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Governing the Bioeconomy: What Role for International Institutions?

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Abstract: With increasing globalisation of bioresource use, expanding trade in bio-based products, and transboundary environmental impacts, distinct international dimensions arise in the governance of the bioeconomy. These international dimensions suggest that—despite bioeconomy strategies being largely national endeavours thus far—increased international cooperation and collaboration on the emerging bioeconomy is warranted. This paper looks at the global environmental governance landscape and investigates which fora, institutions, and processes might support and strengthen the international governance of bioeconomy pathways. The paper focuses on institutions that work in a cross-sectoral manner and is, to our knowledge, a first attempt at this exploration in the bioeconomy literature. Thus, the paper aims at increasing our understanding of how global bioeconomy pathways are governed and which venues of cooperation could play a more important role in the future. Based on a focused literature review, stakeholder engagement and semi-structured interviews with bioeconomy experts, we observe that, while there are many institutions playing a role in global bioeconomy governance, several barriers remain. We propose that regional cooperation might be a promising way forward to address common challenges and opportunities.

Keywords: bioeconomy; governance; regional cooperation



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1. Introduction: Envisioning the Bioeconomy

The notion of the bioeconomy arose from different theoretical and applied research, especially in the field of ecological economics that envisioned a shift to a zero-waste economy based on biological processes and renewable resources [1–3]. As bioeconomy has evolved from theory to action, different conceptualisations or *visions* have emerged [4]. A *bio-technology* vision emphasises job creation and economic growth through research and commercialisation of bio-technologies; a *bio-resource* vision focuses on the potential of upgrading and converting biological raw materials; and a *bio-ecology* vision highlights the importance of preserving biodiversity, conserving eco-systems and promoting re-use, recycling, and waste management [4].

The case of genetically modified organisms (GMO) illustrates one difference between the three visions. Bio-technology and bio-resource visions would see the use of GMOs as a possible strategy for making progress on a bioeconomy, whereas the bio-ecology vision would normally rule out pathways based on GMOs [4]. Similarly, Issa et al. (2019) point out that stakeholder preferences of what a bioeconomy should achieve differ significantly for experts from low income countries compared to those from high income countries [5]. At the same time, empirical evidence suggests that some broad societal goals, such as sustainable consumption, biodiversity preservation, or increased income for farmers, are widely emphasised across stakeholder groups in different world regions and also apply across the three bioeconomy visions [6,7].

As of 2020, more than 40 countries and regions have adopted bioeconomy strategies, each emphasising different approaches or pathways [8]. This situation is rendered more complex due to the lack of a universally accepted definition of the bioeconomy (Expert

Interview_02). In recent years, there has been convergence towards a transformative, cross-cutting view of the bioeconomy that is widely applicable in developed and developing regions alike [9,10]. These views transcend sector-based approaches and seek a broader long-term societal transformation towards biological processes and bio-based systems [8]. The Global Bioeconomy Summit defines bioeconomy as ‘the production, utilization and conservation of biological resources, including related knowledge, science, technology, and innovation, to provide information, products, processes and services across all economic sectors aiming toward a sustainable economy [11,12].

This interdisciplinary view in combination with varying stakeholder visions and the current emphasis on national bioeconomy strategies presents new governance challenges [9,13]. Indeed, despite being mostly national in outlook, bioresource use and bioeconomy strategies have international ramifications. For instance, trade in biomass for energy usage is estimated to have increased from 785 peta joule (PJ) in 2004 to 1250 PJ in 2015 [14]. Animal feed markets (sourced from soya and other crops) are the leading driver of phosphorous trade, which contributes to resource depletion and freshwater eutrophication [15]. This paper investigates how evolving challenges in bioeconomy pathways are—or could be—governed at the global level. We map several institutions and international processes that already play a role in global bioeconomy governance and analyse their strengths and weaknesses. To our knowledge, this is the first attempt at such a mapping that adopts the cross-cutting and interdisciplinary perspective on bioeconomy. Thus, we go beyond existing literature on bioeconomy governance that investigates either specific governance instruments, such as national bioeconomy strategies [16,17], is more normative in nature [9,18], or focuses on specific sectors or aspects of bioeconomy governance, such as bioenergy [19] or forests [20].

The paper is structured as follows: Section 2 reviews arguments for and against more international bioeconomy governance; Section 3 describes the approach and methodology; Section 4 looks at which international fora, institutions, and processes could help to strengthen international bioeconomy governance; and Section 5 elaborates on the regional approach to bioeconomy governance. Section 6 offers conclusions.

2. International Governance of Bioeconomy Issues: Does It Make Sense?

In this paper, we interpret governance—a concept subject to considerable scholarly debate [21–24]—as being a less hierarchical, more networked form of steering society [25,26] as compared to traditional policy making [21]. Moreover, governance is a concept where both private and public sector stakeholders engage in the steering process by using a variety of governance instruments [27] and by fulfilling several different functions, like standard- or agenda setting [28]. While scholars also point out that governance can be exercised on different levels, particularly in the EU [29], this paper is mostly concerned with international and transnational governance [30]. Furthermore, we take a liberal institutionalist perspective of global governance and use the concept as observable phenomenon [31], despite the fact that the concept of governance itself can carry normative meanings, particularly when used in the context of a neo-liberal world order where “good governance” is often equated with less state interference [23,24]. Furthermore, this article does not seek to assess whether international institutions should increase their involvement in bioeconomy pathways but, instead, seeks to assess the strong and weak points of each institution already involved in global bioeconomy governance. Our international perspective is important considering the tendency towards steering bioeconomies at the national level and the common view that biomass should be sourced and used locally (as argued by a bio-ecology vision for bioeconomy) [4]. Similarly, governing bioeconomy pathways at the national level might be seen as more appropriate, due to the wide variation in the focus and objectives of bioeconomy strategies in different countries (Expert Interview_03), thus making international agreement on core issues more difficult (International Environmental Agreements are often linked to transboundary impacts that result in mutual incentives for international cooperation when potential damages outweigh the costs of participation, although stability

in such cooperation tends to rely on significant gains or avoided damage, such as is the case with climate change [32]).

However, the transboundary impacts and risks of bioeconomy pathways, such as land use changes associated with the increased international trade of biomass or bioenergy, may give rise to a need for International Agreements or other international governance structures. Other possible transboundary impacts include competition between food and non-food crops (i.e., biomass for food, feed, fuel, fibre, etc.) for land, water, and nutrients, which may negatively impact biodiversity or food security [33,34]. These impacts are more likely in traditional sector-based policies, whereas the cross-cutting or cross-sector approach adopted in a bioeconomy perspective offers some means of reducing risks but at the same time requires international cooperation and cross-regional learning [35,36].

Indeed, public and private governance mechanisms at the national level for bioenergy and bioeconomy will often need to be complemented by—rather than replaced by—international governance [37]. As more states increasingly embrace the bioeconomy concept, enhanced international cooperation in the fields of Research and Development (R&D) might be warranted to facilitate the exchange of best practices and knowledge [38], which was also emphasised by the last Global Bioeconomy Summit [39].

3. Methodology and Analytical Framework

We first carried out a focused literature review of academic literature, emphasising the core issues related to governance of the bioeconomy. We adopted the categories of market/economic governance, knowledge governance, informational governance, and commitment or agenda-setting governance. We also conducted a review of “grey” literature around those initiatives, organisations and processes that had some focus on bioeconomy in the cross-cutting sense that we use in this paper; consequently, we emphasised those institutions that work across sectors and applications as opposed to those concentrated within one economic sector.

Our approach benefitted from related efforts carried out within the Stockholm Environment Institute (SEI) initiative on Governing Bioeconomy Pathways, especially through policy dialogues on bioeconomy pathways that were carried out in 2019 in Estonia, Colombia, and Thailand [6,40]. These policy dialogues emphasised local and national priorities and targets in terms of future bioeconomy pathways but also aimed to identify longer-term barriers within the global context with respect to policies, institutions, and governance, thus recognising the evolving international implications of global markets for bioresources and biotechnologies. By choosing a fairly broad group of well-informed stakeholders from both public and private organisations in these dialogues, we also aimed to complement the literature review by widening and deepening the understanding around policy and practice on the ground.

Our literature review and the ongoing dialogue with stakeholders allowed us to identify knowledge gaps and key perspectives that might benefit from the elicitation of expert opinions to help to deepen the analysis and improve our characterisation of bioeconomy-relevant international institutions. We identified a small group of bioeconomy experts from different types of organisations, with whom a series of semi-structured interviews were held in late 2019. The interviews were designed so as to complement the literature review and stakeholder engagement in order to reconcile the evidence base in published literature with the bioeconomy developments viewed by practitioners and policy-makers. Eight experts were interviewed over the phone, while one respondent chose to submit answers to our questionnaire in written form. An anonymised list of respondents can be found in Appendix A. Based on this initial review, the interviews, and the stakeholder engagement process, we then mapped international institutions, fora, and processes that could drive forward international governance of bioeconomy pathways. We applied the following amended framework taken from the governance literature to frame our mapping exercise.

Firstly, we focus on international, transnational, and supra-national governance institutions and organisations. As noted, we limit the choice to institutions that are able to tackle bioeconomy governance issues in a cross-sectoral manner, thus excluding institutions focused on only one sector (i.e., forestry, agriculture, energy). Our analysis, therefore, employs the cross-cutting or cross-sectoral lens on the bioeconomy, which is distinguished from both sectoral assessments, as well as more general notions, of natural resource management [13,39].

Second, we categorised our institutions using frameworks synthesised from the literature on governance instruments and functions. Mapping of existing global governance frameworks using a set of governance functions as a unit of analysis in assessing strengths and weaknesses is well-established in the governance literature [41–43]. We, therefore, grouped our institutions into *market and economic governance* (adapted from [27]), *knowledge governance* [44], *informational governance* (adapted from [27]), and *commitment and agenda setting governance* [45].

We understand *market and economic governance* as creating or expanding markets or market-based systems for bio-based or bio-related technologies. We differentiate between *knowledge governance* and *informational governance* in that, while the former focuses on research, innovation, and development, the latter focuses on standard setting, monitoring, and verification. We use the *commitment and agenda setting governance* category to characterise international regimes, such as the UN conventions. Moreover, we do not include finance, even though it has been analysed as a function of governance [45]. We argue that, while finance decisions are important in steering society, international finance institutions govern bioeconomy pathways only indirectly. Furthermore, the proliferation of sustainable finance mechanisms means that this category would require a separate analysis. We also exclude Non-Governmental Organisations (NGOs), as their involvement in governance functions is often broad and/or persuasive in nature [46]. Such functions are outside the scope of this analysis.

4. What International Fora Are There?

Based on our framework, literature review and expert interviews, we map the different institutions that already play a role in the governance of bioeconomy pathways—or those that could, in principle, play such a role. This list is not exhaustive, but an initial mapping exercise for the purpose of illustrating how international governance of bioeconomy pathways might be further analysed and/or strengthened in practice. International institutions and their mandates are usually not as clear-cut as theoretical frameworks would suggest; therefore, several of the institutions listed below could fall under multiple categories, and the table below, thus, reflects our judgement of the primary emphasis in their governance functions. Table 1 gives a brief overview of the organisations and institutions that were included.

Table 1. International institutions relevant for the governance of bioeconomy pathways.

Market and Economic	Knowledge	Informational	Commitment and Agenda
	Biofuture Platform		
WTO	Global Bioeconomy Council	Round Table on Sustainable Biomaterials (RSB)	Convention on Biological Diversity (CBD)
OECD	Food and Agriculture Organisation (FAO)	The Global Bioenergy Partnership (GBEP)	Convention to Combat Desertification (UNCCD) [47]
UNCTAD	UNDP, UNEP	International Organisation for Standardisation (ISO)	United Nations Framework Convention on Climate Change (UNFCCC)
G20, G7	World Intellectual Property Organisation (WIPO)		
	International Bioeconomy Forum (IBF)		

4.1. Market and Economic Governance

Although some scholars observe a general lack of research on the overall economic impact of transitions to bioeconomies [48,49], it is also clear that many visions of a bioeconomy emphasise economic gains and job creation potential [48]. Interviewed experts also argued that international trade (and the governance thereof) could be a viable channel to address potential conflicts related to food security and land-use (Expert interview_02), and several experts mentioned the need for a more market-driven approach (Expert Interview_04; Expert Interview_05) to bioeconomy pathways, particularly since private sector players were, according to experts, currently more in favour of international cooperation than public stakeholders (Expert Interview_05).

4.1.1. The Gs (G7 G20)

The Groups of Seven (G7) and Twenty (G20) are high-level political fora where leaders of the most powerful nations (The G20 represent almost 90% of global GDP and 80% of international trade) meet at regular intervals to exchange viewpoints and confer on pressing global issues [50]. Both institutions include nations that have bioeconomy strategies in place. All G7 nations formulated bioeconomy strategies [39], but no systematic engagement on the issue has taken place during G7 meetings. In the same vein, the G20 acknowledge the concept of a bioeconomy in some documents [51] (G20 Meeting of Agriculture Ministers 2018) or address related topics, such as food security [52], but, in general bioeconomy, has yet to capture the continuous attention of Member States.

Scholars often argue that institutions, like the G7 or G20, could play a more concrete role in governing environmental issues. In literature on climate change governance, for instance, groupings, such as G7 and G20, are referred to as examples of ‘clubs’ that drive action on climate change forward beyond official UNFCCC processes [53]. Scholars emphasise the clubs’ convening and coalition building power to tackle issues, such as fossil fuel subsidies [54,55], an issue discussed prominently in past meetings [56], which could help bioeconomy pathways by levelling the playing field for bio-based products (Expert Interview_08). Here, economic governance clearly meets agenda setting governance. However, other scholars are less optimistic and point to the need for reform of these institutions to reflect a changing (geo) political landscape [57]. Furthermore, despite having a lot of convening power, the G7 or G20 cannot adopt binding rules, and their limited memberships would constrain their effectiveness for bioeconomy issues.

4.1.2. The World Trade Organisation (WTO)

One of the main objectives of the WTO is to set up a forum where nations can discuss and deal with rules of global trade in order for trade to flow as “smoothly, predictably and freely as possible” [58]. Unlike the G7 and the G20, the WTO has a mandate to directly govern trade and economic issues. However, recent developments have put the WTO-based trade system under stress. Current rounds of trade liberalisation negotiations have been declared “dead” multiple times [59,60], while regional and/or bilateral trade agreements, such as CETA (a trade agreement between Canada and the EU Member States), have fragmented the international trade system [61]. Alternatively, bilateral agreements have under-utilised potential; for example, the enforcement of sustainability standards requires institutional capacity-building that the EU with its long experience could provide to developing economies [62]. (Johnson and Westberg 2013).

Some unresolved issues holding back negotiations have direct impact on bioeconomy pathways. For instance, subsidies for renewable energy (admissible only under certain circumstances) have come under scrutiny, leading to challenges under WTO law [63,64]. Furthermore, while international trade can be mutually beneficial, several impacts on sectors relevant for bioeconomy are still disputed. For example, exposing developing countries’ agricultural sector to more free trade might affect not only their economies but also their food security [65], and not always positively. In the same vein, clean technology trans-

fer might be facilitated by low tariffs, but intellectual property rights might be infringed upon by increasing trade in biotechnologies, further straining the WTO system [61].

There is scope under the WTO to give preference to environmentally-preferred products which, in principle, could help level the playing field and expand the bioeconomy. However, because the most significant environmental sustainability impacts occur in the upstream part of the supply chain, i.e., in forestry, agriculture, and land use more generally, the impacts may be quite different, even for “like” products, an issue that already arose for biofuels sustainability criteria under the first EU Renewable Energy Directive, thus posing potential conflict with WTO mechanisms [66]. In a similar vein, domestic support, especially in the EU, for greenhouse gas (GHG) reductions in agriculture has moved into the WTO “Green Box” of allowed subsidies (the Green Box is the category where environmentally-based subsidies normally fall) and can be seen as stimulating innovation in the bioeconomy through competition for safer and more climate-friendly products [67].

At the same time, bio-based products are increasingly traded across borders and their share in world trade has increased from 10% in 2007 to 13% in 2014 [9]. This might be why interviewed experts still see a role for the WTO to address issues, such as food security and land-use change via international trade agreements (Expert Interview_02). In the same vein, experts opined that a harmonisation of international trade rules when it comes to biomass and bioproducts might be useful for the advancement of bioeconomy pathways (Expert Interview_08). Moreover, an interesting argument made was to treat unenforced environmental regulations (such as ignored or not enforced environmental protection provisions in the sectors relevant to bioeconomy pathways, such as forestry) as indirect subsidies under WTO law. By challenging these indirect subsidies as illegal under WTO law, environmental regulation and governance could be strengthened (Expert Interview_02).

4.1.3. United Nations Conference on Trade and Development (UNCTAD)

The United Nations Conference on Trade and Development (UNCTAD) is a permanent intergovernmental body which aims to help developing countries benefit from international trade [68]. According to experts, the three main sectors of activity of UNCTAD are (a) research and analysis, (b) consensus building, and (c) technical assistance (Expert Interview_04). Quite interestingly, UNCTAD was initiated by developing countries, many of which felt that trade rules at the time were unfavourable to them [69].

UNCTAD has had several initiatives related to bioeconomy. Its biofuels initiative produced numerous reports between 2005 and 2016 and worked with the UN’s ‘Sustainable Energy For All’ programme [70]. To support the Convention of Biological Diversity (CBD), UNCTAD also has a ‘bio trade’ initiative which itself manages the ‘Linking Trade, Biodiversity and Sustainable Development Programme’ (financed largely by the Swiss government), a work stream on the circular economy and a research initiative on ‘Sustainable Manufacturing and Environmental Pollution (SMEP)’, financed by UK’s Department for International Development (DFID) [71].

UNCTAD could be an interesting venue to explore international bioeconomy issues and their governance further, particularly since the institution has credibility to bring developing country perspectives on these issues to the fore. Its near universal membership is also an asset. Moreover, a Memorandum of Understanding (MoU) links UNCTAD with the WTO, which could make UNCTAD a more productive forum to tackle global trade issues concerning bio-based products rather than negotiating those issues within the WTO framework.

4.1.4. The Organisation for Economic Co-operation and Development (OECD)

The OECD, an intergovernmental organisation, is quite difficult to define [72,73]. Although its main focus is on economic challenges [72], the OECD works on many other issues, such as education or climate change, thus crossing over into knowledge and informational governance. Although the organisation has a complex structure of working groups, committees and ministerial meetings, policy suggestions elaborated in those fora can easily

become national policies due to the high level of the people involved [72]. In addition, and thanks to the OECD's membership of rather influential nations, its policy recommendations are more likely to become international standards, which could streamline approaches to the bioeconomy.

Indeed, the OECD developed its own comprehensive bioeconomy strategy, akin to that of the EU. The document 'The Bioeconomy to 2030: designing a policy agenda' reveals that the OECD's strategy is primarily focused on the contributions of biotechnology to economic activity [74]. Moreover, the OECD's specialised agency on energy matters, the International Energy Agency (IEA), regularly publishes roadmaps and assessments of bioeconomy relevant sectors, policies, and technologies, most notably via its specialised tasks under the umbrella of IEA Bioenergy (<https://www.ieabioenergy.com/>). However, a significant share of its efforts are sector-based rather than cross-cutting, focusing on agriculture or forestry, as well as energy [75].

4.1.5. Assessment

The economic or market governance of bioeconomy pathways faces several challenges. While several institutions have bioeconomy strategies or bioeconomy pathways on their agenda, the current climate seems less conducive for them to pursue multilateralism and enhanced international governance. The G7 and G20 have been somewhat divisive in recent years due in part to the unilateralism of the current U.S. administration. The same holds true for the WTO, which seems to be stymied in disputes and fragmented by regional trade deals. Other institutions, such as UNCTAD, seem to be more promising to move the bioeconomy agenda forward, thanks to its neutral convening power (Expert Interview_04, Expert Interview_03), but, like many other UN agencies, UNCTAD was assessed as being weakened by cumbersome bureaucracy (Expert Interview_04). When it comes to the OECD, it is clear that the organisation has a track record on bioeconomy governance, albeit steeped in the biotechnology vision [74]. Furthermore, the limited membership might pose challenges in terms of equity, representativeness and, importantly, accountability. Table 2 summarises the main findings of this section.

Table 2. Institutions for the economic and market governance of bioeconomy pathways.

Institution	Existing Structures in Place Relevant to the Bioeconomy	Potential Future Role in International Governance	Shortcomings and Challenges
WTO	<ul style="list-style-type: none"> No specific strategies, but have mandate and authority to play important role in economic and market governance 	<ul style="list-style-type: none"> Address issues of food security and land use change via international trade agreements Harmonisation of trade rules for biomass and bioproducts Potentially treat unenforced environmental regulations as indirect subsidies under WTO, thus strengthening environmental governance 	<ul style="list-style-type: none"> Implications of WTO law, e.g., impacts of free trade within agricultural sector impacting food security in developing countries decreasing appetite for multilateralism
OECD	<ul style="list-style-type: none"> Comprehensive bioeconomy strategy in place IEA regularly publishes roadmaps and assessments of bioeconomy policies and technologies 	<ul style="list-style-type: none"> elaborated policy recommendations to become international standards 	<ul style="list-style-type: none"> Limited membership Limited accountability

Table 2. Cont.

Institution	Existing Structures in Place Relevant to the Bioeconomy	Potential Future Role in International Governance	Shortcomings and Challenges
UNCTAD	<ul style="list-style-type: none"> Biofuels initiative Bio trade initiative 	<ul style="list-style-type: none"> Has credibility to champion developing country perspectives Convening power under neutral flag MoU linking UNCTAD with WTO providing potential for dealing with global trade issues relating to bio-based products 	<ul style="list-style-type: none"> High levels of bureaucracy making progress difficult
G20, G7	<ul style="list-style-type: none"> Most member countries have bioeconomy strategies in place Acknowledgement of concept of bioeconomy by some G20 documents 	<ul style="list-style-type: none"> Potential to act as ‘clubs’ driving actions on delivering the bioeconomy forward Convening and coalition building power to tackle environmental issues 	<ul style="list-style-type: none"> Agenda of meetings often dictated by U.S. priorities Lack of continued systematic engagement on bioeconomy issues No mandate or authority to adopt operational decisions or binding regulation

4.2. Knowledge Governance

As mentioned above, we understand knowledge governance as the governance of knowledge, research, and innovation when it comes to bioeconomy pathways or in sectors important to the bioeconomy. We have identified several institutions that already engage in some sort of knowledge governance and which could, in principle, intensify such activities.

4.2.1. The Biofuture Platform

The Biofuture Platform, an inter-governmental body of 20 members, was launched at the UNFCCC climate conference COP22 at the initiative of the Brazilian government and has the goal of being an “[. . .] action-oriented, country-led, multi-stakeholder mechanism for policy dialogue and collaboration [. . .]” [76]. Besides countries, international organisations, such as the International Renewable Energy Agency (IRENA) and the Food and Agriculture Organisation (FAO), are also members, with the IEA now acting as the facilitator or secretariat. The stated goals of this initiative are, amongst others, to promote international collaboration on bioeconomy issues, to promote research, and to facilitate an enabling environment for bioeconomy related investments. Publications and events are tracked through its website, while the platform seems to focus on facilitating dialogues and fostering collaboration as opposed to deeper governance efforts. Nevertheless, experts see the platform as a promising forum on bioeconomy governance issues, given its inclusion of important biofuel producers, such as Brazil or Indonesia, and its mandate to potentially assume a more “hands on” approach to bioeconomy issues, such as monitoring (Expert Interview_05).

4.2.2. Global Bioeconomy Council

The Global Bioeconomy Council (GBC) is an advisory body to the German Federal Government. Since 2015, it has organised a high-level forum of policy makers, practitioners and research on bioeconomy issues, the Global Bioeconomy Summit (GBS), which brings together more than 700 stakeholders from 80 countries. According to a communiqué adopted at the end of the first gathering, the aim of the summit was to make the bioeconomy work for sustainable development and to establish an informal network to foster dialogue on bioeconomy issues [12]. During the following summit three years later, involved stakeholders clearly called for increasing cooperation on knowledge exchange and on stronger governance of bioeconomy pathways [77]. Guidance of the summit is

assured by an International Advisory Council (IAC) of experts, private sector players, scholars, and policy makers. The GBS is the only truly global gathering of its kind on bioeconomy in its broad transformational sense and could eventually help to stimulate action similar to the way side events at UN conferences might—see for instance Hjerpe and Linner’s paper on the usefulness of side-events during the UNFCCC COP gatherings [78]. However, international governance functions per se are not yet part of their mandate, and it is largely financed by one government.

4.2.3. The International Bioeconomy Forum

The International Bioeconomy Forum, launched in November 2017, and spearheaded by the European Commission and AgriFood Canada, aims to “[...] guide international cooperation on a limited number of Research and Innovation (R&I) priorities and horizontal activities which are crucial for the development of a global, sustainable bioeconomy and addressing related global challenges” [79]. Members of the forum include the USA, the EU, Canada, New Zealand, China, India, and observers, such as FAO, collaborating in different ad-hoc working groups.

The body focuses on the exchange of information and viewpoints on bioeconomy issues (Expert Interview_05), activities usually summarised under knowledge governance. It is organised along four working groups: Plant Health, Information and Communication Technology in Precision Food Systems, the Forest Bioeconomy, and Microbiomes. This endows it with a somewhat tighter focus than general platforms, like the GBC, and some experts see a potentially effective governing role for the International Bioeconomy Forum (IBF) for instance in the field of biomedical issues (Expert Interview_05).

4.2.4. The Food and Agriculture Organisation (FAO)

The UN system has a number of specialised agencies, such as UNESCO, WHO, or the International Maritime Organisation (IMO), (tasked by the Kyoto protocol to tackle emissions from maritime shipping [80], but, for issues directly related to bioeconomy pathways, the Food and Agriculture Organisation (FAO) certainly is well placed to explore governance of those issues. Established in 1945, the FAO works to help eliminate hunger, poverty and food insecurity, with the objective to make agriculture, forestry and fishery more sustainable [81]. The FAO has been active on bioeconomy and is one of the UN’s most “cross-cutting” agencies in terms of work areas (Expert Interview_05). In 2015, at the Global Forum for Food and Agriculture (GFFA), ministers of agriculture recommended that the FAO develop guidelines for a sustainable bioeconomy to support bioeconomy strategies [82]. Financed to a large extent by the German government, those guidelines are currently elaborated in cooperation with a group of 34 experts in the International Sustainable Bioeconomy Working Group (ISBWG), and are scheduled for release in 2021. Clearly, the FAO is engaged in knowledge governance, but, depending on their exact form, those guidelines could prove to be a more hierarchical form of governance. At the very least, those guidelines could be used voluntarily, thus presenting at least some form of soft standardisation. Moreover, since those guidelines will be validated through regional stakeholder meetings, the FAO is potentially playing a role in bioeconomy governance by building networks of stakeholders, thus participating in networked governance.

4.2.5. Special UN Programmes, UNDP and UNEP

The United Nations Environment Programme (UNEP) has the objective of promoting “international co-operation in the field of environment and to recommend, as appropriate, policies to this end [...]” (quoted by [83]). While the programme underwent some significant changes and suffers from underfunding and overstretching of its resources, scholars, nevertheless, credit the programme with a long track record of instigating, servicing and coordinating multilateral environmental agreements (MEA) [83]. Indeed, UNEP has had responsibility for the Convention on Biological Diversity (CBD) [84], the Vienna Conven-

tion for the Protection of the Ozone Layer, and the Montreal Protocol on Substances that Deplete the Ozone Layer [85].

When it comes to bioeconomy issues, UNEP has a programme focused on “green economy”, supported by the economic and fiscal policy unit, a green growth knowledge platform (GGKP) and the Environment and Trade Hub. However, the concept of a “green economy” has not been quite as widely accepted as the bioeconomy. Interviewed experts opined that the green economy idea could focus more on the policy aspects to “get the incentives” right, while the idea of a bioeconomy was a concept more rooted in science and technology (Expert Interview_02). Moreover, several aspects of the concept have been criticised as “greenwashing” of unsustainable practices, while others see the concept as more transformative and sustainable than critics admit [86]. Be that as it may, there are certainly overlaps in the concepts of green economy and bioeconomy [87]. UNEP is generally well-placed to play a role in governing knowledge-sharing aspects of the bioeconomy, such as by providing specific recommendations to stakeholders, as they already did for the green economy [88]. The UNEP DTIE programme, based in Paris, could also have some role related to technology transfer for bio-based technologies. However, in light of its increasingly complex mandates, there is a risk that UNEP’s institutional capacity can become overstretched [89].

The UNDP stems from the post-WWII effort to develop an international programme for technical assistance and development from industrialised to developing nations [90]. Its Administrator sits on the board of the UN Sustainable Development Group, which in turn links the UNDP to the UN 2030 Agenda and the UN Sustainable Development Goals (SDGs). Naturally, this agenda is closely related to issues important for the bioeconomy, such as clean energy access (SDG7) or food security (SDG2). Moreover, in 2012, the European Commission and UNDP launched the finance initiative BIOFIN to finance and support biodiversity (<https://www.biodiversityfinance.net/>). However, bioeconomy as a concept does not seem to be a UNDP priority. In addition, the programme’s main operationalisation role of channelling funding, building capacity, and supporting policy implementation does play a more downstream role compared to the more upstream role of governance and policy making.

4.2.6. The World Intellectual Property Organisation (WIPO)

As one of the UN’s specialised agencies, the WIPO’s role is to “[...] promote the protection of intellectual property throughout the world through cooperation among States and, where appropriate, in collaboration with any other international organization” (Article 3) (WIPO 1967) [91]. Unlike other UN agencies, the WIPO’s budget is significant and largely self-funded, stemming from administrative fees the organisation charges for trademark registration or patent applications [92]. WIPO also carries out administrative functions for several treaties on intellectual property rights, although the only one which allows for enforcement mechanisms, such as sanctions, the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), is administered by the WTO [92].

When it comes to bioeconomy issues, the WIPO is home to the WIPO GREEN platform which serves as a ‘market place’ for green technologies and offers, amongst other things, a searchable database of bioeconomy relevant technological solutions to connect technology providers with ‘technology seekers’ [93]. Moreover, patents and intellectual property rights (IPRs) are a relevant issue for bioeconomy pathways. On the one hand, strong intellectual property rights create a favourable business environment for innovation [94]. On the other hand, IPRs might have a negative impact on the transfer of technology from industrialised to less industrialised economies due to high costs for developing countries, restrictive patent rights, and lengthy licensing procedures [16,95]. Therefore, some scholars call for a revision of IPR rules and regulations [9].

4.2.7. Assessment

When it comes to knowledge governance, many institutions have recently started to work on bioeconomy pathways, and we have seen a proliferation of different initiatives. Indeed, experts laud these fora of dialogue and exchange particularly for a topic of complexity, such as bioeconomy. Moreover, the guidelines currently elaborated by the FAO might provide a valuable overarching framework. However, there are overlaps in terms of topics and working groups. In addition, it seems that organisations that would have an impactful mandate on knowledge governance, such as the WIPO, seem to be less involved in bioeconomy governance than they could, given the importance of patents for technology transfer and development of bio-based products, technologies, and processes. Furthermore, UN institutions, such as UNEP, seem to be stretched beyond capacity, which makes the increase of their governance of bioeconomy issues doubtful. Table 3 gives an overview.

Table 3. Institutions for the knowledge governance of bioeconomy pathways.

Institution	Existing Structures in Place Relevant to the Bioeconomy	Potential Future Role in International Governance	Shortcomings and Challenges
Biofuture Platform	<ul style="list-style-type: none"> Intergovernmental body promoting international collaboration and dialogue on bioeconomy issues Promote research and facilitate an enabling environment for bioeconomy related investments 	<ul style="list-style-type: none"> Promising forum for driving international governance due to inclusion of important biofuel producers (Brazil, Indonesia) and due to ambition to extend to bioeconomy 	<ul style="list-style-type: none"> Still focuses primarily on biofuels rather than broader bioeconomy Somewhat limited membership at national level and depends on each country's willingness to engage
Global Bioeconomy Council	<ul style="list-style-type: none"> Organises high-level forum bringing together stakeholders to foster dialogue 	<ul style="list-style-type: none"> Talks and meetings held could lead to more concrete measures and actions Ability to bring together 700+ stakeholders and enable participation from a range of sectors 	<ul style="list-style-type: none"> Mandate does not yet extend further than dialogue facilitation and conference organisation
FAO	<ul style="list-style-type: none"> Cross-cutting work Is currently developing guidelines for a sustainable bioeconomy Is host secretariat of initiatives, such as GBEP 	<ul style="list-style-type: none"> Could help countries formulate their bioeconomy strategies, providing soft standardisation Has a large network of relevant stakeholders 	<ul style="list-style-type: none"> Mandate does not extend further than dialogue facilitation
UNDP, UNEP	<ul style="list-style-type: none"> UNEP "green economy" programme, green growth knowledge platform and Environment & Trade Hub UNDP finance initiative (BIOFIN) to finance and support biodiversity 	<ul style="list-style-type: none"> potential role in governing knowledge sharing aspects of bioeconomy or providing recommendations UNEP DTIE programme could emphasise bio-based technologies and processes Convening power under the neutral flag of the UN 	<ul style="list-style-type: none"> UNEP concept of "green economy" somewhat vague UNEP's limited institutional capacity UNDP bioeconomy not a priority

Table 3. Cont.

Institution	Existing Structures in Place Relevant to the Bioeconomy	Potential Future Role in International Governance	Shortcomings and Challenges
WIPO	<ul style="list-style-type: none"> WIPO Green market place serves as a database and stakeholder engagement tool concerning technologies relevant for the bioeconomy Patents shape new biotechnologies 	<ul style="list-style-type: none"> Potential administrative function for treaties on patents and intellectual property rights (IPRs) Potential to build on current initiatives providing knowledge governance 	<ul style="list-style-type: none"> IPRs may have a negative impact on technology transfers to less industrialised (or low income) countries
IBF	<ul style="list-style-type: none"> Guide international cooperation for development of a global, sustainable bioeconomy and address global challenges Exchange of information and viewpoints on bioeconomy issues 	<ul style="list-style-type: none"> Continued knowledge governance role Potential governance role in field of biomedical issues 	<ul style="list-style-type: none"> May be limited to softer forms of governance Relation to, and redundancy with, other bioeconomy platforms, is not always clear

4.3. Informational Governance

As described in our methodology, we differentiate informational governance from knowledge governance. While the former category concerns institutions in the fields of research, innovation, and development, we understand informational governance as being more about labels, standards, and information about performance, thus putting it close to the issue of monitoring, reporting, and verification (MRV), which is a common approach in international governance, especially in relation to climate change, conservation, and natural resources.

4.3.1. The Global Bioenergy Partnership (GBEP)

Launched in 2005, this partnership brings together countries, including those of the G8 (plus Brazil, China, India, Mexico, and South Africa), with stakeholders from UN agencies (FAO) and programmes (UNEP, UNDP), as well as international organisations, such as the IEA or the World Council of Renewable Energy (WCER) [96]. In total, the partners include 23 countries and 15 organisations, with the objectives to promote dialogue and cooperation on research and innovation but also to facilitate demonstration projects and advise policy makers [97]. While the membership seems limited, the partnership itself aims to cover the large majority of bioenergy and biofuels production [98]. The FAO acts as secretariat, while a steering committee and a technical working group manage three task forces on sustainability, methodologies (GHG accounting), and capacity building.

Besides bringing stakeholders together, the GBEP also offers several toolkits, such as methodological documents for GHG accounting or a searchable database for bioenergy funding. Moreover, in 2011, the organisation published a set of 24 sustainability indicators with a number of countries having tested those indicators since then [99]. Although GBEP is focused on energy and, thus, does not easily meet the cross-cutting criteria for bioeconomy, their multi-faceted emphasis on climate change and food security leads to interactions across multiple sectors, nonetheless; thus, its informational governance functions are relevant from a bioeconomy perspective.

4.3.2. Roundtable for Sustainable Biomaterials (RSB)

The RSB is a private sector led initiative, bringing together academics, NGOs, and business partners. It emerged from the Roundtable for Sustainable Biofuels, which was subsequently enlarged to include non-energy products (Expert Interview_04). This expansion of the RSB recognised the many interactions between energy and non-energy uses of land

and biomass. The RSB organises annual stakeholder meetings and works through different working groups on many issues related to bioeconomy pathways, such as land-use or biofuels. Besides engaging in this knowledge governance function, RSB also issues its own sustainability certificates for sustainably produced biomass and offers advice to policy stakeholders on sustainable biomass production, including in the form of member-exclusive GHG calculators, thus employing several informational governance instruments.

4.3.3. The International Organisation for Standardization (ISO)

The International Organisation for Standardization (ISO) is an independent, non-governmental organisation with a membership of 164 national standard bodies [100]. Its main aim is to provide consensual, market-relevant international standards to support innovation and best practice; its current 22,825 standards comprise a diverse range of products, from shoelaces to shipping containers, as well as technical and environmental management systems and processes [100]. In the fields of environment and sustainability, the ISO has adopted standards for environmental management systems and GHG accounting systems, to name a few. While the ISO is not free from criticism—the standards are not free of charge and the organisational set-up (and ensuing standards) seem to favour industrialised nations [101], their standards play a role in bioeconomy governance through new policy tools (voluntary agreements, environmental management systems, informational instruments). In recent years, ISO standards have addressed sustainability issues with strong relevance to the bioeconomy, namely criteria for bioenergy sustainability and reducing land degradation.

4.3.4. Assessment

There are several international bodies that play a role in informational governance. The GBEP assembles many important public and private stakeholders, and its linkages to the G7/8 or G20 could be useful: experts identified the forum as well-placed to try new approaches to governance beyond traditional channels (Expert Interview_05). However, its sectoral focus on energy, as well as the limited membership, can be regarded as a shortcoming. The RSB has a broader focus, and its standards—although leaving room for improvement and being not the only ones available—have been well-received [102]. But, while experts welcomed the increasing market- and private sector-driven approach to bioeconomy governance (arguing indeed that the main driving force of closer collaboration and governance will be private sector led) (Expert Interview_04; Expert Interview_05), overlaps of different standard systems might create legitimacy issues and parallel markets between certified and non-certified systems. A more independent body, like the ISO, might be better suited. However, ISO standards are usually quite general, and it is up to national legislators to “translate” those standards into detailed, enforceable legislation (Expert Interview_01). Those derived from ISO standards are usually compatible with WTO law (Expert Interview_01), but the need to pass through the national level might make the ISO a less concrete, albeit important, player in bioeconomy governance. Table 4 shows an overview of our assessment.

4.4. Commitment and Agenda Setting Governance

4.4.1. The United Nations Conventions

Perhaps the most elaborated system of international governance arises from the environmental conventions adopted in the UN system, providing the only international forum that assumes almost universal membership. Several issues either close to bioeconomy concepts or having certain overlaps with it, such as biodiversity or climate change, are already governed by UN conventions, which might present some “docking sites” for governance of bioeconomy issues. These three environmental conventions are often referred to as the Rio Conventions since they were adopted in 1992 at the “Earth Summit” in Rio de Janeiro, Brazil.

Table 4. Institutions for the informational governance of bioeconomy pathways.

Institution	Existing Structures in Place Relevant to the Bioeconomy	Potential Future Role in International Governance	Shortcomings and Challenges
RSB	<ul style="list-style-type: none"> Organise meetings and working groups Issues its own sustainability certificates for sustainably produced biomass Produces GHG calculators offering advice to policymakers 	<ul style="list-style-type: none"> Potential to fill the gap in standardisation of the bioeconomy 	<ul style="list-style-type: none"> Overlaps with other standards used by the international community Room for improvement in transparency and in standards monitoring and evaluation
GBEP	<ul style="list-style-type: none"> Brings together a wide range of stakeholders, including large majority of bioenergy and biofuel producers Provide toolkits and methodological documents on eg bioenergy Published 24 sustainability indicators in 2011, helping bring about common rules and standards 	<ul style="list-style-type: none"> Strong linkages to G7/8 could be useful for international governance Forum could be well-placed to try new approaches to governance beyond the UN system 	<ul style="list-style-type: none"> Limited membership and capacity could be barrier to universal acceptance of measuring and accounting tools developed Biased focus on bioenergy and biofuels could make the forum too specialised, limiting collaborative thinking
ISO	<ul style="list-style-type: none"> Adopted standards of environmental management systems, GHG accounting systems, biofuels, etc. Provides information that support best practices for both technology and management aspects 	<ul style="list-style-type: none"> Potential to use new policy tools in governance of bioeconomy Norms and standards derived from ISO standards generally compatible with WTO law 	<ul style="list-style-type: none"> Organisational set-up seems to favour industrialised nations Standards need to be “translated” into detailed, enforceable legislation by national legislators

4.4.2. The Convention on Biological Diversity (CBD)

The main objective of the Convention on Biological Diversity (CBD) is the “[...] conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources” (CBD, Article 1). The convention has two supplementary agreements—the Cartagena Protocol (CP), dealing with the safe transfer, handling, and use of living modified organisms resulting from modern biotechnology (CP, Article 1), and the Nagoya Protocol (NP), dealing with “[...] the fair and equitable sharing of the benefits arising from the utilization of genetic resources [...]” (NP, Article 1). These agreements are highly relevant to the bioeconomy, such as the recently adopted voluntary guidelines for “design and effective implementation of ecosystem-based approaches to climate change adaptation and disaster risk reduction [...]” [103], which might provide internationally agreed guidelines for more sustainable bioeconomy strategies. Furthermore, the CBD already deals with thorny issues relevant for bioeconomy, such as GMOs, via the Cartagena Protocol (CP). However, GMOs are also a good illustration of how provisions in the convention might run counter to some of the alternative visions of the bioeconomy [4].

4.4.3. The Convention to Combat Desertification (UNCCD)

Formally adopted in 1994, the convention’s objectives are to combat desertification and mitigate the effects of droughts and to focus on the “[...] conservation and sustainable management of land and water resources” (UNCCD, Article 2). The convention also established a Committee on Science and Technology (CST), advising the biennial conferences of the parties (COP) of the convention (UNCCD 2019). Like the CBD, the UNCCD touches upon issues relevant for the bioeconomy but without explicitly referring to bioeconomy as

such. However, land use issues figure prominently in the convention's action programmes, through which developed nations pledged to help developing countries implement sustainable land management practices [104], particularly via the convention's knowledge hub. Land use management associated with bio-based products and biological processes is often critical for overall sustainability; some bioeconomy pathways are closely connected (positively or negatively) to land degradation, which reduces productivity and can be a precursor to desertification.

4.4.4. The United Nations Framework Convention on Climate Change (UNFCCC)

The UNFCCC, adopted in 1992, its conferences of the parties (COPs) and its subsidiary bodies are tasked with the "[...] stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system" (UNFCCC, Article 2). Under the convention, treaties, like the Kyoto protocol and the Paris Agreement (PA), have been negotiated, the latter with the aim of limiting global warming to "well below 2 degrees (Paris Agreement, Article 2). Similar to aforementioned conventions, the UNFCCC is highly relevant for the bioeconomy since many of the proposed solutions to mitigate global climate change, such as increasing the share of renewable energies or using re- and afforestation measures to increase carbon sinks, do have strong interlinkages with bioeconomy concepts. Of course, the UNFCCC itself does not prescribe specific mitigation measures, but the Nationally Determined Contributions (NDCs) do; the NDCs are a key element of the PA, whereby parties lay out their mitigation and adaptation strategies.

4.4.5. Assessment

All of the three Rio conventions are highly relevant to the bioeconomy; treaties or initiatives stemming from those conventions would be influential via the agenda setting and convening power of UN processes. In addition, conventions, like the CBD, already work on relevant issues, such as GMOs, while the UNFCCC is an example of how dialogue and stakeholder meetings in one forum pertaining to one issue (in this case: climate change) could beget a treaty or convention with impacts on other issues (biodiversity and conservation) as seen with the forest management initiative REDD+, which was negotiated under the UNFCCC.

However, all the Rio conventions face some significant challenges in terms of the governance of bioeconomy pathways. UN-related processes in general, and some conventions, in particular, have been assessed as quite cumbersome and bureaucratic (Expert Interview_04). More concretely, issues, like land use change, would often be treated bilaterally instead of by the UNCCD [105] which makes scholars argue that, compared to its "sister" conventions on biodiversity and climate change (see below), the UNCCD has been less effective in achieving its objectives [104]. But, also, some aspects of the CBD's Nagoya Protocol, such as its cumbersome bureaucracy, have been criticised [106], and the implementation of governance provisions stipulated in the CP were assessed as rather weak by experts, thus leading to an implementation gap (Expert Interview_05). Similarly, the current pushback against the rule-based, international order [107] makes it unlikely that new treaties or initiatives will be launched from the conventions, particularly since the negotiating parties might not agree to explicitly extend the conventions' mandate to the bioeconomy. Table 5 gives an overview of our assessment.

Table 5. Institutions for the agenda setting and commitment governance of bioeconomy pathways.

	Existing Structures in Place Relevant to the Bioeconomy	Potential Future Role in International Governance	Shortcomings and Challenges
CBD	<ul style="list-style-type: none"> • Cartagena Protocol (CP) • Nagoya Protocol (NP) • Touches on issues relevant to bioeconomy but does not explicitly mention bioeconomy 	<ul style="list-style-type: none"> • Recently adopted voluntary guidelines for design and effective implementation of ecosystem-based approaches to climate adaptation and DRR could offer internationally agreed guidelines on how to make bioeconomy strategies more sustainable 	<ul style="list-style-type: none"> • Cumbersome bureaucracy that might delay new bio-based product development • Potential for conflicts between objectives of CBD and different bioeconomy visions, as illustrated by GMOs
UNCCD	<ul style="list-style-type: none"> • Touches on issues relevant to bioeconomy but do not explicitly mention bioeconomy 	<ul style="list-style-type: none"> • Potential to govern land use issues in linkage with bioeconomy issues 	<ul style="list-style-type: none"> • Criticisms of treatment of land use issues • Historically less effective in achieving objectives than other UN conventions
UNFCCC	<ul style="list-style-type: none"> • Climate-related mitigation measures, e.g., renewable energy, afforestation, etc., have strong linkages with bioeconomy concepts • Facilitative role in bringing about REDD+ initiative 	<ul style="list-style-type: none"> • Potential to utilise UNFCCC as a forum to discuss bioeconomy and find synergies with climate aims • Potential to adopt initiatives, guidelines, or frameworks on bioeconomy issues 	<ul style="list-style-type: none"> • Governing bioeconomy pathways may be beyond mandate of convention

5. A Regional Approach to Governing Bioeconomy Pathways?

On a global level, the China-U.S. trade dispute [108], the United States' announced retreat from several international institutions, such as the WHO [109], and the breaking away of the United Kingdom from the EU, might signal increasing difficulties for international cooperation. Moreover, international governance has become increasingly fragmented and polycentric [110,111], thus adding complexity and potentially inefficiencies in responses to climate change, bioeconomy, and other global development challenges [112]. However, against this development, it is noteworthy that regional cooperation (as a linkage between the global and the local, sub-national) has been proposed as a way forward to tackle global issues [113], such as climate change [114]. The process of European integration, leading to the European Union of today might be the most well-studied example for regional integration and cooperation, but many other regional institutions have come into being, such as the African Community of West African States (ECOWAS, 1975), the South Asian Association for Regional Cooperation (SAARC, 1985), the Southern Common Market (MERCOSUR, 1991), the South African Development Community (SADC, 1992), the Economic Community of Central African States (CEMAC, 1998), and the Union of South American Nations (UNASUR, 2008), joining earlier initiatives, such as the Association of South East Asian Nations (ASEAN, 1967) [115]. Regional integration is often seen as driven by economic considerations to facilitate the exchange of goods and services [116], but scholars point to other reasons, ranging from an increased welfare or lower transaction costs for ever expanding markets [117] to hopes that regional integration will strengthen mutual security [118]. When it comes to bioeconomy governance, several arguments can be made for why a regional approach might present a way forward. It is important to note that this discussion is identified more as a question for future research rather than a postulate, since regional cooperation mechanisms and institutions have not been the main frame of this paper.

First, interviewed experts argued that regional similarities encourage bioeconomy governance on the regional level (Expert Interview_02). Of course, geographic diversity and difference in resource endowments are a feature even within the same region, but it

is evident that regions, such as Latin America or South-East Asia, share communalities and common issues (high biodiversity, dependence on a specific feedstock, such as rice, etc.). They may also share common languages, cultural traits, and historical development patterns. These regional similarities could incentivise regional cooperation.

Second, regional governance initiatives could function as a meso-level that connects the local level to the international level (Expert Interview_03). This can be achieved by rather procedural linkages from a governance perspective (i.e., linking regional governance processes to international ones) or by practical considerations. For instance, experiences and lessons learnt when deploying new biotechnologies or new bioeconomy policies could be tested and shared regionally, before upscaling internationally (Expert Interview_02).

Third, increased regional cooperation could be particularly beneficial for the countries of the Global South. If countries with regional similarities and similar interests agree regionally on certain strategies and negotiating positions, they could then make their voices heard more easily in international fora, such as the UN (Expert Interview_07), i.e., by developing more clout in negotiations [119], thus ensuring a more balanced representation of countries between the global South and the global North, which is a main weakness of current bioeconomy governance (Expert Interview_01).

If a regional approach to bioeconomy governance was to be pursued, there are already various regional institutions available (see above). Some, such as ASEAN or ECOWAS, already have a track record on bioeconomy. Indeed, experts argued that those organisations would be suitable candidates for increased regional bioeconomy governance (Expert Interview_07). In addition, the UN system provides for Regional Commissions (UN-ECLAC, UNECA, etc.) that could drive bioeconomy cooperation and governance forward under the more neutral flag of the UN. Moreover, in the field of climate change action, the UNFCCC has recently turned to a regional approach of spurring climate action by launching regional climate weeks in order to foster more stakeholder collaboration (<https://www.regionalclimateweeks.org/>). The above-mentioned regional trade agreements seem to confirm the value of regional governance for cross-cutting, international issues, such as climate change, trade, or bioeconomy pathways. More importantly, all interviewed experts saw regional cooperation as one promising way forward to explore stronger international bioeconomy governance.

6. Conclusions

Bioeconomy is a somewhat complex concept that lacks a universally accepted definition and is characterised by a divergence of opinions on what goals or targets should be prioritised when applying a bioeconomy perspective. While this shortcoming might seem benign in nature, many of the interviewed experts argued that this confusion presented a major governance challenge (Expert Interviews_01, 02, 04, and 06). If interests, outlooks, and visions of bioeconomies differ, then cooperation on those interests, outlooks, and visions becomes more complicated. Moreover, different visions surely beget different pathways; the above-mentioned issues, such as land use change or GMOs, seem to warrant a more profound discussion on bioeconomy pathways at different levels from local to global.

In the same vein, not only is the concept of a bioeconomy quite complex, but its governance is equally complex, particularly due to the broad range of institutions working on bioeconomy issues. Whether this polycentricity, fragmentation and divergence will (or should) lead again to converge is, for the time being, uncertain. In the wake of rising nationalism and the current attacks on the multilateral-, rule-based order, this fragmentation might even proliferate, indicating a low appetite at present for international institutionalism on the bioeconomy and for global solutions to challenges posed by alternative bioeconomy pathways.

However, we have identified several fora and international processes that might help to coordinate and strengthen international governance of bioeconomy issues. It is true that many of those institutions are limited by their mandate or their functioning to address some of the pressing issues of bioeconomy pathways on a global level, but there is

often room within those institutions to incorporate bioeconomy issues more prominently into their work streams. Where international cooperation and collaboration might seem too cumbersome, regional cooperation might fill the voids and be an interesting avenue forward for strengthening the governance of bioeconomy pathways. In order to harness the power of networked, international governance, however, several considerations are critical.

Attention should be paid to possible risks of duplication. Although our analysis provided just an initial overview and more in-depth research would be needed to identify exact overlaps and parallel work streams, it seems that, particularly when it comes to knowledge exchange, many fora work on bioeconomy-relevant issues (Biofutures Forum, Bioeconomy Summit, GBEP). Here, formal linkages or a regular exchange of experts between organisations could be established to facilitate synergies instead of competition.

Second, international bioeconomy governance seems to make more sense for less controversial issues. Trade and economic issues, while high on the agenda, seem to be controversial; thus, consensus at international level seems unlikely. A productive way forward might be to focus on issues, such as increased cooperation in research, development, and innovation. Perhaps a bit more controversial, but nevertheless of crucial importance, would be to enhance collaboration on standardisation, monitoring, and verification of bioeconomy products and value chains. Indeed, several existing bioeconomy and bioenergy efforts have been on sustainability indicators.

Third, it might be an option to explore what strength each level of governance provides for the bioeconomy, from the top international level, right down to the local level. Even diverging visions for bioeconomy pathways have associated goals or targets in common that do tend towards a national framing. Therefore, instead of seeking to internationalise national or even sub-national issues, a good way forward may be to adopt the EU's subsidiarity principle as guidance which postulates that issues are preferably addressed on the appropriate lower level (Member States in the EU context) and only referred to the higher level (EU institutions) if progress is "better" achieved at the higher level [120].

When national approaches fail, or when issues arise that are clearly transnational in nature, governance on the next higher (regional) or the international level might be sought since each level of governance has its own advantages and disadvantages. For instance, while international institutions, like the UN, have some significant convening power under a neutral flag (Expert Interview_04) or, like the WTO, might be useful when tackling rather specific issues, such as tariffs or subsidies, several experts opined that new governance impetus for bioeconomy pathways might come either from the private sector (Expert Interview_04; Expert Interview_05) or more localised initiatives (Expert Interview_07). Indeed, some experts even argued that, while the appetite for international cooperation between governments might be low at the moment, private sector players would be the ones interested in increased cooperation (Expert Interview_05).

Despite this, pursuing a more regional approach to bioeconomy pathways might be a promising way forward due to its bridging function between the international and the national level. There is often greater similarity of challenges and opportunities within a region and easier exchange of lessons learnt. Better representation of the Global South in international processes could thereby be achieved, once common regional positions are adopted or established.

Some limitations of our study should be noted so as to consider ways to widen or deepen the scope in analysing international bioeconomy governance. First, our study is broad but is not intended to represent stakeholder perspectives equally or proportionally from the whole spectrum of institutions that have been or might be involved in bioeconomy governance. Future complementary research could adopt, for example, approaches, such as surveys or systematic reviews, that might better capture the range of views. Second, because we purposely adopt a cross-cutting view on bioeconomy, we place somewhat less emphasis on institutions and/or organisations that are strongly rooted in particular sectors. It is possible, in some cases where particular sectors are dominant, that it might be more effective to adapt sector-based international governance to include cross-cutting aspects,

which could be analysed through deeper analysis around a given sector for particular geographies or systems. Third, we did not include financial institutions nor NGOs as these considerations would have broadened the scope to such an extent that a separate analysis would be required. Finally, our study is oriented towards policy and practice as opposed to theoretical research on governance of bioeconomy pathways; research from a more theoretical perspective could complement this analysis by exposing logical flaws or fundamental barriers that might complicate future institutional design.

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Institutional Review Board Statement: The ethical guidelines (<https://www.sei.org/about-sei/organization/governance/guideline-on-ethical-practice/>) established by the Stockholm Environment Institute (SEI) have been followed with respect to the engagement with external stakeholders and expert interviews.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: No new data were created or analyzed in this study other than the insights provided through the expert interviews and the information presented in tables, which are already reflected in the article. Data sharing is thus not applicable to this article.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A. List of Engaged Bioeconomy Experts

Expert Interview	Institution
Expert Interview No. 1	WWF
Expert Interview No. 2	University of Bonn
Expert Interview No. 3	Solidaridad Network
Expert Interview No. 4	Harvard University/UNCTAD
Expert Interview No. 5	IINAS
Expert Interview No. 6	BioInnovate Africa
Expert Interview No. 7	UN Economic Commission for Latin America and the Caribbean
Expert Interview No. 8	OECD
Expert Interview No. 9	FAO

References

1. Boulding, K. The Economics of the Coming Spaceship Earth. In *Environmental Quality in a Growing Economy, Resources for the Future*; Jarret, H., Ed.; Johns Hopkins University Press: Baltimore, MA, USA, 1966; pp. 3–14.
2. Georgescu-Roegen, N. *The Entropy Law and the Economic Process*; Harvard University Press: Cambridge, MA, USA; London, UK, 1971. Available online: <https://www.hup.harvard.edu/catalog.php?isbn=9780674281653> (accessed on 7 September 2020).
3. Gowdy, J.; Mesner, S. The Evolution of Georgescu-Roegen's Bioeconomics. *Rev. Soc. Econ.* **1998**, *56*, 136–156. [CrossRef]
4. Bugge, M.M.; Hansen, T.; Klitkou, A. What Is the Bioeconomy? A Review of the Literature. *Sustainability* **2016**, *8*, 691. [CrossRef]
5. Issa, I.; Delbrück, S.; Hamm, U. Bioeconomy from Experts' Perspectives—Results of a Global Expert Survey. *PLoS ONE* **2019**, *14*, e0215917. [CrossRef] [PubMed]

6. Canales, N.; Gladkykh, G.; Bessonova, E.; Fielding, M.; Johnson, F.X.; Peterson, K. *Policy Dialogue on a Bioeconomy for Sustainable Development in the Baltic Sea Region*; Stockholm Environment Institute: Stockholm, Sweden, 2020. Available online: <https://www.sei.org/publications/policy-dialogue-bioeconomy-sustainable-development-baltic/> (accessed on 11 December 2020).
7. Gladkykh, G.; Aung, M.T.; Takama, T.; Johnson, F.X.; Fielding, M. *Policy Dialogue on a Bioeconomy for Sustainable Development in Thailand*. 2020. Available online: <https://www.sei.org/publications/dialogue-bioeconomy-sustainable-development-thailand/> (accessed on 7 September 2020).
8. Priefer, C.; Jörissen, J.; Frör, O. Pathways to Shape the Bioeconomy. *Resources* **2017**, *6*, 10. [CrossRef]
9. El-Chichakli, B.; Von Braun, J.; Lang, C.; Barben, D.; Philp, J. Policy: Five Cornerstones of a Global Bioeconomy. *Nature* **2016**, *535*, 221–223. [CrossRef] [PubMed]
10. Virgin, I.; Morris, E.J. *Creating Sustainable Bioeconomies: The Bioscience Revolution in Europe and Africa*; Routledge: London, UK, 2016. [CrossRef]
11. Global Bioeconomy Summit. Conference Report. 2018. Available online: https://gbs2018.com/fileadmin/gbs2018/GBS_2018_Report_web.pdf (accessed on 12 October 2020).
12. Global Bioeconomy Summit. Communiqué Global Bioeconomy Summit 2015. Making Bioeconomy Work for Sustainable Development. International Advisory Committee. 2015. Available online: https://gbs2020.net/fileadmin/gbs2015/Downloads/Communique_final_neu.pdf (accessed on 3 July 2020).
13. Johnson, F.X.; Canales, N.; Fielding, M.; Gladkykh, G.; Aung, M.T.; Bailis, R.; Ogeya, M.; Olsson, O. A Comparative Analysis of Alternative Bioeconomy Visions and Pathways Based on Stakeholder Dialogues in Colombia, Rwanda, Sweden, and Thailand. *J. Environ. Manag.* **2020**. (submitted).
14. Proskurina, S.; Junginger, M.; Heinimö, J.; Vakkilainen, E. Global Biomass Trade for Energy—Part 1: Statistical and Methodological Considerations. *Biofuels Bioprod. Biorefining* **2019**, *13*, 358–370. [CrossRef]
15. Nesme, T.; Metson, G.S.; Bennett, E.M. Global Phosphorus Flows through Agricultural Trade. *Glob. Environ. Chang.* **2018**, *50*, 133–141. [CrossRef]
16. Dietz, T.; Börner, J.; Förster, J.J.; Von Braun, J. *Governance of the Bioeconomy: A Global Comparative Study of National Bioeconomy Strategies*; Center for Development Research University of Bonn: Bonn, Germany, 2018.
17. Meyer, R. Bioeconomy Strategies: Contexts, Visions, Guiding Implementation Principles and Resulting Debates. *Sustainability* **2017**, *9*, 1031. [CrossRef]
18. Devaney, L.; Henchion, M.; Regan, Á. Good Governance in the Bioeconomy. *EuroChoices* **2017**, *16*, 41–46. [CrossRef]
19. Fritsche, U.; Iriarte, L. Sustainability Criteria and Indicators for the Bio-Based Economy in Europe: State of Discussion and Way forward. *Energies* **2014**, *7*, 6825–6836. [CrossRef]
20. Guerra, F.D.; Isailovic, M.; Widerberg, O.; Pattberg, P. *Mapping the Institutional Architecture of Global Forest Governance*; R-15/04; IMV Institute for Environmental Studies: Amsterdam, The Netherlands, 2015. Available online: https://www.researchgate.net/publication/277524062_Mapping_the_Institutional_Architecture_of_Global_Forest_Governance (accessed on 23 August 2020).
21. Pierre, J. (Ed.) *Debating Governance. Authority, Steering and Democracy*; Oxford University Press: Oxford, UK, 2000.
22. Rhodes, R.A.W. Understanding Governance: Ten Years on. *Organ. Stud.* **2007**, *28*, 1243–1264. [CrossRef]
23. Rhodes, R.A.W. *Understanding Governance. Policy Networks, Governance, Reflexivity and Accountability*; Open University Press: Milton Keynes, UK, 1997.
24. Stoker, G. Governance as Theory: Five Propositions. *Int. Soc. Sci. J.* **1998**, *50*, 17–28. [CrossRef]
25. Jordan, A. The Governance of Sustainable Development: Taking Stock and Looking Forwards. *Environ. Plan. C Gov. Policy* **2008**, *26*, 17–33. [CrossRef]
26. Schout, A.; Jordan, A. Coordinated European Governance: Self-Organization or Centrally Steered? *Public Adm.* **2005**, *83*, 201–220. [CrossRef]
27. Jordan, A.; Wurzel, R.K.; Zito, A.R. ‘New’ Instruments of Environmental Governance: Patterns and Pathways of Change. *Environ. Politics* **2003**, *12*, 1–24. [CrossRef]
28. Abbott, K.W.; Genschel, P.; Snidal, D.; Zangl, B. Two Logics of Indirect Governance: Delegation and Orchestration. *Br. J. Political Sci.* **2016**, *46*, 719–729. [CrossRef]
29. Bache, I.; Bartle, I.; Flinders, M. Multi-Level Governance. In *Handbook on Theories of Governance*; Ansell, C., Torfing, J., Eds.; Edward Elgar Publishing: Cheltenham, UK, 2016. Available online: <https://www.elgaronline.com/view/edcoll/9781782548492/9781782548492.00052.xml> (accessed on 15 November 2020).
30. Bulkeley, H.; Andonova, L.B.; Betsill, M.M.; Compagnon, D.; Hale, T.; Hoffmann, M.J.; Newell, P.; Paterson, M.; VanDeveer, S.D.; Roger, C. *Transnational Climate Change Governance*; Cambridge University Press: Cambridge, UK, 2014. [CrossRef]
31. Dingwerth, K.; Pattberg, P. Global Governance as a Perspective on World Politics. *Glob. Gov.* **2006**, *12*, 185–203. [CrossRef]
32. Nkuiya, B. Stability of International Environmental Agreements under Isoelastic Utility. *Resour. Energy Econ.* **2020**, *59*, 101128. [CrossRef]
33. Von Braun, J.; Birner, R. Designing Global Governance for Agricultural Development and Food Nutrition Security. *Rev. Dev. Econ.* **2017**, *21*, 265–284. [CrossRef]
34. Rulli, M.C.; Bellomi, D.; Cazzoli, A.; De Carolis, G.; D’Odorico, P. The Water-Land-Food Nexus of First-Generation Biofuels. *Sci. Rep.* **2016**, *6*, 1–10. [CrossRef] [PubMed]

35. Johnson, F.X.; Virgin, I. Future Trends in Markets for Food, Feed, Fibre and Fuel. In *Food versus Fuel: An Informed Introduction*; Rosillo-Calle, F., Johnson, F.X., Eds.; Zed Books: London, UK, 2010; pp. 164–190.
36. Kline, K.L.; Msangi, S.; Dale, V.H.; Woods, J.; Souza, G.M.; Osseweijer, P.; Clancy, J.S.; Hilbert, J.A.; Johnson, F.X.; McDonnell, P.C.; et al. Reconciling Food Security and Bioenergy: Priorities for Action. *Gcb Bioenergy* **2017**, *9*, 557–576. [CrossRef]
37. Englund, O.; Berndes, G. The Roles of Public and Private Governance in Promoting Sustainable Bioenergy. In *The Law and Policy of Biofuels*; Edward Elgar Publishing: Northampton, MA, USA, 2016. Available online: <https://www.elgaronline.com/view/edcoll/9781782544548/9781782544548.00010.xml> (accessed on 25 August 2020).
38. Schütte, G. What Kind of Innovation Policy Does the Bioeconomy Need? *New Biotechnol.* **2018**, *40*, 82–86. [CrossRef]
39. Bioökonomierat. Bioeconomy Policy Synopsis and Analysis of Strategies in the G7. A Report from the German Bioeconomy Council. 2015. Available online: https://bioekonomierat.de/fileadmin/Publikationen/berichte/BOER_Laenderstudie_1_.pdf (accessed on 12 October 2020).
40. Canales, N.; González, J.G. Policy Dialogue on a Bioeconomy for Sustainable Development in Colombia. 2020. Available online: <https://www.sei.org/publications/policy-dialogue-bioeconomy-sustainable-development-colombia/> (accessed on 11 December 2020).
41. Bausch, C.; Mehling, M. Alternative Venues of Climate Cooperation: An Institutional Perspective. In *Climate Change and the Law*; Hollo, E.J., Kulovesi, K., Mehling, M., Eds.; Ius Gentium: Comparative Perspectives on Law and Justice; Springer: Dordrecht, The Netherlands, 2013; pp. 111–141. [CrossRef]
42. Hermwille, L. Hardwired towards Transformation? Assessing Global Climate Governance for Power Sector Decarbonization. *Earth System Gov.* **2020**, 100054. [CrossRef]
43. Oberthür, S.; Khandekar, G.; Wyns, T. Global Governance for the Decarbonization of Energy-Intensive Industries: Great Potential Underexploited. *Earth Syst. Gov.* **2020**, 100072. [CrossRef]
44. Van Buuren, A.; Eshuis, J. Knowledge Governance: Complementing Hierarchies, Networks and Markets? In *Knowledge Democracy: Consequences for Science, Politics, and Media*; In't Veld, R., Ed.; Springer: Berlin/Heidelberg, Germany, 2010; pp. 283–297. [CrossRef]
45. Widerberg, O.E.; Pattberg, P.H.; Kristensen, K.E.G. Mapping the Institutional Architecture of Global Climate Change Governance V.2. Vrije Universiteit Amsterdam. 2016. Available online: <https://research.vu.nl/en/publications/mapping-the-institutional-architecture-of-global-climate-change-g> (accessed on 23 August 2020).
46. Murphy-Gregory, H. Governance via Persuasion: Environmental NGOs and the Social Licence to Operate. *Environ. Politics* **2018**, *27*, 320–340. [CrossRef]
47. UNCCD. The Committee on Science and Technology (CST). 2019. Available online: <https://www.unccd.int/convention/committee-science-and-technology-cst> (accessed on 18 August 2020).
48. Pfau, S.F.; Hagens, J.E.; Dankbaar, B.; Smits, A.J. Visions of Sustainability in Bioeconomy Research. *Sustainability* **2014**, *6*, 1222–1249. [CrossRef]
49. Viaggi, D. Towards an Economics of the Bioeconomy: Four Years Later. *Bio-Based Appl. Econ.* **2016**, *5*, 101–112. [CrossRef]
50. McBride, J.; Chatzky, A. The Group of Twenty. Council on Foreign Relations. 2019. Available online: <https://www.cfr.org/backgrounders/group-twenty> (accessed on 27 July 2020).
51. G20 Meeting of Agriculture Ministers. Declaration. 2018. Available online: http://www.g20.utoronto.ca/2018/2018-07-28-g20-agriculture_declaration_final.pdf (accessed on 21 July 2020).
52. G20. G20 Action Plan on Food Security and Sustainable Food Systems. 2015. Available online: <https://www.mofa.go.jp/files/000111212.pdf> (accessed on 21 July 2020).
53. Widerberg, O.; Stenson, D.E. Climate Clubs and the UNFCCC. *FORES*. 2013. Available online: <https://fores.se/wp-content/uploads/2013/11/ClimateClubsAndTheUNFCCC-FORES-Study-2013-3.pdf> (accessed on 23 August 2020).
54. Kim, J.A.; Chung, S.Y. The Role of the G20 in Governing the Climate Change Regime. *Int. Environ. Agreem. Politics Law Econ.* **2012**, *12*, 361–374. [CrossRef]
55. Kirton, J.J.; Kokosis, M.E. *The Global Governance of Climate Change: G7, G20, and UN Leadership*; Routledge: London, UK, 2016. [CrossRef]
56. Gerasimchuk, I. G20 Countries Must Speed up Fossil Fuel Subsidy Reforms. IISD. 14 December 2018. Available online: <https://iisd.org/blog/g20-fossil-fuel-subsidy-reforms> (accessed on 3 July 2020).
57. Sinclair, J. The G20 Needs to Change with the Times. Policy Options. 2019. Available online: <https://policyoptions.irpp.org/magazines/january-2019/g20-needs-change-times/> (accessed on 27 July 2020).
58. WTO. What Is the WTO? 2019. Available online: https://www.wto.org/english/thewto_e/whatis_e/whatis_e.htm (accessed on 24 July 2020).
59. Charlton, A. The Collapse of the Doha Trade Round in Brief. *CentrePiece Autumn* **2006**, 2006, 21.
60. Financial Times. The Doha Round Finally Dies a Merciful Death. 2015. Available online: <https://www.ft.com/content/9cb1ab9e-a7e2-11e5-955c-1e1d6de94879> (accessed on 23 July 2020).
61. Droege, S.; Van Asselt, H.; Das, K.; Mehling, M. *The Trade System and Climate Action: Ways forward Under the Paris Agreement*; SSRN Scholarly Paper ID 2864400; Social Science Research Network: Rochester, NY, USA, 2016. Available online: <https://papers.ssrn.com/abstract=2864400> (accessed on 24 September 2020).

62. Johnson, F.X.; Westberg, J. *The Path Not yet Taken: Bilateral Agreements to Promote Sustainable Biofuels under the EU Renewable Energy Directive—Working Paper*; Stockholm Environment Institute: Stockholm, Sweden, 2013. Available online: <https://www.sei.org/publications/the-path-not-yet-taken-bilateral-agreements-to-promote-sustainable-biofuels-under-the-eu-renewable-energy-directive-working-paper/> (accessed on 3 November 2020).
63. Bougette, P.; Charlier, C. Renewable Energy, Subsidies, and the WTO: Where Has the ‘Green’ Gone? *Energy Econ.* **2015**, *51*, 407–416. [CrossRef]
64. WTO. Subsidies and Countervailing Measures. 2019. Available online: https://www.wto.org/english/tratop_e/scm_e/scm_e.htm (accessed on 24 July 2020).
65. Bouet, A.; Laborde, D. *Agriculture, Development, and the Global Trading System: 2000–2015*; International Food Policy Research Institute: Washington, DC, USA, 2017.
66. Johnson, F.X. Regional-Global Linkages in the Energy-Climate-Development Policy Nexus: The Case of Biofuels in the EU Renewable Energy Directive. *Renew. Energy Law Policy Rev.* **2011**, *2*, 91–106.
67. Herwig, A.; Pang, Y. WTO Rules on Domestic Support for Agriculture and Food Safety: Institutional Adaptation and Institutional Transformation in the Governance of the Bioeconomy. In *EU Bioeconomy Economics and Policies*; Palgrave Macmillan: Cham, Switzerland, 2019; pp. 69–88. [CrossRef]
68. UNCTAD. About UNCTAD. 2019. Available online: <https://unctad.org/en/Pages/aboutus.aspx> (accessed on 19 August 2020).
69. Karshenas, M. Power, Ideology and Global Development: On the Origins, Evolution and Achievements of UNCTAD. *Dev. Chang.* **2016**, *47*, 664–685. [CrossRef]
70. Biofuels and Renewable Energy. UCTAD. 2019. Available online: https://unctad.org/en/Pages/DITC/ClimateChange/UNCTAD-Biofuels-Initiative.aspx?Me=,,ows_Title,ascending (accessed on 19 August 2020).
71. SMEP. Manufacturing Pollution in Sub-Saharan Africa and South Asia: Implications for the Environment, Health and Future Work. UK Aid & UNCTAD. 2020. Available online: <https://southsouthnorth.org/wp-content/uploads/2020/12/Manufacturing-Pollution-in-Sub-Saharan-Africa-and-South-Asia-Implications-for-the-environment-health-and-future-work.pdf> (accessed on 17 August 2020).
72. Woodward, R. The Organisation for Economic Cooperation and Development. *New Political Econ.* **2004**, *9*, 113–127. [CrossRef]
73. Richard Woodward. *The Organisation for Economic Cooperation and Development*; Routledge Global Institutions: Abingdon, UK; Oxon, UK; Routledge, Taylor & Francis Group: New York, NY, USA, 2019.
74. OECD. The Bioeconomy to 2030: Designing a Policy Agenda—OECD. 2009. Available online: <https://www.oecd.org/futures/long-termtechnologicalsocietalchallenges/thebioeconomyto2030designingapolicyagenda.htm> (accessed on 23 August 2020).
75. Diakosavvas, D.; Frezal, C. *Bio-Economy and the Sustainability of the Agriculture and Food System: Opportunities and Policy Challenges*; OECD: Paris, France, 2019. Available online: https://www.oecd-ilibrary.org/agriculture-and-food/bio-economy-and-the-sustainability-of-the-agriculture-and-food-system_d0ad045d-en (accessed on 23 November 2020).
76. BioFuture Platform. 2019. Available online: <http://biofutureplatform.org/about/> (accessed on 11 November 2020).
77. Communiqué Global Bioeconomy Summit 2018. Innovation in the Global Bioeconomy for Sustainable and Inclusive Transformation. Global Bioeconomy Summit. 2018. Available online: https://gbs2018.com/fileadmin/gbs2018/Downloads/GBS_2018_Communique.pdf (accessed on 3 July 2020).
78. Hjerpe, M.; Linnér, B.O. Functions of COP Side-Events in Climate-Change Governance. *Clim. Policy* **2010**, *10*, 167–180. [CrossRef]
79. European Commission. The International Bioeconomy Forum (IBF). 2017. Available online: <https://ec.europa.eu/research/bioeconomy/index.cfm?pg=policy&lib=ibf> (accessed on 25 July 2020).
80. Oberthür, S. Institutional Interaction to Address Greenhouse Gas Emissions from International Transport: ICAO, IMO and the Kyoto Protocol. *Clim. Policy* **2003**, *3*, 191–205. [CrossRef]
81. What We Do | FAO | Food and Agriculture Organization of the United Nations. 2019. Available online: <http://www.fao.org/about/what-we-do/en/> (accessed on 23 July 2020).
82. FAO. Bioeconomy | Energy | Sustainable Bioeconomy Guidelines. 2019. Available online: <http://www.fao.org/energy/bioeconomy/en/> (accessed on 25 July 2020).
83. Mee, L.D. The Role of UNEP and UNDP in Multilateral Environmental Agreements. *Int. Environ. Agreem. Politics Law Econ.* **2005**, *5*, 227–263. [CrossRef]
84. CBD. The Convention on Biological Diversity. History of the Convention. 2019. Available online: <https://www.cbd.int/history/> (accessed on 24 October 2020).
85. Multilateral Environmental Agreements. 2019. Available online: <https://unep.ch/iuc/geclist.htm#atmosphere> (accessed on 20 August 2020).
86. Borel-Saladin, J.M.; Turok, I.N. The Green Economy: Incremental Change or Transformation? *Environ. Policy Gov.* **2013**, *23*, 209–220. [CrossRef]
87. Loiseau, E.; Saikku, L.; Antikainen, R.; Droste, N.; Hansjürgens, B.; Pitkänen, K.; Leskinen, P.; Kuikman, P.; Thomsen, M. Green Economy and Related Concepts: An Overview. *J. Clean. Prod.* **2016**, *139*, 361–371. [CrossRef]
88. UNEP. *Towards a Green Economy. Pathways to Sustainable Development and Poverty Eradication*; A Synthesis for Policy Makers; UNEP: Nairobi, Kenya, 2011. Available online: https://sustainabledevelopment.un.org/content/documents/126GER_synthesis_en.pdf (accessed on 20 August 2020).
89. Governance and Institutional Flexibility. In *The Oxford Handbook of Governance*; OUP Oxford: Oxford, UK, 2012. [CrossRef]

90. Browne, S. *The United Nations Development Programme and System*; Routledge Global Institutions; Routledge, Taylor & Francis Group: New York, NY, USA, 2011.
91. WIPO GREEN—The Marketplace for Sustainable Technology. 2019. Available online: <https://www3.wipo.int/wipogreen-database/> (accessed on 23 July 2020).
92. Gross, R. World Intellectual Property Organisation (WIPO). Global Information Society Watch. 2007. Available online: https://giswatch.org/sites/default/files/gisw_wipo_0.pdf (accessed on 18 July 2020).
93. WIPO. Convention Establishing the World Intellectual Property Organization. 1967. Available online: https://www.wipo.int/treaties/en/text.jsp?file_id=283854 (accessed on 23 July 2020).
94. Bennich, T.; Belyazid, S. The Route to Sustainability—Prospects and Challenges of the Bio-Based Economy. *Sustainability* **2017**, *9*, 887. [CrossRef]
95. Oh, C.; Matsuoka, S. Complementary Approaches to Discursive Contestation on the Effects of the IPR Regime on Technology Transfer in the Face of Climate Change. *J. Clean. Prod.* **2016**, *128*, 168–177. [CrossRef]
96. EUBIA. Global Bioenergy Partnership (GBEP)—European Biomass Industry Association. 2019. Available online: <https://www.eubia.org/cms/about-eubia/international-recognition/global-bioenergy-partnership/> (accessed on 23 July 2020).
97. GBEP. Global Bioenergy Partnership. Purpose and Fuction. 2019. Available online: <http://www.globalbioenergy.org/aboutgbep/purpose0/en/> (accessed on 17 August 2020).
98. Global Bioenergy Partnership. Partners and Membership. 2019. Available online: <http://www.globalbioenergy.org/aboutgbep/partners-membership/en/> (accessed on 17 August 2020).
99. Report “The GBEP Sustainability Indicators for Bioenergy”. 2019. Available online: <http://www.globalbioenergy.org/programmeofwork/task-force-on-sustainability/gbep-report-on-sustainability-indicators-for-bioenergy/en/> (accessed on 3 July 2020).
100. ISO. About US. 2019. Available online: <http://www.iso.org/cms/render/live/en/sites/isoorg/home/about-us.html> (accessed on 2 August 2020).
101. Heires, M. The International Organization for Standardization (ISO). *New Political Econ.* **2008**, *13*, 357–367. [CrossRef]
102. Schlamann, I.; Wieler, B.; Walther-Thoss, J.; Haase, N.; Malthe, L. *Searching for Sustainability. Comparative Analysis of Certification Schemes for Biomass Used for the Production of Biofuels*; WWF Deutschland: Berlin, Germany, 2013. Available online: http://awsassets.panda.org/downloads/wwf_searching_for_sustainability_2013_2.pdf (accessed on 5 August 2020).
103. Secretariat of the CBD. Voluntary Guidelines for the Design and Effective Implementation of Ecosystem-Based Approaches to Climate Change Adaptation and Disaster Risk Reduction and Supplementary Information. 2019. Available online: <https://www.cbd.int/doc/publications/cbd-ts-93-en.pdf> (accessed on 23 September 2020).
104. Gisladdottir, G.; Stocking, M. Land Degradation Control and Its Global Environmental Benefits. *Land Degrad. Dev.* **2005**, *16*, 99–112. [CrossRef]
105. Chasek, P.; Safriel, U.; Shikongo, S.; Fuhrman, V.F. Operationalizing Zero Net Land Degradation: The next Stage in International Efforts to Combat Desertification? *J. Arid Environ.* **2015**, *112*, 5–13. [CrossRef]
106. Kamau, E.C.; Fedder, B.; Winter, G. The Nagoya Protocol on Access to Genetic Resources and Benefit Sharing: What Is New and What Are the Implications for Provider and User Countries and the Scientific Community. *Law Environ. Dev. J.* **2010**, *6*, 246.
107. Hooghe, L.; Lenz, T.; Marks, G. Contested World Order: The Delegitimation of International Governance. *Rev. Int. Organ.* **2019**, *14*, 731–743. [CrossRef]
108. Li, M.; Balistreri, E.J.; Zhang, W. The U.S.–China Trade War: Tariff Data and General Equilibrium Analysis. *J. Asian Econ.* **2020**, *69*, 101216. [CrossRef]
109. Hinshaw, D.; Armour, S. Trump Moves to Pull U.S. Out of World Health Organization in Midst of Covid-19 Pandemic. *Wall Street J.* 2020. Available online: <https://www.wsj.com/articles/white-house-says-u-s-has-pulled-out-of-the-world-health-organization-11594150928> (accessed on 5 November 2020).
110. Carlisle, K.; Gruby, R.L. Polycentric Systems of Governance: A Theoretical Model for the Commons. *Policy Stud. J.* **2019**, *47*, 921–946. [CrossRef]
111. Ostrom, E. *Understanding Institutional Diversity*; Princeton University Press: Princeton, NJ, USA, 2005.
112. Held, D.; Hervey, A. Democracy, Climate Change and Global Governance: Democratic Agency and the Policy Menu Ahead. In *The Governance of Climate Change*; Polity: Cambridge, UK, 2011.
113. Van Lanngenhove, L. *Regional Integration and Global Governance*; United Nations University: Tokyo, Japan, 2003. Available online: <https://collections.unu.edu/eserv/UNU:7172/O-2004-4.pdf> (accessed on 17 September 2020).
114. Asheim, G.B.; Froyen, C.B.; Hovi, J.; Menz, F.C. Regional versus Global Cooperation for Climate Control. *J. Environ. Econ. Manag.* **2006**, *51*, 93–109. [CrossRef]
115. Bolanos, A.B. *A Step Further in the Theory of Regional Integration: A Look at TheUnasur’s Integration Strategy*; University of Lyon: Lyon, France, 2016. Available online: <https://halshs.archives-ouvertes.fr/halshs-01315692/document> (accessed on 17 September 2020).
116. Balassa, B. The Theory of Economic Integration: An Introduction. In *The European Union: Readings on the Theory and Practice of European Integration*; Nelsen, B.F., Stubb, A., Eds.; Macmillan Education: London, UK, 1994; pp. 125–137. [CrossRef]
117. Mattli, W. Explaining Regional Integration Outcomes. *J. Eur. Public Policy* **1999**, *6*, 1–27. [CrossRef]

-
118. Slocum-Bradley, N.; Felício, T. *The Role of Regional Integration in the Promotion of Peace and Security*; United Nations University: Tokyo, Japan, 2006. Available online: <http://cris.unu.edu/sites/cris.unu.edu/files/O-2006-2.pdf> (accessed on 17 August 2020).
 119. Schneider, C.J. The Political Economy of Regional Integration. *Annu. Rev. Political Sci.* **2017**, *20*, 229–248. [CrossRef]
 120. European Parliament. The Principle of Subsidiarity. Fact Sheets of the European Union. 2019. Available online: http://www.europarl.europa.eu/ftu/pdf/en/FTU_1.2.2.pdf (accessed on 25 July 2020).