occupies space and possesses rest mass, especially as distinct from energy'. The term 'material' should not be confused with the term 'matter'. The definition of the word 'material' allows the interpretation of the term to include the set of information associated with the genetic resource, that is, the substrate information or working material" (Brazil, COP15).

> "Although the word 'material' refers to 'matter,' which is a physical and tangible substance, and which is generally distinguished from and opposed to mind and spirit (intangible realities), the term 'material' should not be confused with matter. In this sense, in the field of genetic resources in general, and plant genetic resources in particular, the definition of the term 'material' admits the interpretation that it includes the information associated with the genetic resource, of which this information is a constituent part, regardless of the mode in which it is transmitted." (tr. Spanish, Argentina, GB8 and COP15).

162. Following these arguments, it becomes clear that the tangibility of genetic material is not as self-evident as asserted by some States (Papers 4, 9, 12). From my perspective, these reductionist and physicalist arguments are deployed for political reasons and strategically draw on the ontological background of Western scientific narratives, which are marked by separations between nature and culture, and between the material and the immaterial. However, this scientific argument is not automatically linked to a restrictive interpretation. To take a recent example, at the eleventh session of the Governing Body of the ITPGRFA in 2025, the Burkina Faso for the African Group also mobilized scientific narrative to defend positions contrary to physicalist arguments:

> It is not possible to 'manufacture' genes virtually: it is necessarily required to start from the physical resource and the knowledge associated with that resource in order to produce the corresponding data. DSI therefore do not constitute mere disembodied information. *Scientifically*, this fact must be acknowledged: DSI derive from PGRFA" (tr. French, Burkina Faso for the Groupe Afrique, GB11).

163. Arguments for or against the inclusion of DSI have also hinged on the expressions "containing" and "functional units of heredity." Some authors argue that PGRFA must be understood as "functional" (in the sense of "working"), thereby limiting them to plants capable of transmitting heredity, and thus to physical and living elements (Spranger 2017). This technical terminology nevertheless enabled some States to advance restrictive interpretations, arguing, for example, that:

> "To consider digital sequence information a genetic resource under the Convention and the Nagoya Protocol would require a renegotiation of both the Convention and the Nagoya Protocol to redefine 'genetic material'. This is because 'information' does not contain 'functional units of heredity' or genes" (Australia, COP15).
>
> Or that: "by definition, genetic sequence data do not contain functional units of heredity such as DNA and therefore do not constitute genetic resources or genetic material" (Italy, GB9).
>
> Or again that: "genetic sequence data, by their nature, do not and cannot contain functional units of heredity such as DNA" (Canada, GB9).

164. In my view, these positions once again rely on partial interpretations. I criticize physicalist positions as being less self-evident than some States seek to present them. In this sense, as explained in Papers 9 and 12, and based on the explanatory guides of the ITPGRFA, the CBD, and its Working Group on Access and Benefit-Sharing (WG-ABS), these notions do not designate precise technical or scientific categories, but rather reflect political compromises reached between the Parties (WG-ABS 2010; Moore and Tymowski 2005; Tvedt and Schei 2014; Schei and Tvedt 2010; Tvedt and Young 2007). Moreover, Frison (2018) notes an ambiguity arising from the fact that the "parts and components" associated with the definition of PGRFA were relocated during the negotiations to Article 12.3(d). For this reason, the explanatory guide considers that "functional units of heredity" could encompass, at a minimum, all genetic elements containing DNA, including living cells, chromosomes, genes, or DNA fragments (Moore and Tymowski 2005). In addition, the technical nature of these terms can also be approached through a series of linguistic and technical indicators pointing toward possible evolutionary interpretations. It is also on the basis of these technical terms that Argentina reaffirmed an inclusive interpretation of PGRFA, arguing that, in light of current scientific and technological development:

> "utilization may occur from the genetic resource in situ, ex situ, or through the genetic sequence of the resource (whether digital or another format, e.g., analog)" (Argentina, GB9).

165. Before turning to the conclusion of this analysis, these references to science as a guarantor of objectivity and externality must be treated with caution, as several points of

interference between science and law remained present throughout these science–policy processes. In the present case, States were able to peer-review the CBD studies and to submit comments, some of which were explicitly linked to their preferred views. Although these comments were non-binding for the authors of the studies, they nevertheless illustrate such informal interferences, with States advocating different positions even upstream of the peer-review process. These positions ranged from inclusive approaches (e.g. Colombia) to restrictive interpretations (e.g. Japan). As stated by Colombia:

> "In Colombia, we understand that an in vivo obtained DNA sequence is completely homologous to its unmodified digital sequence; therefore, the genetic information of both sequences is the same but stored in different ways. The possibility to turn digital information into biological material again is one of the main facts that gives digital information its potential value; therefore, this information should be considered in ABS regimes."(Colombia, peer review 2020).

166. By contrast, Japan's submission adopts an exclusionary approach:

> "We would like to reiterate our firm position on this matter: that DSI is not equivalent to genetic resources, even under the so-called narrow scope definition of Group 1 […]. It is our view that DSI is not captured within the Convention and Protocol texts, and thus should not be considered under the CBD or its subsidiary bodies. While understanding that this is a technical paper that seeks to conceptualize the term 'DSI', we would like this view/element/controversy to be reflected […] as an underlying assumption and framework of the discussion."(Japan, peer review 2020; Bendimred and Frison 2022, 414).

167. To conclude, across the various statements by States, there is a persistent epistocratic approach operating through appeals to science-based policy, presented as essential for defining DSI and determining its legal status. However, as argued in Papers 4, 9, and 12, these scientific arguments are not neutral and are embedded in a particular onto-epistemological context with concrete consequences. As illustrated by the CBD studies and the proximity criterion, certain types of data are privileged, while other epistemologies are excluded. These scientific approaches may pursue a data-centric logic that frames genetic lines as fixed, static, and exploitable, thereby erasing the agency of living organisms and their relations within communities (Leonelli 2016; Nawaz et al. 2021; Sievers-Glotzbach et al. 2021). They may also reinforce, through their underlying ontological assumptions, a distinction between physical and immaterial genetic resources, the latter being treated as freely usable. As shown through the examples discussed above, States have been able to strategically mobilize these genetic narratives as tools of "ontological stabilization" in relation to DSI, thereby influencing both policy processes and legal interpretation. Moving to a more normative dimension, the following chapter examines the role of law in these debates and defends an interpretation of the ITPGRFA that encompasses DSI. Building on a cosmopolitical approach to law, it further explores how

the ITPGRFA could integrate other knowledge systems to define PGRFA and genetic material, and their "actual or potential value.".

Chapter 2. A Legal, Relational, and Cosmopolitical Approach to the Dematerialization of Genetic Resources

168. The first chapter analyzed the role of scientific arguments in shaping the ontological constructions surrounding DSI, the political debates on how DSI should be regulated, and their influence on the legal interpretation of existing ABS instruments. In this second chapter, I return to these debates from a legal perspective. In this sense, this chapter mobilizes the tools of legal technique and the methods of treaty interpretation in international law to defend an inclusive interpretation of the ITPGRFA. Under this inclusive interpretation, PGRFA are understood to include both tangible and intangible elements, and should therefore encompass DSI. I argue that this inclusive interpretation is the only legally coherent one when the three methods of interpretation under the Vienna Convention are applied in a complementary manner, and that it is further supported by a posthuman approach to PGRFA.

169. In this respect, the analysis does not remain confined to a purely legal positivist framework, but is enriched by posthuman, cosmopolitical, and relational approaches to law (Paper 11). As further developed in Section 2, these theories emphasize the relational entanglements between humans and seeds, as well as the interdependence of "matter" vis-à-vis its immaterial dimensions (Figure 2). Following this combined methodology, Paper 9 argues that the Treaty has consistently treated PGRFA as matters of property and rights, whether through IPR or through States' sovereign rights over PGRFA. Approaching PGRFA through the lens of property regimes (IPR or sovereign rights) shows that their regime complex establishes continuities between tangible elements (seeds) and intangible elements (passport data, DSI) (Correa 1994; Käll 2020; 2022; Sherman 2024).

170. Finally, the posthuman approaches further enriches the analysis by revealing the strategic "ontological cuts" made by Global North States to dissociate physical PGRFA from their immaterial elements to circumvent benefit-sharing obligations, while similar continuities are maintained within IPR instruments. Posthuman theories also provide conceptual tools to think through rhizomatic human–seed–DSI relations beyond strictly state-centered legal systems (Paper 9). In addition, on the basis of legal interpretive techniques, I argue that the ITPGRFA contains several elements of positive law that require Indigenous knowledge systems to be understood not as passive "traditional knowledge" to be protected, but as essential

knowledge in guiding the interpretation of the actual and potential values of PGRFA and genetic material (Paper 12). The second section applies my cosmopolitical approach to law and discusses, drawing on collaborative work with Kahehtoktha Janice Brant cofounder of the Kenhteke Seed Sanctuary & Learning Centre (KSSLC 2026), how pluriversal epistemologies and Indigenous knowledge systems could be heard in debates on DSI, and how these forms of knowledge can contribute to interpreting the actual and potential values of PGRFA.

Section 1. Legal Analysis of the Status of DSI under the ITPGRFA

171. This section builds on the arguments developed in Paper 9, which defended an inclusive interpretation of the ITPGRFA. This interpretation followed and extended arguments already present in the literature, including Tvedt and Schei (2014), Frison (2018), Morgera et al. (2020), Bendimred and Frison (2021), and Silvestri and Roig-Cerdeño (2025). I also argue against the restrictive views (Spranger 2017; Sollberger 2018). The purpose of this section is to revisit an inclusive interpretation of the definitions of PGRFA and genetic material, which would include DSI. It also aims to justify why an inclusive interpretation is the most convincing, based on the classical methods of treaty interpretation established by the Vienna Convention (1969; Corten et al. 2006; Linderfalk 2007; Gardiner 2015; Corten 2017; Lekkas et al. 2023). This section briefly outlines the interpretative methods of the Vienna Convention and the indirect role of scientific arguments, before developing the textual, contextual, and teleological approaches. Table 7 summarizes these arguments, which were also the subject of a policy paper presented at GB11 (Paper VIII).

Table 7. Interpretation of the Treaty text following the Vienna Convention methods of interpretation (Paper VIII).

Methods	Analyses
Textual Analysis	Art. 2 of the ITPGRFA refers to the "**actual or potential value**" of the genetic material of PGRFA. This wording supports an inclusive interpretation where DSI is included in the definition. The Treaty recognizes the "value" of PGRFA in a broad sense, extending beyond economic considerations to encompass social, cultural and spiritual dimensions, which are by nature immaterial. Indeed, PGRFA are recognized for their "value," which can be economic, but also social, cultural, and spiritual, hence "immaterial". Further, "**Material**" is used as a noun and not as an adjective (i.e. a generic term that could be replaced by carrier, container, [that contain the functional units of heredity]). It is thus overly restrictive to reduce it only to the physical shell of PGRFA. "**Functional units of heredity**," a terminology originating from the CBD, is not a precise

	scientific category but rather the result of political compromise. It allows for a range of interpretations: encompassing at least DNA, RNA, chromosomes, genes, and other fragments.
Contextual analysis	Several articles and principles in the ITPGRFA confirm and reinforce this contextual and inclusive interpretation of DSI. In particular: **Article 1** – complementary objective: conservation and ABS. **Article 3, 10** – Scope and States' sovereign rights over PGRFA. **Articles 5, 9, 12, 17** – Link between PGRFA and related information. Yet, **Article 13** includes information such as non-monetary benefit-sharing. **Article 12** – "genetic parts or components" should be interpreted in conjunction with the definition of genetic material. The GB is the competent authority for authentic interpretation. The GB can draw inspiration from other developments within the ABS regime complex (such as BBNJ which includes DSI, or CBD's COP15 and COP16 with the Cali Fund) according to the principle of "systemic integration", which holds that the interpretation and application of treaties must consider other relevant rules of international law (Article 31(3)(c) of the VCLT). However, the *pacta tertiis nec nocent nec prosunt* principle, which recognizes that third Parties to a treaty cannot be imposed obligations they have not consented to, should be taken into account as well. Additionally, in support of the present analysis, IPR and data-protection instruments show continuity between the material and the immaterial elements (eg Art. 9 of the EU Biotech Directive) and do not create an artificial dichotomy separating the information from the physical shell of the PGRFA.
Object and purpose of the Treaty	The teleological method is divided into subjectivist (initial intent of the Parties) and objectivist (the spirit of the Treaty) approaches. Examining the initial intention of the Parties at the time of the treaty's conclusion demonstrates their ambition for an inclusive interpretation (cf. the International Undertaking) and their willingness to establish a long-term system, which would likely have encompassed DSI if it had existed, without distinguishing between the physical or immaterial dimensions of PGRFA. Interpreting the text according to the spirit of the Treaty obliges us to take into account contemporary (technological) challenges and further confirms this inclusive interpretation.
Conclusion	The inclusive interpretation, linking the immaterial and material components of PGRFA as one inseparable whole, is the most convincing under the current rules and principles of international law. Any other restrictive interpretation would render the Treaty deprived of its substance and would run contrary to the principle of effet utile (*ut res magis valeat quam pereat*).

Subsection 1. The Vienna Convention and Informal Uses of Science

172. This first subsection recalls the interpretative methods of the Vienna Convention and discusses the ways in which scientific and extra-legal arguments are advanced by the Parties to defend either inclusive or restrictive views on DSI. Pursuant to Article 31(1) of the Vienna Convention:

> "A treaty shall be interpreted in good faith in accordance with the ordinary meaning to be given to the terms of the treaty in their context and in the light of its object and purpose."

173. On this basis, three main interpretative methods can be identified: textual interpretation (based on the ordinary meaning of the terms), contextual interpretation (taking into account the systemic economy of the treaty, including the text, preamble, annexes, and subsequent agreements or practice of interpretation), and teleological interpretation (based on the object and purpose of the treaty).[15] Some views justify a physicalist reading based solely on the textual method of interpretation, considered the principal method (Spranger 2017). I do not agree with this argument, and following the prevailing doctrine, I consider that textual, contextual, and teleological methods of interpretation must be applied in a harmonious and complementary manner to achieve the most convincing result in light of all three methods (Kolb 2007; Lekkas et al. 2023; Portier 2022; Corten 2017). In addition, several principles of international law are relevant when considering the adaptation of international law over time. These include the will of States as the source of international law, the formal equality of States, and the balance between treaty stability and dynamism (Chanaki 2013). Among these, I mobilize the principle of *effet utile*, according to which a rule must be interpreted so as to have effect rather than none at all (Fitzmaurice 1951; Linderfalk 2007; Lekkas et al. 2023).

174. Paper 12 also discussed that, although scientific arguments are not explicitly recognized as methods of interpretation (textual, contextual, teleological), States have nonetheless been able to mobilize them in the interstices of these methods through several means. The first example involves the use of dictionaries (legal, scientific, technical) to interpret the meaning of textual elements. In the *Kasikili/Sedudu Island* case, for instance, the International Court of Justice (ICJ) relied on definitions drawn from scientific dictionaries to determine the meaning of the term "main channel" of a river (Lekkas et al. 2023). Similarly, in the *Whaling in the Antarctic* case, the Court noted divergences between the definitions of "scientific research" put forward by the scientists and experts mandated by the Parties (Peat 2014). In that instance, however, the Court distinguished the definitions proposed by scientists from the interpretation

[15] Following Article 32 of the Vienna Convention, additional means of interpretation (such as historical elements, preparatory works, and the context of adoption of the treaty) may also be used to confirm an interpretation, to clarify a meaning where it is ambiguous or obscure, or to reach a different meaning where the result of the primary analysis would be manifestly absurd or unreasonable (Linderfalk 2007; Corten 2017, 218, 240).

of the law, which remains the prerogative of the Court, thereby avoiding any "category mistake" (Papers 1, 12).

175. Where contextually relevant, the precautionary principle may also provide a point of entry for scientific argumentation, as argued by Judge Charlesworth in her separate opinion in the *Whaling in the Antarctic* case (Peat 2014; Mangel 2016). Another informal recourse to scientific arguments lies in the analysis of technical and scientific vocabularies as indicators of evolutionary interpretation. Indeed, the Court has held in the *Navigational and Related Rights* case that the use of generic terms in long-term treaties reflects States' presumed intent to allow those terms to evolve over time. This evolution may be justified in line with social, technical, and scientific progress (Portier 2022; Lekkas et al. 2023). In this way, treaty interpretation may de facto incorporate scientific arguments. Argentina's arguments (see *supra* § 164), follow this same logic, referring to contemporary scientific and technological developments to reinterpret the scope of uses related to genetic resources.

176. In connection with the mapping and analysis provided in the first chapter regarding the arguments advanced by the Parties, Table 4 (see *supra* § 131), also lists the legal and extra-legal arguments invoked by States according to the types of interpretative methods mobilized. These elements served as the basis of Paper 9, which defends an inclusive interpretation of the ITPGRFA as the most coherent in light of the combined methods of interpretation. These conclusions are summarized in the following sections, which present the findings according to textual (subsection 2), contextual (subsection 3), and teleological (subsection 4) methods of interpretation, and are further discussed in light of posthuman and relational approaches to international law (Section 2).

Subsection 2. Textual Interpretation

177. The definitions of the ITPGRFA relevant for the interpretation are the following:

> "Plant genetic resources for food and agriculture" means genetic material of plant origin of actual or potential value for food and agriculture (ITPGRFA, Art. 2).
>
> "Genetic material" means any material of plant origin, including reproductive and vegetative propagating material, containing functional units of heredity. (ITPGRFA, Art. 2).

178. Following the textual method, Paper 9 identified several indicators in favor of an inclusive interpretation. First, the definition of PGRFA is composed of two elements: "genetic material" and "actual or potential value for food and agriculture." On the one hand, the reference to "actual or potential value" allows for a dynamic and inclusive interpretation. On the other hand, the notion of "value for food and agriculture" encompasses a prospective and utilitarian approach (Moore and Tymowski 2005; Frison 2018). This justifies the inclusion of DSI as valuable for food and agriculture, for instance for the detection of specific gene changes or the selection of mutations (Houssen et al. 2020). I also argue that this notion of value is not strictly economic, but may also encompass social, cultural, and spiritual values. This argument is based on a comparative analysis, with reference to the studies of the WG-ABS (2009; 2010), and on a comparison with the 1983 International Undertaking (a non-binding precursor instrument to the ITPGRFA, discussed *infra* §§ 189-191), whose objectives included PGRFA of "economic and/or social interest" (IU, Art. 1).

179. Paper 9 then interpreted textually the definition of "genetic material" and rejected the physicalist argument. As recalled in Table 4 (see *supra* §131) and in the discourse analysis, the term "material" has been used as a pretext by some States to assert physicalist readings (see *supra* §§147–167, spec. §160). Such positions rely on a partial and contestable reading of the term "material," strategically reused to exclude DSI in line with their political agendas. As discussed here, this physicalist view disregards both the context and the object and purpose of the Treaty, which do not limit PGRFA to their tangibility, and it also fails to comply with textual interpretation, in which the term "material" is not used to denote tangibility (Papers 9 and 12). Moreover, pursuant to Article 31(4) of the Vienna Convention, the ordinary meaning of a term may be interpreted in a special or specific sense only if it can be demonstrated that the Parties intended to give it that meaning (Corten 2017). Yet this condition is not met to sustain the physicalist argument.

180. Contrary to physicalist views, the analysis of the ordinary meaning shows that the term "genetic material" is used as a noun rather than as an adjective.[16] Used as a noun, it does not equate to "tangible" and could be replaced by generic terms such as carrier, container, or device. Finally, the notion of "functional units of heredity," originating from the CBD, is not a precise scientific category but the result of a political compromise. This notion allows for a broad interpretation, already encompassing DNA, living cells, chromosomes, genes, and DNA fragments (Paper 9, 12). Therefore, the proposed inclusive interpretation is consistent with the Explanatory Guide of the ITPGRFA, according to which genetic materials contain the functional units of heredity but do not themselves have to be functional units of heredity (Moore

[16] This nominal use is confirmed by grammatical logic (as there cannot be two adjectives without a substantive) and by capitalization in the German translation.

and Tymowski 2005, 37). Based on these elements, Paper 9 proposed the following interpretation:

> PGRFA are defined as "any material [used here as a noun in the definition rather than as an adjective, and which could be replaced by terms such as carrier, container, or device] of plant origin, including reproductive and vegetative propagating material, containing functional units of heredity.
>
> By interpreting DSI as genetic material and by considering their "actual or potential value for food and agriculture," DSI clearly fall within the definition of PGRFA.

181. Finally, this inclusive interpretation that links the material and immaterial dimensions of PGRFA is consistent with that proposed by Schei and Tvedt, who argue that a genetic resource:

> "should include all of the following: (i) the micro or physical component, including extracting, multiplying, and studying genetic or biochemical material; (ii) the information component, including synthesis or other development, or processes to do so; and (iii) intangible and tangible elements used together, for instance where a molecule or sequence cannot be synthesized or multiplied but must be continuously collected from wild sources" (Tvedt and Schei 2014, 21; Tvedt and Young 2007, 65).

The following sections confirm this inclusive interpretation by mobilizing the contextual and teleological methods of interpretation.

Subsection 3. Contextual Interpretation

182. Paper 9 also reinforced the inclusive interpretation on the basis of the contextual method of interpretation. Pursuant to Article 31(2) of the Vienna Convention, interpretation must be carried out in light of the context, which includes the text, the preamble, and the annexes of the Treaty, as well as any related instruments made or accepted by the Parties in connection with the conclusion of the Treaty (Kolb 2007; Corten 2017; Portier 2022). In addition, Article 31(3) extends the context to subsequent agreements or practice, as well as relevant rules of international law applicable between the Parties. Paper 9 therefore undertook a contextual analysis following De Visscher's (1963) concentric-circle logic, starting from the immediate context and progressively moving toward the broader context.

183. With regard to the textual elements of the ITPGRFA, Paper 9 argued that PGRFA are primarily treated as matters of property and rights, without any distinction between their tangible and intangible elements. This property-based approach is reflected in several provisions, including the objectives of the Treaty (Art. 1); the scope of the Treaty and the States' sovereign rights over PGRFA (Arts. 3 and 10); Farmers' Rights (Art. 9); and the establishment of the Multilateral System of ABS (Arts. 10–13), in particular through its interaction with IPR instruments (Paper 9; Tvedt 2021; Aoki 2008). This interpretation is further confirmed by provisions that demonstrate the links between PGRFA and information related to them. Indeed, Articles 5 and 13.2(a) illustrate the connections between the material and immaterial dimensions of PGRFA and related information. This connection between seeds and knowledge is also reflected in Article 17, which establishes the Global Information System on PGRFA, including the use of Digital Object Identifiers. Similar connections between the intangible elements of genetic resources are also found in the protection of traditional knowledge within Farmers' Rights under Article 9.2(a), as well as in references to passport data of PGRFA in Article 12.3(c).

184. Against an artificial distinction between material and immaterial dimensions, the ITPGRFA thus establishes several connections between PGRFA and their intangible components (see a similar argument under the CBD with respect to traditional knowledge associated with genetic resources; Lawson 2022). Article 12.3(d) also refers to "genetic parts and components," which, as highlighted by Frison (2018) and Aubry et al. (2022) on the basis of the negotiating history (Moore and Tymowski 2005), should be included in the contextual interpretation of the definition of "genetic material." Article 13, which lists the sharing of information on PGRFA as a form of non-monetary benefit, further reinforces the relational continuity between the tangible and intangible dimensions of PGRFA. This provision has been invoked by certain States to support open access to DSI as a form of benefit-sharing. Yet, considering the increasing use of DSI as a substitute for PGRFA, my analysis considers DSI as PGRFA and not a form of benefit-sharing (Paper 9). Finally, several elements of the preamble also support this inclusive interpretation, including the clarification of the Treaty's objectives, the reaffirmation of national sovereignty, the references to related information and documentation, and the acknowledgment of the role of biotechnology (Lawson 2022).

185. The contextual analysis also integrated the resolutions of the Governing Body. The Governing Body is the competent authority to provide an authentic interpretation of the Treaty or to adopt a formal amendment. Yet, as discussed previously, it remains characterized by contested views on the inclusion of DSI, due to differing political interests on this issue (Paper II). Nevertheless, certain progress remains significant, such as references to the work of the CBD, which established a multilateral system of benefit-sharing (the "Cali Fund"), thereby constituting an implicit recognition of DSI within benefit-sharing logics (CBD/COP/DEC/16/2). Papers 9 and V discuss the ongoing negotiation trends toward the

establishment of the "Cali Fund" and the failure to reach an agreement in Lima. In addition, these discussions are oriented toward benefit-sharing rules and not toward "access," yet continuing to reflect a link between DSI and the objectives of the Treaty, and that references to Indigenous worldviews remain indicators of the persistence of these legal contestations and ontological controversies (see *infra* §§ 206-227).

186. The contextual analysis was further enriched by comparative analyses of the PGRFA regime complex, drawing on the principle of systemic integration (Vienna Convention, Art. 31(3)), which nonetheless remains difficult to include formally in the contextual analysis due to the principle *pacta tertiis nec nocent nec prosunt* (Vienna Convention, Art. 34; McLachlan 2005; Linderfalk 2007; Portier 2022). Nonetheless, the analysis shows that DSI remains a contested issue across the ABS regime complex, while certain instruments, such as the BBNJ Agreement, have opted to incorporate DSI within ABS frameworks. Moreover, in contrast to the physicalist arguments underlying ABS instruments, the analysis of IPR instruments reveals a continuity (or "transmateriality") from the tangible to the intangible (Bendimred and Frison 2022; Sherman 2024). Three examples were discussed: the UPOV developments, the WIPO Treaty on Genetic Resources and Associated Traditional Knowledge, and the EU Biotechnology Directive. The latter establishes a continuity of genetic information across different materials, stating that:

> "protection conferred by a patent on a product containing or consisting of genetic information shall extend to all material […] in which the product in incorporated and in which the genetic information is contained and performs its function." (EU Biotech Directive 2008, Art. 9).

187. This transmateriality thus extends patent protection to materials incorporating the parent genetic information (Paper 9; Bendimred and Frison 2022). Negotiations within UPOV have also revealed similar efforts to integrate the use of molecular data to determine Essentially Derived Varieties (Kock 2022). By contrast, the analysis of the WIPO Treaty on Genetic Resources and Associated Traditional Knowledge highlights a movement of discontinuity, as negotiators carefully avoided addressing DSI in relation to disclosure requirements based on genetic resources and associated traditional knowledge (Oguamanam 2024a; 2024b).

188. As discussed later in connection with posthuman theories (see *infra* § 200), there are contrasting approaches between IPR and ABS negotiations. On the one hand, IPR regimes are marked by continuity and transmateriality between tangible and intangible elements across instruments (Sherman 2024; Käll 2020). On the other hand, Global North States seek to limit the scope of ABS through "ontological cuts" between tangible and intangible elements of PGRFA, advanced to limit redistributive requirements (Paper 9). This physicalist interpretation

appears unconvincing when ABS is situated within the broader international legal framework, which is not intended to be limited to physical elements alone, whether with respect to sovereign rights of States over their natural resources or to human rights to benefit from them (Correa 1994; Lwango Mirindi 2019). In short, this contextual analysis reinforces an inclusive interpretation of the ITPGRFA, in that it governs PGRFA as matters of property and rights extending to both tangible and intangible elements. This interpretation is also confirmed by the teleological interpretation.

Subsection 4. Teleological Interpretation

189. The teleological interpretation focuses on the object of the Treaty (what it addresses) and its purpose (its objectives). A thorough examination of the object and purpose combines both an objective teleological approach, which presupposes treaty autonomy in addressing new challenges as they arise over time, and a subjective teleological approach, which pays attention to the original intentions of the Parties at the conclusion of the treaty (Kolb 2007; Portier 2022; Corten 2017; Lekkas et al. 2023).

190. Each approach was mobilized in Paper 9 to confirm the inclusive interpretation. On the one hand, the subjectivist analysis of the object and purpose focuses on the initial intent of the Parties to establish a sustainable and long-term multilateral system of access and benefit-sharing under the ITPGRFA. The negotiators would therefore have included DSI within the system if it had been relevant at the time (Coupe and Lewins 2007). Historical contextual elements were used complementarily to support this analysis, in particular references to the International Undertaking (IU 1983), which initially provided a broader definition of PGRFA that was later narrowed in subsequent interpretations to avoid impacts on IPR (Aoki 2009; Frison 2018). This already shows that PGRFA governance is situated within a property-oriented approach to PGRFA, in which the material/immaterial axis is not determinative. In this respect, Paper 9 discussed that the International Undertaking also explicitly mentioned broad objectives for PGRFA, which are relevant for interpreting their values:

> "The objective of this Undertaking is to ensure that plant genetic resources of *economic and/or social interest*, particularly for agriculture, will be explored, preserved, evaluated and made available for plant breeding and scientific purposes" (IU, Art. 1).

191. During the drafting of the ITPGRFA, these prospective notions can be observed in relation to biotechnologies and the desire to create a long-term system (Fowler 2003; Coupe and Lewins 2007). In this sense, Paper 9 relied on several historical indicators. These included

the fact that sequencing was not relevant at the time; the coverage of both tangible and intangible elements of PGRFA through States' sovereign rights over them; the intention to adopt an inclusive definition capable of accommodating new biotechnologies; and the choice to retain the definition of genetic material. Taken together, these elements show that the Parties' intention would have incorporated DSI if it had existed.

192. This inclusive interpretation is also supported by the objective teleological approach, which accounts for the autonomy of the treaty in relation to the initial intentions of the Parties, notably seeking to assess what the treaty itself, as a living instrument, requires in addressing new challenges as they occur through time (Kolb 2007; Portier 2022; Corten 2017). Based on this objective teleological interpretation, I argue that the Treaty should adapt to advances in research and include DSI to keep pace with evolving research practices, where DSI is used both in place of and alongside physical PGRFA (Laird and Wynberg 2018; Aubry et al. 2022). This interpretation is further reinforced by the studies of the WG-ABS:

> "If the concept of genetic resources is understood only narrowly, in terms of the original or current state of knowledge, the ABS system may fail to capture the future potential value of genetic material, particularly when used in or as a basis for synthetic biology or other emerging bio-economic technologies." (WG-ABS 2010; see also: Tvedt and Schei 2014; Lawson et al. 2019).

193. Paper 9 concluded that the inclusive interpretation is not merely one interpretation among others, but the most consistent one when the textual, contextual, and teleological methods of treaty interpretation are used in a complementary manner. Moreover, ignoring DSI would run counter to the principle of *effet utile*, as it would render the ITPGRFA devoid of practical effect (Frison 2018; Bendimred and Frison 2022; Paper VIII). Although an inclusive interpretation can be reached through a "simple" interpretation, an evolutionary interpretation may also be advanced as a complementary argument. Following the method established by the ICJ in *Navigational and Related Rights* case, an evolutionary interpretation can be justified, given that the ITPGRFA is a treaty adopted for a long duration and that it contains textual "margins of evolution" through the use of generic terms such as "resources," "actual or potential value," "material," and "functional units of heredity" (Paper 9).

194. In sum, this proposed legal interpretation of the ITPGRFA understands the Treaty as governing PGRFA as matters of property and rights, encompassing both material and immaterial elements. Consequently, States' sovereign rights over their PGRFA apply to both tangible and intangible forms of PGRFA, and DSI should be included within the ITPGRFA and be subject to benefit-sharing obligations. DSI should also fall within the provisions limiting the granting of intellectual property rights over materials under the Multilateral System (ITPGRFA,

Art. 12.3(d)). Nevertheless, the practical modalities of such inclusion remain to be determined (Carlson et al. 2025), and several questions arise regarding the current limitations of techno-scientific, market-based ABS systems (Paper 9). Are these economic systems adequate for the values embedded in PGRFA and their digital counterparts? Are all epistemologies, including Indigenous knowledge systems, heard when defining the "actual and potential value" of PGRFA? Is a State-centered property framework sufficient to address PGRFA and their intangible elements in light of the ongoing sixth mass extinction and the urgency of biodiversity conservation? Some of these questions are taken up in the following section, which turns to a posthuman analysis of the ITPGRFA.

Section 2. Toward a Cosmopolitical Interpretation of the ITPGRFA

195. This final section extends the inclusive interpretation already defended and enriches it through posthuman theories (Arvidsson and Jones 2024; Paper 11). These approaches emphasize the relational continuity between the material and immaterial elements of PGRFA, including the cultural, spiritual, and relational dimensions of seeds (Figure 1; Sievers-Glotzbach et al. 2021; Swiderska and Argumedo 2022). Drawing on posthuman theories, this section denounces States' strategic use of "ontological cuts" between the tangible and the intangible to limit ABS obligations (Paper 9). It also criticizes that, although science is not formally incorporated into the methods of treaty interpretation, Western sciences and their ontological assumptions nevertheless continue to influence legal interpretation. By denouncing these epistemic injustices, this section defends a cosmopolitical approach to international law (see *supra* §§ 88-95, 119-124), which conceives international law as a space that should remain open to ontological diplomacy between worlds and knowledge systems (Escobar 2007, 2018, 2020; Stengers 2018).

196. This cosmopolitical interpretation is used in the context of the ITPGRFA to show that the definitions of PGRFA and genetic material must also be interpreted through Indigenous worldviews. This cosmopolitical interpretation is further supported by legal arguments identifying ontological openings in the ITPGRFA and related ABS instruments. These include the "actual or potential value" of PGRFA, their "economic and/or social interest," references to Mother Earth, and the Programme of Work aimed at valuing traditional knowledge at the latest COP16. Following this cosmopolitical approach, I conclude this study by listening to the views, knowledge, and relationships to seeds articulated by Kahehtoktha Janice Brant, co-founder of the Kenhteke Seed Sanctuary. These testimonies are also taken up in connection with my earlier proposals on the "rights of relations" between humans, seeds, and DSI, as well as for a relational approach to law, politics, and knowledge (Papers 2, 6, 8, 12).

Subsection 1. From Posthuman to Cosmopolitical Interpretations of the ITPGRFA

197. Throughout this thesis, I have drawn on several methodological tools from posthuman approaches, as well as from related theoretical currents brought into dialogue with them (Paper 11; see *supra* §§ 45–59). In this respect, I associate posthuman theories with a cosmopolitical approach to law (Stengers and de Sutter 2004; Gutwirth 2004), as well as with relational approaches to law, politics, and knowledge (Papers 2, 6, 8). In these dialogues, these approaches can also be placed in parallel with regimes of truth and their articulation. From this perspective, scientific and legal regimes of truth mutually reinforce one another. Through studies that stabilize DSI and through positivist legal interpretations, their articulation consolidates a physicalist view of PGRFA, while sidelining the ontological conflicts that complicate these arguments (Papers I, VII).

198. Among the tools specific to posthuman theories, this thesis has mobilized the notion of "ontological cuts" and applied it to analyze the ways in which modern sciences and positive law produce and perform such "cuts" (Barad 2007; Arvidsson 2024). Paper 9 denounces the ways in "science-based" legal discourses serve as a pretext for States to impose "physicalist" and "naturalist" "ontological cuts." These "cuts" divide genetic resources into tangible and intangible elements, or draw "naturalistic" distinctions between allegedly unprocessed nature or data and the cultural and spiritual elements associated with seeds (Girard 2019; Bonneuil 2019). Following a critical and historical perspective, this analysis can also be connected to earlier debates within the FAO, where scientific narratives were mobilized to produce similar "ontological cuts." Indeed, Whatmore shows how scientific discourse was used by negotiators to objectify and fix distinctions between plants characterized as "raw materials," which were framed as falling under the common heritage of humankind, and improved plants which should be protected through IPR (Whatmore 2000, see also: Whitt 2009; Jones et al. 2024).

199. In Paper 9, posthuman theories were advanced to reinforce an inclusive interpretation through two additional arguments. First, seeds are relational entities encompassing both material and immaterial dimensions (Figure 1). Second, legal regimes governing PGRFA treat them as matters of property and rights extending to both tangible and intangible aspects. This argument is further supported by posthuman theories of property (Käll 2022; Jones et al. 2024; Gibson 2020; Davies 2017; See also: Nedelsky 2022; Pistor 2020; Sherman 2024). Käll (2022) shows how property "goes to places and spaces where capital wants it to go," exceeding traditional distinctions between objects and subjects, and between the tangible and the intangible. Entities may be extracted, dematerialized, and commodified, while remaining subject to property rights (Käll 2022). Sherman (2024) makes a similar observation regarding intellectual property rights, which have historically extended across material and immaterial

continuums, notably through tangible manifestations of the intangible, in order to incorporate elements such as chemical inventions, software, and isolated DNA.

200. In the contextual interpretation of the ITPGRFA (see *supra* §§ 186–188), I argued that IPR instruments are marked by continuities between the tangible and intangible dimensions of PGRFA. By contrast, Global North States tend to draw sharp discontinuities through "ontological cuts" in the context of ABS instruments or redistributive requirements. I can illustrate this argument along two axes (Figure 6). With the MLS, the ITPGRFA seeks to strike a balance in between common management of PGRFA and their appropriation through IPR. Accordingly, the ITPGRFA is situated along a horizontal axis of PGRFA governance. With the dematerialization of genetic resources, however, Global North States strategically rely on a vertical material/immaterial axis that is artificially superimposed onto the logic of the ITPGRFA. In contrast to the continuities recognized in IPR instruments, this vertical axis is mobilized by Global North States to justify the exclusion of DSI from ABS mechanisms and disclosure requirements (for the WIPO Treaty on GRATK). This undermines the credibility of the physicalist argument. This is so insofar as it strategically asserts "ontological cuts" to detach DSI from ABS obligations, while continuity is simultaneously recognized within IPR instruments. This analysis of DSI echoes the debates on NGT, where I observed that certain legal objects may be traversed by multiple "ontological cuts," even contradictory ones, depending on the interests at stake (Paper 11; Figure 3).

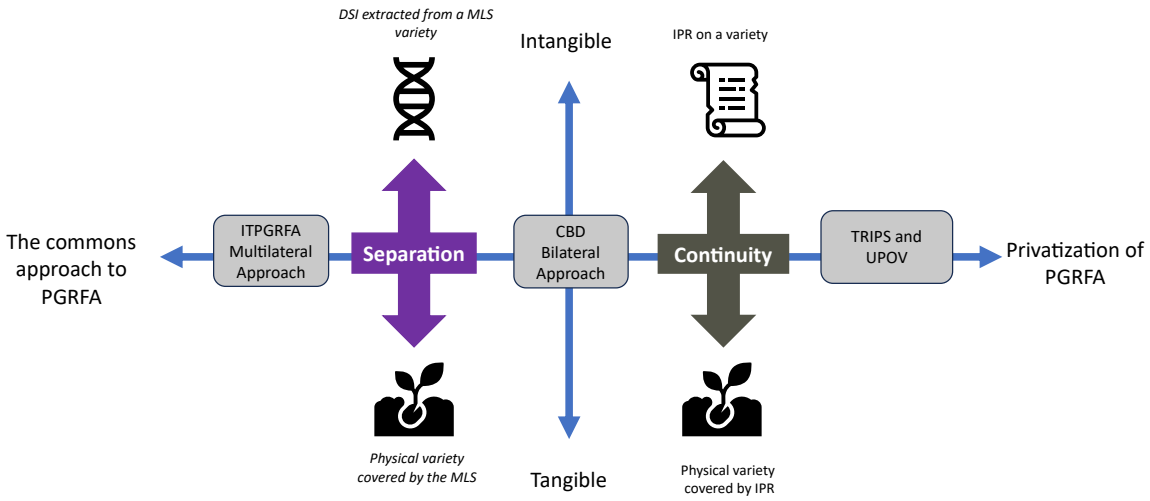

Figure 6. Two axes in PGRFA governance (Paper 9).

While the ITPGRFA operates along a horizontal axis, the physicalist approach strategically and pragmatically relies on a vertical axis (material/immaterial) to exclude immaterial elements of PGRFA from ABS instruments, whereas intellectual property rights maintain continuity between material and immaterial dimensions.

201. Posthuman theories, through their post-anthropocentric perspective, also invite a certain distance from a strictly state-centered property system governing PGRFA and DSI. Rather than asking how States might unilaterally regulate genetic resources and associated data, these approaches ask how such resources follow their own trajectories, interact, and generate other forms of normativity (Käll 2020). From this perspective, the pathways of seeds co-evolved with communities, and their associated information exists with a form of agency of its own, well before the consolidation of international legal regimes governing them. Through processes of exchange or appropriation, seeds and their information became embedded in rhizomatic structures, making it difficult to situate them under the sovereignty of any single State. This dynamic partly explains why a multilateral mechanism was adopted under the ITPGRFA, and why much of the literature proposes treating seeds and their digital counterparts as biocultural heritage and as "common goods" (Frison 2018, 95, 167–216; Halewood 2013; Halewood et al. 2013; Lemaire 2025). The momentum of the ITPGRFA and its initial objectives (moving beyond a state-centered model) must therefore be recalled and gain further significance in light of the rhizomatic connections and agency proper to DSI.

202. Posthuman theories have finally been used to address the epistemic injustices in debates on DSI. Drawing on posthuman theories, Paper 12 denounced the way international law privileges Western sciences as the primary reference, while marginalizing Indigenous Knowledge Systems. Indeed, in the debates on DSI, I observed several calls by States for "more science" in the process of interpreting DSI (see *supra* § 149). Nevertheless, these appeals to "neutral," "objective," and "universal" science fail to address the epistemological question of which science is being invoked, by whom, and with what ontological and political-legal implications. Paper 12 therefore argued that the ITPGRFA should not be interpreted solely in the light of Western sciences and their ontological presuppositions.

203. I therefore proposed a cosmopolitical interpretation of the ITPGRFA, assuming that it may also be re-articulated through other ontologies and be open to different knowledge systems and epistemologies. This cosmopolitical approach extends the refusal to take for granted the "ready-made" answers of legal positivism (Arvidsson 2024). It also refuses any process that diminishes the world (Stengers and Debaise 2023). Instead, it calls for taking seriously the binding rules of our practices as jurists (Gutwirth 2013; Gutwirth and Stengers 2016; Stengers and de Sutter 2004). Through this argument, I also follow a principled reading of international

law and human rights. If they genuinely aspire to be international, they should be capable of accommodating diverse knowledge systems. This cosmopolitical approach is therefore also diplomatic in principle, as it implies treating the other as an equal and as a rights-holder within this pluriverse, and therefore taking the other, their knowledge, and their obligations seriously (Gutwirth 2004).

204. This cosmopolitical approach may also echo the metaphor of ruins (see *supra* § 121), in their sense of erasure as well as their creative potential (Van Eynde 2022). All formal precautions aside, the metaphor of ruins may be applied as an analytical grid to comment on this erosion of ABS instruments, through terms such as erosion, dematerialization, fragmentation, weakening, and the erasure of principles of justice. Yet international law, like a ruin that is fading, also carries a potential for creativity and renewal, within which new constructions are possible. From these existing fragments of positive law, other directions are possible, which are not based on modern understandings of phenomena. From this law in erosion, it is indeed possible to seek new constructions, explorations, and cosmopolitical attempts that may be accommodating to the ontological questions at stake.

205. This cosmopolitical interpretation is justified by several elements of positive law. Indeed, within the ITPGRFA and other instruments of the regime complex, several elements demonstrate the relevance of Indigenous Knowledge Systems for being meaningfully heard in the interpretation of the ITPGRFA and of its definitions of genetic resources. I identify, in particular, references to the "actual or potential value" of PGRFA, as well as to their economic and/or social interest in the International Undertaking, as indicators of these ontological openings. Within the ITPGRFA framework, the definition of PGRFA is utilitarian rather than inherent, as it depends on their use (Moore and Tymowski 2005; Frison 2018). In this sense, "value" is not inherent. It is redefined through the political, economic, and social relations woven around genetic resources. Indeed, following the discussion papers and studies of the WG-ABS (2009, 2010), these values are:

> "social, economic, cultural and spiritual in nature. In considering the actual values of genetic resources and traditional knowledge we are forced to recognise the multiple dimensions of the values that are placed on genetic resources and traditional knowledge and the multiplicity of human societies holding these values" (WG-ABS 2009, 28).

206. Ontological politics are even more evident in a recent COP16 decision, noting that:

> "in some world views, all natural genetic information belongs to Mother Earth" (CBD/COP/DEC/16/2).

In addition, at the same COP16, the Programme of Work on Article 8(j) affirms the following principle:

> "The traditional knowledge, innovations, practices and technologies of indigenous peoples and local communities should be valued, considered essential and given the same respect and consideration as other forms of knowledge" (CBD/COP/DEC/16/4; Paper 13).

These elements are not merely symbolic elements of negotiations. They constitute the integration, within positive international law, of elements of ontological diplomacy. Taken seriously, they therefore call for other ontological and epistemological perspectives to validly guide the interpretation of law.

207. Seizing these openings, and relying on elements of positive international law, Paper 12 experimented with this cosmopolitical approach. It proceeded through a process of dialogue and listening with Kahehtoktha testimonies and knowledge about seeds and their spiritual dimensions. Key elements of this engagement are taken up in the following section.

Subsection 2. Listening to Indigenous Epistemologies to Interpret the ITPGRFA

208. Paper 12 aimed to question the forms of scientific knowledge mobilized in the interpretation of the ITPGRFA, to examine the ontological assumptions underlying these sciences, and to analyze their influence on legal interpretation. Yet this paper is first and foremost a work of collaboration and attentive listening to the testimonies of Kahehtoktha Janice Brant, co-founder of the Kenhteke Seed Sanctuary, located in the Mohawk territory of Tyendinaga. This moment of dialogue is part of research conducted in an Indigenous context at the University of Montreal under the supervision of Prof. Konstantia Koutouki, a process through which I also questioned my own research ethics practices (see *supra* §§ 45–59). Together with Alex Alexis, I had the opportunity to meet Kahehtoktha Janice Brant at the Kahnawà:ke Seed Conference, and after several moments of exchange, we jointly developed the project of writing Paper 12 together. The aim was to highlight the actions of the Seed Sanctuary and to explore what they may contribute to a rereading of international law through this situated worldview.

209. The paper began by pointing out that, although ABS instruments such as the ITPGRFA and the CBD contain elements intended to accommodate "traditional knowledge," these voices are not sufficiently taken into account in international negotiations when a so-called "science-based" approach is followed to regulate the intangible elements of PGRFA, or to determine

what constitutes the value or ontology of a genetic resource. Criticizing this situation, Paper 12 reflected a moment of exchange with Kahehtoktha, aimed at learning from her knowledge and relationships with seeds. As discussed in the following lines, Kahehtoktha highlights the holistic dimensions of seeds in this relational context, as carriers of social, spiritual, and collective meanings that could inspire the interpretation of the ITPGRFA. The proposed approach therefore assumes a pluralism of truths and seeks to break with the tendency to reduce the world on the basis of elements selected through a presumed universalist approach of modern science.

210. The testimonies emphasize the importance for Western science to listen to Indigenous sciences, and insist that they must guide its younger sibling that refuses to listen. In addition, these knowledge systems recognize the inseparable relations between humans, seeds, territories, and non-human entities, and interconnection with cultural, spiritual, and ecological practices. They have been preserved across generations despite colonization and the erasure of knowledge. As explained:

> "Indigenous people have a wholistic view and practice of life that involves acknowledgement of the environment and natural surroundings and interconnections seen and unseen. Despite colonization, despite attempts of genocide, we have preserved a great part of our science through our oral code, our persistent teachings, and the time spent on the land with elders, teachers, hunters, and gatherers" (Paper 12).

211. As Kahehtoktha explains, these scientific practices are in constant interactions and exchanges of this information, these stories, and these dialogues:

> "I care about our sciences. I find it fascinating. I still learn from the land and gardening and seed keeping, cooking, growing and eating our unique and traditional sustenance and teaching that to others and building networks of relationship and support. I feel like I am a scientist. I feel like all Haudenosaunee might be scientists. I do experiments and keep journals of notes about crops and climate and weather and the moon, animals, birds, and insects. This information gets shared and grows when it is shared at conferences like Kahnawake. We use the information gathered to decide what plant in the garden for the coming season, based on the sharing and my land experience, including what I know about the cycles of living things. So, I'm always interacting, we are always interacting with that information, stories, always engaging with that knowledge. We have a beautiful worldview" (Paper 12).

212. These sciences are also expressed through chants and dances, which constitute additional layers of knowledge. Against a Cartesian science that creates "ontological cuts" between material plants and intangible information, Kahehtoktha insists on the attachments and relations between humans and seeds:

> "I use the word 'magical'. Something that goes beyond the physical to touch the metaphysical. We have respect for seeds both in their physical and spiritual dimensions. Seeds are the future generations of seeds. Their energy is similar to that of children: we care for them

> with gentleness, we speak to them kindly, and we make sure to offer them a safe space [Taking the example of] corn, beans, and squash, they are much more than an agricultural complex: together they are the Three Sisters, and there are numerous legends and stories about their kinship and origins. Seeds and plants are living beings; they are animated, they have a spirit. When seeds are cultivated, they are given the opportunity to adapt to the ecological and cosmic changes of the environment and climate. They carry genetic memories and connections with peoples and places. They know when to stay dormant and when to awaken. Our ancestors knew when to sow and how to prepare the soil. They worked in collaboration, in co-creation. Perhaps this is the true treaty"(Paper 12).

213. Beyond a strictly geneticist definition of the scope of DSI, or beyond the formal obligations of benefit sharing through mechanisms that are increasingly complex and even ineffective, these discussions highlighted the wholistic and spiritual relations between humans and seeds. These wholistic relations are important for the Sanctuary: the story of the Skywoman explains that seeds are sacred, cultivated by communities since time immemorial, with which relations of mutual assistance and affection have been established with the Three Sisters (Kimmerer 2015). The social, spiritual, and cultural dimensions of seeds were also expressed as a way of communicating with the Sisters of Providence of St. Vincent de Paul, the former landowners, at the time of the foundation of the Sanctuary. These spiritual relationships with seeds are reaffirmed through speeches, rituals, ceremonies, and dances. Furthermore, these relations of affection and care are expressed through words and practical actions (protecting seeds with covers, keeping them dry and away from light, speaking to them with kindness, limiting risks of contamination), or through references to the dialogues between generations, as seeds are entrusted to young Mohawks by their ancestors (Paper 12).

214. Paper 12 also addressed questions relating to the ontology and epistemology of law, as discussed through the "Passing the Seeds" wampum belt (Figure 7). Wampum belts are sacred living legal agreements for the Haudenosaunee and other Indigenous nations, and serve as signs of commitments (Kahehtoktha 2022; Lajoie et al. 1998). This wampum belt evokes a mutual responsibility and commitment between humans, non-humans, and ancestors to transmit "physical" seeds from generation to generation, but also to protect and transmit immaterial elements such as knowledge, rites, and cultures in order to keep these relations alive. As she explains:

> The Seed Wampum belt "symbolizes not only the act of physically sowing but also the sharing of knowledge, skills, cosmology, songs, and recipes that accompany them and are necessary to take care of them" (Paper 12).

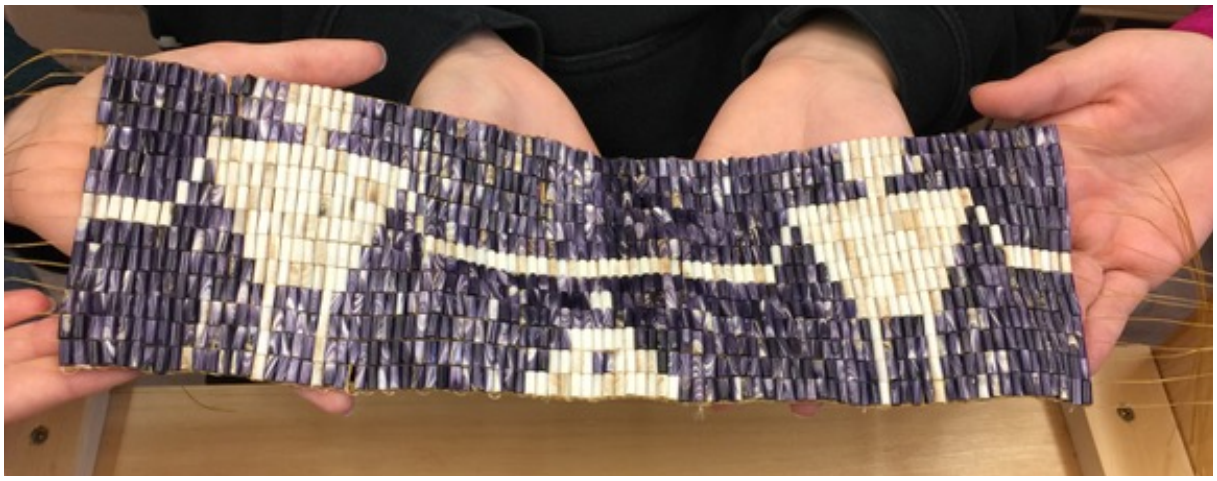

Figure 7. Passing the Seeds Wampum Belt.

Youth from Tyendinaga holding the "Passing the Seeds" wampum belt. Photo credit: Kahehtoktha (Kahehtoktha 2022; Lisk 2019).

215. Read in the light of the notion of "rooted constitutionalism" (Mills 2016), these perspectives have influenced my own ontology and epistemology of law (see *supra* §§ 88-95). B yond legal positivism, this wampum belt, as a "true treaty," represents this intergenerational and more-than-human responsibility: to transmit seeds, both immaterial and material, including the knowledge required to care for them, and to preserve these relations of coevolution between humans and seeds. Relating this collaboration to my own research, I can thus identify holistic relations that could, if deemed appropriate, be defended through the relational approach: a "right of relations," a relational approach to knowledge, to politics, and to law, or through a cosmopolitical approach.

216. Applied to the seed regime complex in Paper 2, and more specifically to the case of the dematerialization of seeds in Paper 8, or again in a political approach in Paper 5, this notion of rights of relations would focus on the relations between humans and seeds, without pronouncing on the ontological status of isolated entities. It would aim to make visible and protect these holistic links, which are often erased in techno-scientific or legal-positivist readings. Referring to the spiritual relations of seeds (both material and immaterial) within the Seed Sanctuary, this vocabulary of rights of relations could also be used to protect collectives, as well as the spiritual, cultural, and intergenerational links between the Sanctuary, its people, and the seeds. Similarly, this relational approach could help to identify legal arguments to resist elements that threaten these relations, notably those mentioned in the interviews: risks of contamination by GMOs, the commercialization of seeds, patents, or the replacement of traditional seeds (Paper 12).

217. In conclusion, several relational elements between humans and seeds, and between seeds in their material and immaterial forms, emerge from the testimonies of Kahehtoktha and from the references to the Wampum Belt. These relational perspectives enrich my legal interpretation of the ITPGRFA and of the definition of the values of PGRFA, which should encompass the holistic links between humans and seeds, reconnecting their physical, immaterial, and spiritual dimensions.

Conclusion

218. This article-based thesis examined the strategic use of scientific arguments in political and legal spheres, and more particularly in the discussions on DSI within the PGRFA regime complex (Raustiala and Victor 2004; Frison 2018). Drawing in particular on legal philosophy, philosophy of science, and critical posthuman theories, the thesis analyzed how science, in its modern and positivist definition, may be presented as neutral and "objective", and subsequently integrated within epistocratic dynamics that limit the space for "subjective" political arguments (Latour 2004; Viala 2024). The thesis thus drew on several critical perspectives on modern science and on the ontological dualism it reproduces (separating nature from culture, facts from values, and the tangible from the intangible) which may become normative and unquestionable within well-"ordered" interdisciplinary projects (Braidotti 2019; Stengers 2022).

219. This thesis also examined how Western science and legal positivism articulate as two regimes of truth (Foucault 2014). These regimes shape and influence the formulation of knowledge related to DSI, the interpretation of law, and political decision-making, leaving little or no room for epistemological and ontological controversies. In this respect, I also interrogated the forms of knowledge and relations that are included or excluded from these scientific discourses and from sequencing processes, particularly with regard to Indigenous Knowledge Systems and the social, cultural, and spiritual relationships between humans and seeds (Whitt 2009; Tuhiwai Smith 2012; Ajates 2023).

220. These questions surrounding the roles, functions, and risks of scientific arguments emerge clearly in debates on DSI, which are analyzed as a hybrid issue (Latour 1993; 2004; 2013). The DSI conundrum is indeed highly technical, marked by strong political and legal contestation, and embedded in deeper, long-standing ontological and epistemological controversies (Frison and Tsioumani 2022; Alexis 2023). These different levels of conflict manifest in concrete legal and policy contestations, notably over the maintenance of open access to DSI or its inclusion within ABS systems. They also reflect broader concerns over biopiracy,

gene editing, and the patenting of genetic resources, which may be obscured behind issues presented as purely technical. Within this hybrid context, as this thesis shows, the use of scientific arguments plays a central role in stabilizing the ontologies associated with dematerialized genetic resources, such as the type of data, information and knowledge covered.

221. In this context, I have also shown that States use modern science as a strategic narrative tool to steer political processes and the interpretation of international law. Accordingly, despite formal separations between science and law in the Vienna Convention or theoretical distinctions between regimes of truth, I argue that legal interpretations may be influenced by carefully selected references to Western science that share an underlying ontological background. In debates on DSI, these forms of Western science function performatively to impose "physicalist" "ontological cuts" between the material and immaterial worlds, or "naturalist cuts" between "unprocessed" plants, on the one hand, and associated social, cultural, and spiritual dimensions, on the other. These arguments also raise concerns regarding the types of knowledge recognized in the interpretation of international law, and support the claim that Indigenous Knowledge Systems must be meaningfully heard within these interpretive processes.

222. The present study aimed to bring coherence to the articles that compose this thesis, as well as to their shared methodologies and transversal ideas. As explained in the methodological section, this study also provided an opportunity for a reflexive exercise on my own ontology of law and science, the standpoint from which this research is conducted, its methods and modes of knowledge production, and the ways in which my concepts and methodology have evolved over time. This reflexive approach also integrates my doubts and uncertainties, in particular those arising from research conducted in Indigenous contexts (see *supra* §§ 45–59). As a result, this thesis explicitly assumes a situated point of view and does not claim to produce a so-called objective, general, or abstract body of knowledge on the relationship between science and law.

223. Within this reflexive posture, posthuman theories came to occupy a central place over the course of the research for several reasons. At a conceptual level, posthuman theories seek to converge post-humanist and post-anthropocentric approaches, and thus bring together multiple critical and theoretical genealogies (Braidotti 2019; Jones 2023). In this thesis, this convergence takes the form of the joint mobilization of decolonial and feminist theories of international law, legal technique and legal theory, philosophy of science, and political philosophy, as well as works associated with the "ontological turn," the pluriverse, cosmopolitics, and epistemic injustices. Posthuman approaches are also used to integrate empirical (situated, embodied, and embedded) elements into theoretical analysis (Braidotti 2019; 2022; Jones 2023; Arvidsson 2024). I followed this approach to enrich the theoretical framework through empirical analyses and "classical" legal techniques, while at the same time

maintaining a critical distance from the ready-made answers produced by these methods, as well as from attempts at performative empiricism (asserting a "true" reality and overlooking onto-epistemological controversies), or from other extractive research practices.

224. Among these combined methodologies, the thesis integrates legal technique and doctrinal analysis, including the methods of interpretation of the Vienna Convention. These approaches are complemented by empirical NPF analyses of scientific argumentation mobilized by States and political actors in negotiations, and by an examination of their influence on legal and policy processes. These elements were further developed through research stays and fieldwork, including participant observation at the meetings of the ITPGRFA Governing Body (GB10 and GB11), a traineeship at the European Commission, the monitoring of negotiations on NGTs at the European Parliament, and a series of formal and informal interviews with State delegates, UN and EU officials, farmers, and Indigenous peoples, which also led to collaborative research in Indigenous contexts.

225. Beyond their critical dimension, posthuman theories also provide a necessary moment of pause with respect to ready-made legal answers, within which more constructive perspectives can be explored. These constructions make it possible, for example, to rethink international law otherwise: to propose alternative ways of drawing such "ontological cuts," or of re-establishing continuities that are less exclusionary (Jones 2023; Arvidsson 2024). These constructive perspectives underpin several arguments developed in this thesis, including the defense of relational continuity between physical seeds and their immaterial elements; the proposal of a relational approach to law, science, and politics; the "rights of relations" between humans and non-humans; the metaphors of ruins; and the cosmopolitical approach to the interpretation of international law. Together, these perspectives assume that international law may provide a space for temporary stabilization, capable of being reinterpreted by other systems of knowledge and in light of the ontological questions at stake.

226. The different research questions and hypotheses were articulated within a general theoretical framework in Part I and a case study devoted to DSI in Part II. The first part therefore brought together the various conceptual tools developed in my papers to analyze and illustrate the interactions between science, politics, and law. In line with the reflexive approaches outlined in the methodology, the first chapters addressed the ontologies of "law" and "science" in this thesis, as well as their evolution over time. For example, this chapter discussed the evolution of my ontologies of law, moving from a Kelsenian positivist system, conceived as closed upon itself and self-sufficient, to law understood as a mode of existence and as a set of practices that should not be conflated (Gutwirth 2013), and subsequently toward a relational conception of law through the integration of Indigenous approaches to law (Mills 2016; Borrows 2019).

227. Drawing on feminist, decolonial, and posthuman theories of knowledge (Stengers 1993; 2022; Grosfoguel 2007; Haraway 2013; Harding 2008; 2011; Braidotti 2019), this chapter critically examined the definition of "modern science." Situated within a positivist and Western ontological framework, this modern science operates through a series of ruptures (between facts and values, nature and scientists) and through the disqualification of entire fields of experience, thereby excluding other epistemologies and "thinning" the world (Stengers and Debaise 2023). With a view to the valorization of Indigenous Knowledge Systems, I also questioned the notion of "traditional knowledge," as well as their "indirect" legal protection (against their misappropriation), which has the effect of leaving intact the hegemony of modern science. In continuity with the literature on epistemic injustice, I proposed an inclusive definition of science by mobilizing legal tools such as the human right to science and the principle of non-discrimination, as well as a cosmopolitical approach to international law.

228. Following the general research question on the roles, functions, and risks associated with the use of scientific arguments as arguments of authority in politics and law, the second chapter of this theoretical part brought together several concepts to analyze the interferences between science and law. First, I associated dualist ontologies with the concept of epistocracy. Epistocracy follows a "post-political" project that grants political legitimacy to science and expertise on the grounds that they are presented as objective, neutral, and more rational, while political choices are framed as subjective or even irrational (Viala 2022; 2024; Mouffe 2016). Then, I mobilized the concept of epistocracy to analyze the "technical/scientific narratives" used to justify policy choices in debates surrounding the proposal for the EU Regulation on NGT. These empirical analyses were also moments in which I revisited my hypotheses (RH1), where appeals to science went beyond a formal dualist epistocratic framework and took other forms: science as a guide, science as a goal, science as a metaphor, etc. From this perspective, I observed both that "technical/scientific narratives" were strategically mobilized to justify or to criticize the NGT Regulation proposal (Paper 7), and that these narratives were not constant, but evolved in response to political, technological, and ontological contexts (Paper 7, with similar findings in Papers 4 and 9).

229. Epistocratic drifts were also criticized in this chapter as constituting a category mistake, insofar as they conflate law, politics, and science as distinct modes of existence and practice that are endowed with different felicity conditions (Latour 2009; 2013; Gutwirth and Van Dijk 2020). It was also in this chapter that I discussed the articulation and mutual references of the regimes of truth of law and science within an indisputable interdisciplinary project (Foucault 2014). In this project, the stabilization of ontologies is carried out through scientific arguments that are subsequently rearticulated in legal reasoning, and within which ontological conflicts become inaudible. These normative effects of the articulation of regimes of truth recall these

"ontological cuts" of modern law and science, which produce ontological separations that may carry implicit normativity for interpreting law, to the point of entirely erasing relational continuities between humans and non-humans. In sum, I can therefore identify several uses, functions, and risks associated with the use of scientific arguments: stabilizing ontologies, excluding other knowledge systems, thinning the world, limiting the margins of political maneuvering, or erasing ontological controversies and marginalizing relational continuities that are non-translatable within modern framings (RH1).

230. The theoretical framework also engaged with the creative potential of posthuman theories (Jones 2023; Arvidsson 2024) to propose a relational approach to politics, law, and knowledge. This relational approach aimed to recognize, qualify, or protect a multiplicity of ontologies, continuities, and relations between humans and non-humans, without these being disqualified a priori by dualist frameworks, reductionist modern sciences, or formalist legal positivism. In this sense, this relational approach was used to defend a definition of politics as *praxis* rather than as *technē*, and to revive the imagination and autonomy of the political community (Paper 6). It is also mobilized in law, either as a legal argument through the "rights of relations" or through a cosmopolitical interpretation (Papers 2, 8, 12). Read in parallel with the metaphor of ruins (see *supra* § 121), this relational approach assumes a non-ideal theory of law, emphasizing the ambivalence of law as both a vector of an extractivist and colonial world and, at the same time, as a set of fading vestiges upon which it becomes possible to create new constructions. From these remnants, new forms of stabilization and ontological diplomacy can emerge in response to contemporary ontological, ecological, and social questions.

231. Part II then applied these theoretical elements through a case study addressing the dematerialization of genetic resources. The first chapter examined how science was taken up in debates on DSI. I specified the different types of uses of scientific arguments, their effects on the interpretation of international law and on the stabilization of ontologies, as well as the various forms that references to science may take within States' narratives. As with the analysis of debates on NGT, I also observed that references to science are not limited to a dualist ontological framing, and that scientific narratives were articulated both as a guide for policymaking and as a value in itself (supporting open access to DSI, and that ABS mechanisms would hinder scientific innovation). This chapter also discussed the CBD science policy processes through which the ontology of DSI was stabilized, notably by framing their terminology and delimiting the types of data covered (Alexis 2023). I also denounced the way these appeals to modern science excluded Indigenous Knowledge Systems, both within the definition of DSI and as sources of knowledge capable of guiding the interpretation of international law (Oguamanam 2022).

232. Confirming my hypotheses (RH2a, RH2b, RH2c), I observed that modern sciences were strategically mobilized by States and produced normative effects. I observed that States indeed relied strategically on scientific arguments, presented as neutral, objective, or more rational, but which ultimately influenced interpretations and decisions serving their interests (Papers 4, 9, and 12). In this sense, although scientific arguments are not formally included among the interpretive methods of treaty interpretation set out in the Vienna Convention, and although the governance of PGRFA does not correspond to a formal epistocratic system (Viala 2022), such scientific arguments nevertheless operated through informal normativity. They were used by States, specifically, to promote their preferred terminology and to influence which types of data were included or excluded. However, these uses of science were not only technical; they also had broader effects on legal contestations and on the justification for the non-inclusion of DSI within ABS frameworks. Similar to the findings on NGT, I also observed conflicting uses of scientific arguments depending on the interests at stake, in particular to establish continuities or discontinuities with physical genetic resources (Papers 4, 9).

233. At different levels of conflict in PGRFA governance (Figure 1), these strategic uses of science are also linked to underlying ontological controversies and deep-rooted conflicts. In this sense, these uses of modern science rest on a series of implicit ontological and epistemological presuppositions that carry axiological positions and concrete normative effects. For example, behind these ideas of objective, neutral science and a universalist understanding of scientific progress, these appeals mask inequalities among actors within this digital divide (Leonelli 2014). Via these abstract ideas of science, there is the privileged role attributed to scientists in "discovering the world as it really is" by removing any obstacle to this endeavor (Gutwirth and Naim-Gesbert 1995), thereby justifying that DSI should be freely available, as raw materials upon which plant innovations may subsequently be "improved" and patented (Whatmore 2002; Tuhiwai Smith 2012; Tordjman 2021; Jefferson 2023). In this sense, these uses of scientific arguments impose techno-centric framing and situate DSI within physicalist and naturalist ontological frameworks, within which ontological controversies and the relational and spiritual dimensions of seeds have no place.

234. As discussed in Chapter 2, these ontological backgrounds also have informal effects when they are mobilized in the legal exercise of treaty interpretation. This is why Western sciences, and their ontological backgrounds, have been taken up strategically by Global North States in their physicalist arguments to impose "ontological cuts" that are both naturalistic (separating nature and culture) and physicalist (separating the material and the immaterial). In this way, scientific discourses have been used to support the dissociation of "physical" PGRFA from their intangible elements and, consequently, to exclude DSI from the scope of ABS instruments. Once again, the analysis of these "ontological cuts" demonstrates the strategic and contradictory uses by States. I denounced the strategies of Global North States that, to avoid ABS commitments, rely on Cartesian scientific assumptions to artificially impose "ontological

cuts" between the material and immaterial dimensions of PGRFA. Hence, by jointly analyzing the IPR applicable to PGRFA, I observe that these instruments reflect continuities between the tangible and the intangible, and that such "ontological cuts" appear only insofar as they serve to avoid compliance with ABS obligations (Paper 9; Figure 6).

235. In line with my hypotheses (RH2d and RH2e), Chapter 2 also defended an inclusive legal interpretation of the ITPGRFA, recognizing PGRFA as matters of property and rights, marked by relational continuities between tangible and intangible elements. I argue that the inclusion of DSI within the scope of the Treaty is the only convincing interpretation, when applying in a complementary manner the textual, contextual, and teleological methods of treaty interpretation set out in the Vienna Convention (see Table 7). I therefore reject the existing physicalist approaches, which rely on a partial reading of the treaty text and mobilize "ontological cuts" inherited from Western scientific traditions to impose a distinction between the physical and the immaterial. Such a distinction is not supported by the text, the context, or the object and purpose of the Treaty, and artificially imposes "ontological cut" between the material and the immaterial.

236. This argument is further reinforced by posthuman theories, based on which I argued that PGRFA are relational entities, both material and immaterial (Figure 1), and that the ITPGRFA governs them as matters of property and rights, establishing continuity between the material, its dematerialization, and its rematerialization. From a posthuman perspective, I also highlighted the limits of a state centered model for governing these seeds and their digital counterparts, which, due to their rhizomatic nature and their co-evolutionary relationships with human communities, partly explain the choice of multilateral governance under the ITPGRFA, as well as proposals to manage them as commons (Frison 2018).

237. The final part of the thesis followed my hypotheses (RH3a–c) and proposed a cosmopolitical approach to law, based on the assumption that international law may function as a space of ontological politics and may be interpreted through other knowledge systems. I argued for this cosmopolitical interpretation by drawing both on tools of positive law and on posthuman approaches, notably through the metaphor of ruins. Applied to the ITPGRFA, this metaphor assumed its ambivalence: the Treaty was approached in its erosion, effacement, and fragmentation, but at the same time as a source of resurgence through its potential to be reinvested and reinterpreted via other ontologies and relations. I also justified this cosmopolitical interpretation by highlighting several elements within the regime complex that invite meaningful dialogue between knowledge systems. I thus identified as indicators the recognition of spiritual or social dimensions within the definition of "actual or potential value" of PGRFA (WG-ABS 2009, 2010), their "economic and/or social interest" (IU, Art. 1), the

stated objective that Indigenous Knowledge Systems be "valued, considered essential and given the same respect" (CBD/COP/DEC/16/4), as well as the reference noting that, "in some world views, all natural genetic information belongs to Mother Earth" (CBD/COP/DEC/16/2).

238. This cosmopolitical exercise was made possible through a collaborative research project aimed at interpreting the ITPGRFA, relying on the testimonies of Kahehtoktha Janice Brant, co-founder of the Kenhteke Seed Sanctuary & Learning Centre. This collaborative work, Paper 12, highlighted the holistic dimensions of seeds, linking humans and seeds, communities and ancestors, and extending beyond the physical to the metaphysical, immaterial, and spiritual. These holistic relations are recalled and reinforced by the Wampum Belt "Passing the Seed," discussed here in relation to the notion of rooted constitutionalism (Mills 2016). This Wampum Belt was woven as a marker of commitment to preserving holistic relations between humans and seeds across generations, and to ensuring the transmission not only of physical seeds, but also of the knowledge, cultures, cosmologies, and songs necessary to sustain these relations. These holistic relations between humans and seeds, interpreted here in a more embodied manner through the testimonies of Kahehtoktha and the analysis of the Seed Wampum Belt, are essential to enriching the objectives of the ITPGRFA, particularly in defining the value of PGRFA in a holistic way that links their physical, immaterial, social and spiritual dimensions.

239. These relations between humans and seeds are not new; they have existed and persisted alongside a state-centered international law that treats them as passive "resources" to be governed. For this reason, relations between humans and seeds must be recalled with even greater force at moments when they are deliberately ignored by reductionist scientific approaches and techno-centric debates on DSI. These relationships can be reaffirmed by relying on elements already present in positive law that remain open to ontological politics. Beyond a purely doctrinal approach, these relations may also be recalled by reference to the original objectives of fairness and equity of the ITPGRFA and to the ambitions of farmers' rights, which aim to preserve relationships between farmers and seeds (whether material or immaterial) while safeguarding knowledge systems and ensuring a voice for farmers in decision-making. Finally, if this path is considered relevant, these relations may also be recalled through a cosmopolitical and relational approach to law, and through the "rights of relations," to imagine legal narratives better able to visualize, represent, and defend ecological, social, and epistemic relationships.

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List of definitions

"**Commoning**" or "the **commons**" refers to the practice of collective self-organization and sustainable management of resources by community users who possess the capacity to self-organize. It offers models of sustainability grounded in regeneration rather than extraction (Ostrom 1990; Frison 2012).

"**Cosmopolitical approach to law**" compels jurists to act neither freely nor arbitrarily, but creatively and responsibly within the constraints of law's own mode of existence, including its procedures, precedents, and requirements of justification (Stengers and de Sutter 2004). Taken up in this thesis, this conceives law as a space of becoming, capable of accommodating other ontologies and other languages of justice, without being limited a priori by pre-established doctrinal paths.

"Digital Sequence Information" (DSI) is a placeholder term under the CBD, used to refer to dematerialized data derived from genetic resources, for which several alternative terminologies have been proposed. Its scope remains indeterminate, as it may *stricto sensu* comprise DNA and RNA (thereby being equivalent to GSD), while *lato sensu* it may encompass proteins, **metabolites**, or even other phenotypic, structural, and metadata information, as well as traditional knowledge. The definition of DSI lies at the heart of epistemological tensions concerning the types of knowledge that are recognized, the epistemic criteria used to select the data to be protected, and, more broadly, debates regarding its inclusion within ABS systems (Paper V; Oguamanam 2022).

"**Epistemology**" in its philosophical sense, as examines how valid scientific knowledge is constructed, including its foundations, assumptions, methods, and evolution.

"**Epistocracy**" combines *episteme* (knowledge) and *cratos* (power). It follows a dualist ontology in which political legitimacy is granted to knowledge holders, who are thus seen as better placed to propose "rational" and "objective" political solutions that are detached from any subjective political cleavages (Viala 2022; 2024). The thesis identifies epistocracy with its concrete discourses through "technical/scientific narratives."

"**Extractivism**" in "academia refers to the practices and dynamics of exploiting knowledge and resources from marginalized or less powerful communities, often without adequate reciprocity or benefit to those communities" (UAntwerp 2021).

"**Fair and Equitable Benefit-Sharing":** Established initially under the CBD as a form of compensation for access to genetic resources, this principle ensures that the benefits arising from the use of plant genetic resources are shared fairly and equitably. This includes the redistribution of both monetary and non-monetary benefits, access to technology, capacity-building, and the sharing of scientific knowledge (CBD, Art. 15).

"**Farmers' Rights**": Internationally recognized by the ITPGRFA, Farmers' Rights acknowledge and protect the contributions of farmers in conserving, improving, and making available plant genetic resources. The ITPGRFA recognizes Farmers' Rights to protect their traditional knowledge related to plant genetic resources, participate in benefit-sharing and in decision-making related to these resources, and indirectly the right to save, use, exchange, and sell farm-saved seed and propagating material. However, the effective implementation of these rights is left to the discretion of Contracting Parties (ITGRFA, Art. 9).

"**Genetic material**" means any material of plant origin, including reproductive and vegetative propagating material, containing functional units of heredity (ITPGRFA, Art. 2).

"**Genetic Sequence Data**" (GSD) means the order of nucleotides found in a molecule of DNA or RNA. (PIP Framework, Art. 4.2)

"**Genetically Modified Organism**" (GMO) means an organism, with the exception of human beings, in which the genetic material has been altered in a way that does not occur naturally by mating and/or natural recombination (Directive 2001/18/EC).

"**Global law**" refers to sets of mechanisms and technical instruments that are normative without being recognized as law in the strict sense.

"**Great Divide**" refers to a social distribution that separates, on the one hand, what is deemed debatable, including politics, values, and subjects, and, on the other hand, what is presented as indisputable, namely science, facts, and objects (Latour 2004).

"**Hybrids**" result from a modern "misunderstanding" and designate entities that are neither purely objects nor purely subjects, and therefore cannot be reduced to either category. They articulate themselves through multiple determinations involving both human and non-human agencies. Hybrid issues extend well beyond purely technical aspects and are taken up by heterogeneous actors with divergent interests and obligations, depending on their axiological, ontological, and epistemological frameworks (Stengers 2015; Latour 2004).

"**Legal positivism**" conceives of law as an autonomous system of formal rules, independent from moral, political, or social values. In the positivist traditions developed in the nineteenth century, the science of law is primarily associated with the theories of Kelsen (1962), whose ambition was to elaborate a "pure" theory science of law, autonomous from other disciplines. The science of law is thus presented as objective and neutral, according to a claim of axiological neutrality.

"**Modern Science**" designates set of knowledge about an object and a subject of study, produced according to specific methods associated with the positivist moment of the Vienna Circle, through empirical analyses of facts and logical inferences. It is grounded in ontological postulates that separate nature from culture and claims to provide objective, universal, value-free truths external to the social world. Modern science integrates, in parallel, a series of

disqualifications and purifications, excluding values, socio-political contexts, positionality, and other forms of knowledge (Whitt 2009; Debaise and Stengers 2023).

"Modes of existence" refer to specific ways in which beings come to exist, persist, and matter through particular practices, constraints, ontological obligations, and conditions of felicity. Practices are forms of engagement that bind practitioners to specific obligations, hesitations, and responsibilities. To "do law" or to "do science" is to submit oneself to the internal constraints of a practice, including its rules, rituals, standards of success, and modes of accountability (Stengers and de Sutter 2004; Latour 2013). These practices must not be hierarchized or conflated, at the risk of committing category mistakes.

"**Multilateral System of Access and Benefit-Sharing**" is established under the ITPGRFA to facilitate access to plant genetic resources. Unlike the bilateral system under the CBD, where ABS conditions must be bilaterally negotiated, the Multilateral System functions as a common pool of plant genetic resources listed in Annex I of the ITPGRFA. It establishes standard conditions for users through the Standard Material Transfer Agreement, which facilitates access, and benefit-sharing is organized through a Benefit-Sharing Fund (Frison 2018).

"**Naturalism**" or "**Dualism**," according to Descola, is a modern Western ontology that separates nature from culture, isolating humans from non-humans due to their distinct interiorities, moral dispositions, and cognitive capacities. This framework allows humans to withdraw from or externalize themselves in relation to nature (Descola 2014).

"**New Genomic Techniques (NGT) plant**" means a genetically modified plant obtained by targeted mutagenesis or cisgenesis, or a combination thereof, provided that it does not contain any genetic material originating from outside the breeders' gene pool that may have been temporarily inserted during the development of the NGT plant (NGT Proposal 2023). The NGT Proposal introduces Category 1 NGT plants, which meet criteria of equivalence with conventional plants and are therefore subject to a lighter regulatory regime (NGT Proposal 2023, Annex I).

"**Ontological cuts**" are a methodological tool associated with posthuman theory (Arvidsson 2024). Drawing on the notions of individuation (Simondon 2005) and becoming (Deleuze and Guattari 1980), Barad (2007) argues that neither subjects nor objects exist as "readymade" entities. Rather, they emerge through processes of individuation and becoming, in which they are "cut" through knowledge practices, discourses, and categorizations. These "cuts" are performative, by delineating what counts as natural, cultural, material, immaterial, factual, or normative. This thesis uses the concept of "ontological cuts" to critically analyze how science is mobilized by states as a justification to produce such cuts, for example between facts and values, nature and culture, or the physical and the immaterial (Paper 11).

"**Ontology of law**" addresses the nature and existence of law as such. It examines, for example, with the conditions of validity that allow a rule to be regarded as law: by which actors it is produced, according to which procedures, and according to which methods specific to law.

Depending on legal orders, their traditions, methodologies, or approaches to law, disagreements may therefore arise regarding the ontology of law.

"**Ontology**" refers to the study of the nature of being or reality within a given system, that is, the ways in which worlds and the properties of existents are configured, serving as distinct anchoring points for cosmologies, theories of identity and otherness, and models of social bonds. These ontologies are expressed through concrete practices, as well as stories and narratives (Descola 2014; Escobar 2018).

"**Plant genetic resources for food and agriculture**" means any genetic material of plant origin of actual or potential value for food and agriculture (ITPGRFA, Art. 2).

"**Posthuman Critical Theory**" lies at the intersection of critiques of Western humanism—given the discriminations and hierarchies it both overlooks and produces on the basis of gender, race, and class—and critiques of anthropocentrism, which position humans in relations of domination over non-human entities. These theories operate through a dialogue between these theoretical and critical genealogies, bringing them into convergence and generating chains of theoretical, social, and cultural effects that lead to qualitative leaps toward new conceptual directions (Braidotti 2018; 2019). As both a critical approach and a methodological approach, posthuman theories critique the assumptions embedded in international legal frameworks, particularly their claims to universalism despite hierarchies and domination between humans, and the fact that international law reproduces anthropocentric logics. At the same time, posthuman theories retain a constructive dimension, providing conceptual tools to imagine new legal constructs that allow international law to be thought in a more inclusive and virtuous manner, both in relation to humans and in relation to non-humans (Arvidsson and Jones 2024; Paper 11).

"**Regime of Truth**" refers to the corpus of rules and obligations that determine the procedures individuals must follow in order to gain access to truth within a given sphere, such as science, law, or politics. Each regime is characterized by its own criteria, practices, and instances of validation (Foucault 2014; Paper 1).

"Rights of relations" (and "**relational approach to**") are not a form of positive law, but rather an argumentative lens through which to defend human and non-human collectives on the basis of their relationships and interdependencies, instead of approaches that separate humans from nature. In this thesis, the relational approach is applied to knowledge, politics, and law. It seeks (i) to emancipate legal reasoning from the dualism between nature and culture, often hypostatized as universal; (ii) to identify a plurality of ontologies and relational continuities between humans and non-humans, whether existing, unexplored, marginalized, or potential; and (iii) to protect those ontologies, relations, experiences, and forms of knowledge that should not be discredited *a priori* through the application of positivist legal reasoning or technoscientific forms of knowledge.

"**Science (inclusive)**" as a set of collective and situated practices that produce reliable knowledge over time, while remaining open to correction, reflexivity, and pluriversality. It emphasizes trust within epistemic communities alongside critical attention to biases, underlying assumptions, and marginalized forms of knowledge, thereby allowing Indigenous knowledge systems and the knowledge of agricultural communities to be recognized as part of scientific knowledge production (Paper 6, 13).

"**Sovereign Rights over Genetic Resources**" is a principle of public international law affirming that states have the authority over access to genetic resources found within their jurisdictions, and that they can establish the terms and conditions for the sharing of benefits arising from their utilization (CBD, Art. 3, 15). This principle thus opposes approaches based on the common heritage of humanity for genetic resources.

"**Stabilization of ontologies**" refers to epistemic, social, cultural, and legal processes through which certain ontologies are rendered fixed, accepted, and administrable. In this research, such stabilizations emerge where positive law and positive science mutually reinforce each other, framing ontologies as settled while excluding alternative ones. Drawing on anthropologies of ontology and political ontology, this perspective understands realities as enacted through practices; since practices vary, they produce multiple, intersecting realities, giving rise to an ontology of multiplicity (Escobar 2018; Alexis 2023; Paper VII).

"**Traditional knowledge**": "refers to the knowledge, innovations and practices of indigenous and local communities around the world. Developed from experience gained over the centuries and adapted to the local culture and environment, traditional knowledge is transmitted orally from generation to generation. It tends to be collectively owned and takes the form of stories, songs, folklore, proverbs, cultural values, beliefs, rituals, community laws, local language, and agricultural practices, including the development of plant species and animal breeds. Sometimes it is referred to as an oral traditional for it is practiced, sung, danced, painted, carved, chanted and performed down through millennia. Traditional knowledge is mainly of a practical nature, particularly in such fields as agriculture, fisheries, health, horticulture, forestry and environmental management in general" (CBD, Art. 8(j); CBD 2021).

In this thesis, traditional knowledge is approached through its legal definition, while the term "**Indigenous Knowledge Systems**" is preferred in analytical contexts in order to capture the ontological, spiritual, and communal embeddedness of these living knowledge systems within Indigenous peoples' relationships to their territories. This choice also reflects the understanding that no single definition can fully capture their complexity, and that such knowledge systems may be distorted or misrepresented when translated into the categories and methods of modern science (Battiste and Henderson 2000; Oguamanam, 2006).