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Biodiversity Agenda Congruent with 'One Health': Focusing on CBD, FAO, and WHO

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Abstract: The decrease in biodiversity occurs across national borders and has mutual influences on food and health. In this study, we analyzed the links and relationships between the decisions made by the Food and Agriculture Organization (FAO) of the United Nations, the World Health Organization (WHO), and the Convention on Biological Diversity (CBD)—the highest decision-making bodies in each field—from 1994 to 2018. We aimed to determine how each regime related to the decisions of others and identify the critical agendas that mediate the three regimes. Consequently, critical agendas, including agricultural biodiversity, taxonomy, traditional knowledge, access and benefit sharing, antimicrobial resistance, and marine biodiversity, were observed. In the order of degree centrality, the top six agendas were discussed in terms of the cooperation history of 'One Health' and its implications.

Keywords: biodiversity; Convention on Biological Diversity; disease; Food and Agriculture Organization of the United Nations; One Health; World Health Organization

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1. Introduction

Modern science emphasizes the solving of real problems [1], and the reason for the emphasis on interdisciplinary studies is the same. This reason also explains the genesis of the One Health perspective, which has recently attracted attention. The fields of biodiversity, nutrition, and disease—components of "One Health"—comprise distinct groups of experts, making it difficult for them to understand each another. In many countries, different components of One Health are in the remit of specific ministries. For example, in South Korea, regarding international negotiations, the Ministry of Agriculture, Ministry of the Environment, and Ministry of Health and Welfare are responsible for handling issues related to the Food and Agriculture Organization of the United Nations (FAO), Convention on Biological Diversity (CBD), and World Health Organization (WHO), respectively. The experts from different ministries handling the negotiations differ in terms of their knowledge and perspectives, even when faced with the same topic. For instance, geneticists are confident that transgenic plants possess a low level of risk, whereas biological ecologists are concerned that transgenic plants have not been thoroughly researched [2].

The mainstreaming of biodiversity, which is crucial for implementing the post-2020 Global Biodiversity Framework (GBF), cannot be achieved without the participation of the production sector [3]. Similarly, enhancing biodiversity can contribute to productivity in this sector. For example, conserving marine stocks could increase the annual profits of the seafood industry by more than USD 50 billion [4], and protecting coastal wetlands could save the insurance industry USD 52 billion annually by reducing flood damage losses [5]. Similarly, the agricultural sector has an incentive to protect the habitats of wild pollinators, which, along with managed populations, could increase global crop production by USD 235 billion to USD 577 billion annually [6].

Several seafood companies have recognized this benefit and have committed to the Seafood Business for Ocean Stewardship initiative for the sustainable management of

seafood resources and the oceans. However, in the current draft of the post-2020 GBF, it is difficult to identify exactly which part of the productive sectors or agenda can be attributed to an improvement in mainstreaming biodiversity, and which part can be attributed to other related sectors. Although the necessity of cooperation between the three fields of biodiversity, nutrition, and health has been discussed broadly, the nature of the links has not been defined. This study aims to identify the links between the three fields by measuring the connectivity of the agendas of the international organizations dealing with these fields. Thus, this research investigated, via network analysis, the links between the decisions made by the FAO, WHO, and CBD—the highest decision-making bodies in each field—from 1994 to 2018. In this way, we aimed to determine how the regime is related to the decisions of other regimes and identify the critical agendas by which the three regimes are mediated. For each agenda identified through the network analysis, we examined the cooperation history of 'One Health' and its scientific relevance.

2. Literature Review

2.1. Growing Scientific Evidence of One Health

Biodiversity reduction has attracted considerable attention in the health sector following the recent outbreak of the coronavirus disease 2019 pandemic. The 15th Global Risks Report, a study of global risk factors published in 2020 by the World Economic Forum (WEF), stated that the impact and likelihood of the global risk of biodiversity loss has continuously increased over the past three years. Among all the global concerns, biodiversity loss was ranked third and fourth in terms of impact and likelihood, respectively [7]. While biodiversity loss considerably affects humans because it can lead to virus outbreaks, it can provide breakthroughs in disease treatment. Deforestation, land conversion, and waterway changes alter the structure and function of ecosystems and enable new physical and chemical exchanges between organisms, creating an environment conducive to new diseases [8]. An example of which is the Ebola virus spread through contact with fruit bats and primates carrying the virus during deforestation activities in West Africa [9]. When ecosystems are disconnected because of the laying of roads or construction of waterways, biodiversity loss occurs. This acts as a factor accelerating the rate of disease transmission [10]. A case study by Keesing et al. [11] demonstrated that biodiversity loss accelerated disease transmission in the cases of the Sin Nombre hantavirus, West Nile encephalitis, and Lyme disease. Some researchers have argued that biodiversity presents the potential risk of harboring infectious diseases, because it can benefit zoonotic host species with various undiscovered pathogens. However, Keesing and Ostfeld [12] demonstrated that separate taxa play the role of zoonotic reservoir hosts, which are more abundant in disturbed areas of ecosystems. This supports the idea that biodiversity loss has a critical impact on new disease emergence, and the restoration of biodiversity is key to reducing the emergence of new infectious diseases. Alternatively, natural substances have been added to approximately 75% of anticancer drugs developed over the past 70 years, and 49% are developed using only natural materials. Biodiversity loss reduces the resources available for future pharmaceutical treatments and creates a shortage of the previously used materials [6].

Another reason for the high impact of biodiversity loss on humans is that our nutrition depends on biodiversity. The FAO separately defined "biodiversity for food and agriculture" and continues to work to identify the links between biodiversity and food, as biodiversity helps to maintain the resistance of production systems to external shocks. If modern crops and livestock, which are unified, lack resistance to rapidly spreading pests and diseases, the international food supply chain or human health may be threatened [13]. In the US, the fast-dwindling number of bees—which has decreased to less than half compared with that 75 years ago—has severely impacted pollination. Over the last 14 years, 30% of coral reefs have been destroyed owing to climate-change-related bleaching, which has profoundly affected 25% of the fish populations sustained by reefs [14]. An ecosystem with biodiversity is not easily disturbed by the introduction of foreign species and new pests. However, overfishing and the increased use of pesticides reduce biodiversity.

Biodiversity, health, and nutrition have an interconnected relationship. Morand [15], through empirical research, demonstrated that livestock expansion has a positive relationship with the frequency of infectious disease outbreaks and the number of threatened species. This finding also implies a correlation between human infectious disease and biodiversity loss. The workshop on biodiversity and pandemics by the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) also reported the inter-relationship between three factors: agricultural expansion and increases in livestock are associated with zoonotic disease outbreaks, land use for commercial plantations has great influences on biodiversity loss and emerging zoonotic diseases, and wildlife farming and trading and wildlife-derived business, such as apparel, medicine, and food, also cause severe biodiversity reductions and health issues [16].

The decrease in biodiversity occurs across national borders and has complex effects on food and health, which are essential for human life. Therefore, the efforts of the international community to promote biodiversity should consider nutrition and health. However, empirically identifying the connections and links between the fields of health, nutrition, and biodiversity is difficult.

2.2. How International Organizations Have Implemented Shared Agendas

Raustiala and Victor [17] showed that single organizations cannot establish action plans independently. Owing to the transdisciplinary and transboundary nature of biodiversity issues, the membership and shared agendas of international organizations dealing with similar topics are increasing. Connections between organizations that deal with different subjects can create opportunities for problem solving through organic and practical links between themes. Therefore, global interest in the effects of links between organizations centered on biodiversity has considerably increased.

The United Nations Framework Convention on Climate Change made the first attempt to create such a link. Institutional links between the parties and platforms where different actors can gather provide an opportunity to highlight various creative action agendas for climate change. For example, the climate summit held during the UN General Assembly in 2016 provided a fresh impetus for the Paris Agreement and sent a negative signal to the US in regard to its withdrawal from the Agreement [18]. In other words, in many cases, the driving force for efforts to solve problems can be obtained from other related international organizations. Abbott [19] noted that unexpected opportunities arise when different specialties work towards the same purpose. A cooperative initiative could mobilize a broader set of stakeholders, possibly improving the effectiveness of the international organization [20].

Alternatively, from a negative viewpoint, when approaching complex issues such as a link between organizations, it is difficult for actors in other fields to work independently and achieve their goals effectively unless the separate governance encompasses all domains [21]. Hale et al. [22] argued that international organizations covering various issues are "locked", leading to insufficient responses to complex modern challenges. Keohane and Nye [23] found that with the increasing density of international organizations, understanding the degree of influence of the organizations becomes progressively difficult. However, the international community is conducting a new experiment on shared global governance with organic links in the face of complex transboundary problems. Subsequently, accurately diagnosing the current state of this experiment through scientific analysis is necessary.

This study analyzes the relationship between the decisions of the FAO, WHO, and CBD. To the best of our knowledge, this is the first study to analyze the links between the implemented agendas of biodiversity, nutrition, and health. We determined how the related regime is represented in the decisions of each of the other regimes, examined the agendas that were raised to seek cooperation or coordination with international organizations, and identified the critical agendas mediating the three organizations and the three regimes.

3. Materials and Methods

3.1. Data

The background and a brief overview of the three organizations are illustrated in Table 1.

Table 1. Background and brief overview of the CBD, FAO, and WHO.

	CBD	FAO	WHO
Date of establishment	December 1993	October 1945	April 1948
Purpose of establishment	1. Conservation of biodiversity 2. Sustainable use of biodiversity 3. Equal sharing of the benefits of genetic resources	1. Improving nutrition and quality of life for everyone 2. Improving the production and distribution efficiency of food and agricultural products	1. Guidance and coordination of international health services 2. Providing intergovernmental aid for the development of the health sector in the Member States 3. Combating infectious diseases, endemics, and other diseases 4. Promoting cooperation between health sector institutions
Number of Member States	196	194	194
Headquarters	Montreal, Canada	Rome, Italy	Geneva, Switzerland
Highest Decision-Making Body	Conference of the Parties (COP)	Conference	World Health Assembly (WHA)
Conference (Assembly) Cycle	Biannual	Biannual	Annual
Roles of the Conference (Assembly)	- Adoption of decisions - Reports from the subsidiary body, financial mechanism - Review of program implementation	- Final review and decision on the activities and discussions of subgroups (decisions on the overall budget/management, recommendations on food and agricultural issues, reviews of subgroup resolutions, etc.)	- Committee: comprising Committee A (technical and health issues) and Committee B (budget and management issues) - Discussions on approval of decisions - Plenary: determining the adoption of decisions
Governing Bodies	- Conference of the Parties (COP) - Secretariats - Subsidiary Body on Scientific, Technical, and Technological Advice (SBSTTA) - Subsidiary Body on Implementation (SBI)	- Conference - Council - Executive Board - Committee on World Food Security - Regional conferences	- World Health Assembly - Secretariats - Executive Board - Regional Office

This study examined the decisions of the highest decision-making body of each organization to analyze the connections between the topics of the three organizations. Although the organizations technically differ, on the basis of their establishment, in the names of the highest decision-making bodies and decision documents, in this study, they are considered as having the same status for the following reasons. First, they have a comparable number of member states. The CBD is composed of 196 states, whereas the WHO and FAO are composed of 194 states each. Other international organizations in the field of biodiversity include the International Union for Conservation of Nature (IUCN) and IPBES. As of January 2022, the IUCN has 92 member states, whereas IPBES has 138. These numbers are very low compared with those of the WHO and FAO. Second, there is no alternative international body among the UN system or interstate agreements focusing only on food, nutrition, and health. Subsequently, we determined that the WHO, FAO, and CBD have a comparable status. Third, even though the WHO and FAO are not legally binding organizations for the member states, they are similar to the CBD owing to their duty to enact national laws for the member states, which ratify agreements adopted by the organization. For example, member states that ratified the FAO's International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) must enact domestic laws to implement the treaty. Similarly, the member states that ratified the WHO's Framework Convention on Tobacco Control are also obligated to revise their domestic laws according to the agreement. Recently, the WHO announced a plan to start negotiations for an international treaty concerning future pandemics, with the aims of its completion by 2024 and the obligation of the members to reflect the treaty in their domestic laws.

Furthermore, although the year of the first conference/assembly of each organization varies, documents from 1994, when the first Conference of Parties (COP) of the CBD was held, to 2018, when the latest COP was held, were analyzed. Specifically, these documents were from 1994 (1st) to 2018 (14th) for the CBD; 1995 (28th) to 2019 (41st) for the FAO; and 1998 (51st) to 2019 (72nd) for the WHO.

This study aims to identify the core agenda that connects each domain through a network analysis of the agenda documents of the international bodies dealing with different domains. Subsequently, we selected paragraphs from decision documents, including the annexes and appendices that mention other organizations. Consequently, 680 paragraphs were selected. The CBD mentioned the FAO or the WHO in 484 paragraphs. The FAO mentioned the others in 105 paragraphs, whereas the WHO mentioned the others in 91 paragraphs.

As the study purports to identify agendas fostering cooperation between the representative organizations regarding biodiversity, food, and health, some of the selected paragraphs were excluded for three reasons. First, they were excluded if they only mentioned the need to promote cooperation between organizations without a specific agenda; thus, 288 such paragraphs were excluded from the analysis. See, for example, "Encourages FAO to collaborate closely with the Executive Secretary of the CBD in FAO Resolution 1/97." The resolution is entitled "Preservation and Sustainable Utilization of Genetic Resources for Food and Agriculture," and one could infer the subject of cooperation. However, identifying the specific link to a specific agenda from the sentences was difficult.

Second, even when a specific agenda with other organizations was mentioned, it was excluded from the analysis if it merely defined the terms. For example, the paragraphs from Decision II/10 of the CBD were omitted because they cited only the definition of FAO when explaining the concept and scope of marine biodiversity, without mentioning the cooperation between the CBD and the FAO.

Third, paragraphs urging action on the part of the parties, rather than cooperation between them, were also excluded. For example, a paragraph from Resolution 5/97 of the FAO reads, "Urges all members affected by the damage to (a) reinforce their effects to the damage; (b) coordinate their actions through PAAT and the Joint FAO/WHO/OAU/IAEA Secretariat to this Program." It can be inferred that the FAO and WHO are collaborating; however, essentially, the text refers to the call for action to member states.

However, some of the paragraphs were double-counted as valid data. For example, the paragraphs selected from the CBD Decision VIII/27 were coded twice as separate data, with the agenda for "foreign invasive species" and "cooperation with World Organization for Animal Health (OIE)", as they mentioned the different types of specific cooperation.

Eventually, 533 paragraphs were selected, which included 394 CBD paragraphs (360 references to the FAO; 34 to the WHO), 70 FAO paragraphs (39 references to the CBD; 31 to the WHO), and 69 WHO paragraphs (6 references to the CBD; 63 to the FAO). At the general assembly of the three organizations, one decision document is created on one agenda that covers the adoption of agenda-related achievements or results, the status of the cooperation with other organizations, and future cooperation. We extracted the decision title as the agenda and the sub-agenda from the paragraphs when it referred to cooperation with other organizations. This enabled us to identify the sub-agendas that require cooperation with other organizations under each organizational agenda.

For example, the title of Decision VII/5 of the CBD COP7 is "Marine and coastal biological diversity." In Decision VII/5, "Annex1. Elaborated programme of work on marine and coastal biological diversity" is mentioned and cited repeatedly, and one of the paragraphs of "operational objective 5.2" in "programme element 5: invasive alien species" of Annex1 refers to the aim "(a) To invite relevant organizations such the International Maritime Organization (IMO), the Global Invasive Species Programme (GISP), the Food and Agriculture Organization of the United Nations (FAO), and the Ramsar Convention on Wetlands to work together to develop an international cooperative initiative to address impediments to the management of marine alien species, particularly to address technical problems related to the identification and control of marine invasions." This paragraph confirmed that the CBD would cooperate with the FAO regarding "invasive alien species."

3.2. Method

The core negotiation agendas that connect each One Health domain were examined through a network analysis of the agenda documents of the international bodies dealing with different domains so as to demonstrate the relationships between the agendas. Specifically, a centrality analysis was conducted to ascertain the importance of each node in the network in terms of the degree and closeness centralities.

The degree centrality was determined by the number of edges connected to one node and by dividing the analysis into "in-degree" and "out-degree" based on the direction of the connections [24]. As each connection has a direction because of the citation relation between the nodes in this analysis, degree centrality was divided into in-degrees and out-degrees depending on whether the direction of the edge was inward or outward. Therefore, the in-degree or out-degree centrality of node i (n_i) can be described as the sum of node j (n_i)s that is inwardly or outwardly connected to node i, respectively. The calculation is illustrated in Equation (1).

$$C_{D,in}(n_i) = \sum_{j=1}^{l} r_{ij,in}; C_{D,out}(n_i) = \sum_{j=1}^{l} r_{ij,out} \quad (1)$$

Closeness centrality measures the closeness between nodes, and unlike degree centrality, it measures direct and indirect connections. As the location of the node reflects its importance, the more critical the nodes are, the more central their location in the network is. The more essential the nodes are, the shorter their path compared with those of other nodes is, and the easier it is to obtain resources and information and spread them across the entire network. This indicates the directionality on the network, with directions measured separately in terms of in-closeness and out-closeness [25]. It was calculated by averaging the shortest distance from node A to the other nodes and reciprocating it, and the calculation is illustrated in Equation (2):

$$Cc(A) = \frac{N-1}{\sum X \neq A^{l} X, A} \quad (2)$$

where X is the nodes except A, and l is the shortest distance between nodes.

4. Results

Table 2 illustrates the results of our analysis of the degree and closeness centralities aiming to examine the citing–cited relations between the key agendas.

Table 2. Degree of centrality and closeness centrality of each agenda (nodes).

Node	Degree Centrality		Closeness Centrality	
	In-Degree (Citing)	**Out-Degree (Cited)**	**In-Closeness (Citing)**	**Out-Closeness (Cited)**
Access and Benefit Sharing	10	16	0.378	0.380
Access to Genetic Resources	10		0.370	
Agricultural Biodiversity	32	18	0.496	0.402
Alien Invasive Species	6		0.366	
Antimicrobial Resistance	10		0.374	
Article 8(J)		2		0.280
Bees	2		0.266	
Chemical Substances		10		0.368
Climate Change	4	12	0.341	0.365
Codex Alimentarius Commission	4		0.303	
Cold Water Biodiversity	2		0.249	
Disease	8		0.370	
Disease and Health		12		0.347
Dry and Sub-Humid Lands	8		0.363	
Ecosystem	2		0.283	
Ecosystem Approach	6	16	0.332	0.376
Ecosystem Service	2		0.335	
Energy		2		0.333
Food and Nutrition		20		0.389
Food Safety	6		0.363	
Forest Biodiversity	6	18	0.326	0.393
Genetic Resources	8	24	0.378	0.422
Genetic Use Restriction Technologies		2		0.280
Global Biodiversity Outlook	2		0.275	
Health		10		0.310
Health and Biodiversity	6		0.300	
Human Health	4		0.341	
Implementation of the Convention	18	24	0.419	0.412
Incentive	2		0.275	
Indigenous Issue		8		0.307
Infant/Child Nutrition	4		0.320	

Table 2. *Cont.*

Node	Degree Centrality		Closeness Centrality	
	In-Degree (Citing)	Out-Degree (Cited)	In-Closeness (Citing)	Out-Closeness (Cited)
Information and Data		16		0.372
Inland Aquatic Biodiversity		2		0.269
Inland Water Ecosystems	8		0.366	
Intellectual Property		2		0.333
Island Biodiversity	2		0.272	
ITPGRFA	6		0.332	
Land		10		0.385
Mainstreaming Biodiversity	6	14	0.293	0.372
Marine Biodiversity	10	12	0.338	0.330
Nagoya Protocol	2		0.277	
Nutrition	2		0.281	
Other IO Cooperation	16	46	0.419	0.500
Pandemic Influenza Preparedness and Response	2		0.237	
Pesticide	4		0.338	
PIP Framework	6		0.363	
Plant Conservation	8		0.335	
Plant Genetic Resources	6	2	0.363	0.333
Pollinators	8		0.359	
Pollinator Diversity		8		0.361
Poverty Eradication	6		0.311	
Protected Areas	4		0.300	
Strategic Plan/Aichi's Biodiversity Targets	18		0.452	
Sustainable Use of Biodiversity	6		0.363	
Taxonomy	14	2	0.387	0.280
Traditional Knowledge	14	2	0.387	0.252
Water Management		2		0.297
Wildlife	2		0.293	

Among the citing (in) agendas, "agricultural biodiversity" is the most important agenda in terms of both degree centrality (32) and closeness centrality (0.496). In degree centrality, it is followed by the implementation (18), other IOs cooperation (16), taxonomy/traditional knowledge (14), and access and benefit sharing/access to genetic resources/antimicrobial resistance/marine biodiversity (10). In closeness centrality, it is followed by implementation/cooperation (0.419), traditional knowledge/taxonomy (0.387), access and benefit sharing/genetic resources (0.378), and antimicrobial resistance (AMR) (0.374).

Alternatively, "other IOs cooperation", which means cooperation with related international organizations other than the CBD, FAO, and WHO, is necessary and indicates the highest centrality out of both centralities among the cited (out) agendas. Therefore, regardless of the citing and cited relations, the agenda "other IOs cooperation" has many

connections to various agendas (degree), and the distance between the agendas is short (closeness). In degree centrality, it is followed by implementation/genetic resources (24), food and nutrition (20), agricultural biodiversity/forest biodiversity (18), access and benefit sharing/ecosystem approach/information and data (16), mainstreaming biodiversity (14), and climate change/disease and health/marine biodiversity (12). In closeness centrality, it is followed by genetic resources (0.422), implementation (0.412), agricultural biodiversity (0.4), forest biodiversity (0.393), food and nutrition (0.389), land (0.385), and access and benefit sharing (0.38). In Section 5, the agenda is explained, with a focus on the high degree centrality as well as the specific areas in which the three organizations have cooperated historically.

5. Discussion

This study determined the agendas promoting cooperation between the fields of biodiversity, food, and health fields through an empirical analysis. However, it is important to determine whether actual cooperation occurred outside the cooperation table to solve the problems of each agenda and achieve a One Health approach. Thus, as described in this section, we tracked the cooperation activities of the core agendas to identify whether there was real cooperation in the real world. However, collecting all the cases of cooperation in the real world is not possible. Therefore, a limitation of this study is that it only describes cases when cooperation was mentioned in the decisions. The agendas are discussed in the order of in-degree centrality value, which is higher than ten among the citing agendas. This is because they are the core agendas that are highly relevant to those of other organizations.

5.1. Agricultural Biodiversity

Agricultural biodiversity has the highest degree centrality value among the citing agendas, and the CBD has recognized agricultural biodiversity as a critical agenda since its establishment. At the Nairobi Conference for the Adoption of the Agreed Text of the Convention on Biological Diversity, to establish the CBD, the "Nairobi Final Act of the Conference for the Adoption of the Agreed Text of the Convention on Biological Diversity" was adopted. Specifically, Resolution 3, "The Interrelationship between the Convention on Biological Diversity and the Promotion of Sustainable Agriculture," emphasizes the link between biodiversity and agriculture and provides recommendations for future activities [26]. This resolution has been mentioned in the decisions on agriculture since the first CBD conference, which affects decision making by the CBD regarding agriculture. In the decision based on the midterm program of COP 1 (Decision I/9), the "Conservation and Sustainable Use of Agricultural Biological Diversity" was suggested as the main agenda.

As the issue of agricultural biodiversity is extremely relevant to genetic resources, it has affected the operational definition and nature of the agreement, as well as discussions on the cooperation between agricultural and genetic resources, with respect to two decisions (Decision II/15, II/16) of COP 2, wherein the role and activity themes of the CBD began to emerge. Based on Resolution 3 of the Nairobi Final Act, Decision II/15 declared the support of CBD for processes related to the FAO Commission on Plant Genetic Resources (the name was changed to the Commission on Genetic Resources for Food and Agriculture in 1995) by implementing the Resolution 7/93 of FAO and hosting the 4th World Food and Agricultural Genetic Resources Conference. Additionally, Decision II/16 revealed the need and desire to cooperate based on an understanding of two factors that comprise the foundation for building a supplementation program for the CBD and FAO, focusing on genetic resources. These include the importance of the role of the FAO concerning crucial issues related to food and agricultural genetic resources and the number of common member states in the CBD and FAO. Consequently, the CBD decided to establish a working program on agricultural biological diversity at COP 3 (Decision III/11), approved the working program at COP 5 in 2000 (Decision V/5), and adopted its implementation at COP 6 (Decision VI/5). By COP 10, several decisions had been made and recorded in

separate decision documents on agricultural biodiversity (Decision VII/3, Decision VIII/23, Decision IX/2, and Decision X/34).

The CBD implements related activities because biodiversity is directly linked to food and nutrition issues. For example, one of the four cross-cutting initiatives on the agricultural biodiversity program of the CBD is the "Cross-cutting Initiative on Biodiversity for Food and Nutrition." It was established at COP 8 in 2006 (Decision VIII/23A) after the need for initiatives (Decision VII/32) was raised at COP 7 in 2004. In the same year, Ahmed Djoghlaf, then CBD secretary-general, emphasized that investment in biodiversity is the same as investment in food security during a congratulatory speech on World Food Day.

The FAO is a representative international organization governing food and agriculture and, therefore, agricultural biodiversity is a topic directly related to the identity of the FAO. The FAO has emphasized the importance of biodiversity conservation, agriculture, and food because of their great influences on each other. In 2016, the technical and policy guidelines jointly published by the FAO and the CBD entitled "Mainstreaming Ecosystem Services and Biodiversity into Agricultural Production and Management" were provided to the Eastern Africa and Pacific Islands [27], and the FAO Conference in 2019 approved the "FAO Strategy on Mainstreaming Biodiversity Across Agricultural Sectors", indicating that the strategy was part of the post-2020 GBF of the CBD. The strategy applies to all FAO activities that affect biodiversity and ecosystems and emphasizes the necessity of cooperation with the CBD.

Agriculture destroys biodiversity by converting natural habitats into intensely managed systems and releasing pollutants, including greenhouse gases [28]. Thus, reducing the impact of the food system on biodiversity is a critical challenge. Guerrero-Pineda et al. [29] suggested that agricultural expansion will increase national biodiversity loss by 38–52% by 2033, and that doubling investment is necessary to counteract this loss. Moreover, preserving global biodiversity requires rapid agricultural improvements. Therefore, fruit producers have been considering nature-friendly production methods that reduce intensive pesticide use and enhance orchard management [30]. In addition, the concept of organic agriculture has also been suggested. Organic agriculture relies on a number of farming practices based on ecological cycles, and it aims to minimize the environmental impact of the food industry, preserving the long-term sustainability of soil and minimizing the use of non-renewable resources [31].

5.2. Taxonomy

The centrality value of taxonomy as a citing agenda is high, indicating that it cites many other agendas. Although it is essential to establish policies to identify local biological species and preserve biodiversity, numerous countries have been affected by taxonomic impediments because of the absence of taxonomic information and specialty. Therefore, the CBD established and promoted the implementation of the Global Taxonomic Initiative (GTI). It also approved a work program of COP 6 aiming to solve this problem and advocate the sustainable use of, and equitable access to, genetic resources and benefits. The implementation plan in the work plan identifies the participation and cooperation of various players, referring to the FAO as a key player and cooperation partner for activities regarding the assessment of global taxonomic needs, agricultural biodiversity, dry and sub-humid land biodiversity, and access and benefit sharing (Decision VI/8).

At COP 8, mountain biodiversity, invasive alien species, protected areas, and island biodiversity were added to the list of topics in the GTI work plan. Regarding mountain biodiversity, the FAO was mentioned as a key actor (Decision VIII/3). Additionally, at COP 9, the CBD approved the expected performance of each goal of the work plan presented by the GTI and its coordination mechanism, which stated specific figures related to the goals, schedule, and cooperation with the FAO and other organizations (Decision IX/22).

As the FAO also deals with agriculture and food, various taxonomy-related activities are being executed. The FAO/UNESCO Legend of the Soil Map of the World was created in 1974 after the need for a soil map emerged in 1968, and this was revised in 1988. The

FAO published the World Reference Base (WRB) in 1998 with the Working Group World Reference Base for Soil Resources of the International Union of Soil Sciences (IUSS) to build a more sophisticated and scientific soil classification system. The WRB was revised twice, specifically in 2006 and 2014 [32]. Furthermore, the Global Soil Partnership for sustainable soil management was launched in 2012. The document suggests the "harmonization of methods, measurements, and indicators for the sustainable management and protection of soil resources" as one of the core activities in the background paper and mentions the WRB. Additionally, this document emphasizes the cooperation between soil management and the CBD and its relevance. For example, the FAO and CBD jointly conducted the "National Survey on the Status of Soil Biodiversity."

In addition to establishing these international standards, the FAO is also working on the identification and listing of regional fish and aquatic species and the implementation of capacity-building programs to manage food resources using taxonomy in developing countries [33].

Morrison et al. [34] found that the division of taxa tends to increase protection. There are many ways in which taxonomists can improve the value and impact of their research on conservation biology and other biological disciplines, such as the explicit citation of the species concept employed in new taxonomic descriptions and the inclusion of information on distributions, ecology, conservation status, and potential threats [35]. Mace [36] suggested two kinds of taxonomic solutions to support conservation, specifically (i) a set of practical rules to standardize the species units included in lists, and (ii) an approach to the units selected for conservation recovery planning which recognizes the dynamic nature of natural systems and the differences between the units in the resulting listing processes. The development of "best practices" by both conservation biologists and taxonomists who are working together may eliminate many unnecessary problems when using taxon names to represent vulnerable biological units in nature, thereby improving the effectiveness of their protection without impeding scientific progress [35].

5.3. Traditional Knowledge

Traditional knowledge is both a citing and a cited agenda. However, its centrality value is higher as a citing agenda. Thus, it is an agenda that frequently cites other agendas. The first mention of traditional knowledge in the CBD COP decisions is found in Decision III/14 on the implementation of Article 8(j), adopted at COP 3. The decision called for the participation of the indigenous and local communities, member states, and relevant organizations, emphasizing that the traditional knowledge of indigenous and local communities should be respected akin to all other types of knowledge.

At COP 4 in 1998, the intellectual property rights of traditional knowledge were affiliated with the World Intellectual Property Organization. Additionally, the necessity of cooperation with other relevant organizations was discussed over several decisions (Decisions VI/10, VII/16, X/43, XI/14). Various organizations that have discussed the protection of traditional knowledge in the past are mentioned when the CBD deals with issues related to traditional knowledge. For example, in the Trade-Related Intellectual Properties agreement, the World Trade Organization developed regulations to protect traditional knowledge and intellectual property rights concerning patent requirements, medical methods, and source disclosure. The United Nations Educational, Scientific, and Cultural Organization also has regulations to protect folklore.

The FAO also addressed the issues related to the protection of plant genetic resources and traditional knowledge regarding food and agriculture at its 31st conference by adopting the ITPGRFA. The CBD and the ITPGRFA have collaborated for the purposes of access and benefit sharing (ABS), biodiversity, and sustainable utilization. Moreover, in 2018, the two secretariats signed a memorandum of understanding (MOU) to strengthen their cooperation. This MOU created synergy by linking the "Global Information System" of ITPGRFA and "Access and Profit Sharing Information System" of the CBD and aiding cooperation, innovation, and research for the purpose of ABS capacity development [37].

Aichi Biodiversity Target's Detailed Objective No. 18 also deals with traditional knowledge. Farmers' rights are the sharing point between the CBD and the FAO, which are associated with this goal regarding the rights of indigenous people and local communities related to traditional knowledge, innovation, customs, and related genetic resources [38]. They are crucial in the preservation and sustainable use of plant genetic resources for food and agriculture, and even food security. Their rights have been the subject of cooperation between the CBD and the FAO since the former's establishment, as one of the two unsolved problems associated with plant genetic resources in Resolution 3 of the Nairobi Final Act is the "Question of Farmers' Rights." ITPGRFA's Article 9 on farmers' rights highlights the contributions of local and indigenous communities and farmers, particularly in areas where biodiversity is conserved, and suggests measures to protect and realize their rights related to plant genetic resources and profit sharing [39]. Additionally, the CBD participated in the Global Consultation on Farmers' Rights, organized by the FAO and the ITPGRFA.

The FAO also recognized the impacts of family farmers, indigenous people, and local communities on biodiversity and initiated the FAO Globally Imported Agricultural Heritage Systems (GIAHS). The relevance of the GIAHS is explained in Article 10(c) and Article 8(j) of the CBD and mentioned in Decision X/34. The GIAHS attended the CBD COPs 10, 11, and 12 and held a side event to report and discuss the traditional forms of agricultural communities and highlight agricultural methods that contribute to biodiversity conservation [40].

The contributions of traditional knowledge to biodiversity conservation, food security, and health improvements are well acknowledged in the literature. For example, traditional knowledge systems have proved effective and valuable in supporting local biodiversity [41–44]. Additionally, traditional health care is a helpful and trusted service, even in urban areas, where biomedical health care is available [45–48].

5.4. Access and Benefit-Sharing

The discussion of national sovereignty over genetic resources can also be found in the Rio Declaration in 1992. The World Summit on Sustainable Development called for the implementation of profit sharing and fair access to genetic resources, and the CBD adopted The Bonn Guidelines in 2002. In 2010, the Nagoya Protocol was adopted at the CBD COP as an international regime aiming to share genetic resource profits. In the FAO, cooperative issues on access to genetic resources and the sharing of profits arose during the conference in 2009, and since then, several movements have occurred concerning the FAO and the voice of the international community on fair access to genetic resources and profit sharing.

In 1996, the "Leipzig Declaration on Conservation and Sustainable Utilization of Plant Genetic Resources for Food Additionally, Agriculture" and the "Global Plan of Action on Conservation and Sustainable Use of Plant Genetic Resources for Food and Agriculture" were adopted as critical elements of the "FAO Global System for Conservation and Utilization of Plant Genetic Resources," which targets the implementation of Agenda 21 and cooperation with the CBD. In 2001, the FAO member states adopted the International Treatment for Plant Genetic Resources for Food and Agriculture to ensure the conservation and sustainable utilization of plant agricultural genetic resources and the fair and equitable distribution of profits. At the 2009 conference, discussions were held in order to issue the "Report on the State of the World's Plant Genetic Resources for Food and Agriculture" (Resolution 18/2009). Based on this, the "Second Global Plan of Action on Conservation and Sustainable Use of Plant Genetic Resources and Agriculture" was published in 2011.

According to Evans [49], benefits should be shared for four reasons: utility, equity, justice, and liberty. Access and benefit sharing can be helpful in virus outbreaks, such as Ebola or the recent coronavirus [50]. Sett et al. [51] argued that "multilateral" benefit sharing has occurred during the COVID-19 pandemic and that the system has been useful. Access and benefit sharing will become even more important agendas for cooperation between the three organizations in the coming years due to COVID-19.

5.5. Antimicrobial Resistance

Antimicrobial resistance has high degree centrality and closeness centrality values as a citing agenda. However, it has not yet appeared as a cited agenda. In 2014, the Second International Conference on Nutrition, co-hosted by the FAO and the WHO, called for actions to build a sustainable food system, reduce poverty, improve all types of malnutrition, and implement consistent policies across the entire process from food production to consumption. In particular, it raised the need for a food system that can prevent epidemics and tackle antibiotic resistance issues and emphasized the need to establish a legal framework of food safety and quality, such as the proper use of pesticides, through participation in the Codex Alimentarius Commission.

This was reflected in the FAO Conference in 2015 (Resolution 4/2015), which emphasized that the decision adopted at the 67th World Health Assembly needs to address antibiotic resistance through the triangular cooperation of the FAO, OIE, and WHO regarding One Health. Resolution 4/2015 also urged cooperation between the FAO, OIE, WHO, and various intergovernmental organizations and stakeholders so as to participate in the prevention and management of antibiotic resistance, mentioning the adoption of the Global Action Plan on Antimicrobial Resistance (WHA 68.7) at the 68th World Health Assembly.

Since then, various related organizations have made decisions on antibiotic resistance. In 2016, the general session of the World Assembly of the OIE adopted a resolution on antibiotic resistance (No. 36), and in 2018, antibiotic resistance was addressed in UNEP's Decision on Environment and Health (UNEP/EA.3/Res.4). The 72nd World Health Assembly held in 2019 also adopted a decision on antibiotic resistance. In 2018, an MOU regarding cooperation aiming to combine health risks at the animal–human ecosystem interface through the One Health approach, including antimicrobial resistance, between the FAO, OIE, and WHO was established. This led to the Tripartite Workplan on AMR (2019–2020) for long-term cooperation through the One Health approach. Consequently, through close cooperation with the UNEP, the FAO conference in 2019 adopted Resolution 6/2019, highlighting the role of the FAO in strengthening cooperation with the OIE and WHO and implementing the plan.

In addition, many countries have adopted a 'One Health' approach within their action plans to address antimicrobial resistance [52]. The action plans include improvements in the regulations and policies on antimicrobial use, infection control, supervision and stewardship, animal husbandry, and alternatives to antimicrobials. White and Hughes [53] highlighted the importance of 'One Health', which is an integrated and holistic multisectoral approach, in combating antimicrobial resistance. Singh et al. [54]) discussed the global antimicrobial resistance partnership and the 'One Health' participation of stakeholders, including public, government, and healthcare professionals, as key strategies to mitigate antimicrobial resistance.

5.6. Marine Biodiversity

Marine biodiversity has a similar frequency in terms of its citations and subjects. Regarding the degree, it is higher. However, regarding closeness, it is less central to agenda items, with a lower degree. It was mentioned at COP 2 as the working program development began in earnest. Guidelines for the development and implementation of working programs were provided at the relevant General Assembly, and regulations on cooperation with related agreements and organizations were prepared. The Ministerial Statement called the "Jakarta Mandate on Marine and Coastal Biological Diversity" emphasized the role of the COP in the preservation and sustainable use of marine biodiversity and urged the parties to take immediate action to implement the decision (Decision II/10). At COP 4, decisions on the facilitation of program implementation were adopted (decision IV/5), including work programs described in Decision II/10, and various topics related to marine biodiversity were developed and addressed at later general meetings, starting with the addition of coral bleaching to COP 5. Coral-reef-related issues were addressed at COP 6 (Decision VI/3) and COP 7 (Decision VII/5). At COP 8, the decisions on the conservation and

sustainable use of deep-seabed genetic resources beyond the limits of national jurisdiction (Decision VIII/21), integrated marine and coastal area management (IMCAM) (Decision VIII/22), marine protected areas (Decision VIII/24), and ocean fertilization (Decision IX/20) were adopted. Specifically, at COP 13, four decisions were adopted on issues and actions related to marine biodiversity (Decisions XIII/9, XIII/10, XIII/11, and XIII/12).

At COP 10, the Sustainable Ocean Initiative (SOI) was launched to strengthen the capabilities of developing countries by sharing experience and knowledge regarding the conservation and sustainable use of marine biodiversity. The Action Plan For The Sustainable Ocean Initiative (2015–2020) lists various international organizations, initiatives, and countries as partners, including the FAO. Following the launch of the SOI, the Yeosu Declaration was announced in 2012 in cooperation with the Government of South Korea, and the FAO secretary-general attended the Yeosu Declaration Forum. The Sustainable Ocean Initiative Global Dialogues with Regional Seas Organizations and Regional Fisheries Bodies on Accelerating Progress Towards the Aichi Biodiversity Targets were hosted by the CBD and co-sponsored by the FAO in 2016 and 2018. Owing to the 2016 forum, the Seoul Declaration was announced. In 2018, prior discussions were held to prepare for observations on the implementation of the declaration and discussions at COP 14.

The FAO had previously recognized the importance of biodiversity in the fishing sector, including aquaculture. It published the Code of Conduct for Responsible Fisheries in 1995, which provided principles and international standards for the preservation and management of marine biodiversity and ecosystems. It also publishes the State of World Fisheries and Aquaculture (SOFIA) on a biannual basis, emphasizing the importance of fisheries and aquaculture in food production and urging efforts to analyze the status of marine life resources and industries. Aquaculture is set to provide a contribution to supply the majority of global seafood consumption by 2050 [55]. The 2020 edition of the SOFIA mentions the participation of the FAO in multilateral marine-related biodiversity agreements. It also emphasizes that goals such as the post-2020 GBF of the CBD should be well established so as to attract greater international funding and facilitate cross-sector links. This increases the consistency of policies and implementation of biodiversity conservation and generates performance among the sectors, highlighting the importance of defining the goals of biodiversity conservation and the associations between areas [56].

Nonetheless, in spite of the high potential of the 'One Health' framework to act as an indicator of ocean health, there are limitations. For instance, corals present many significant challenges due to the complexity of their biology, as well as the associated higher-level ecological and socio-ecological interactions [57]. Therefore, the integration of marine diversity research into the One Health framework is required to broaden the importance of marine ecosystems for human health.

6. Conclusions

This research investigated, via network analysis, the links between the decisions made by the FAO, WHO, and CBD from 1994 to 2018. We aimed to determine how each regime related to the decisions of others and what critical agendas mediate the three regimes. Consequently, critical agendas, including agricultural biodiversity, taxonomy, traditional knowledge, access and benefit sharing, antimicrobial resistance, and marine biodiversity, were identified. In the order of degree centrality, the top six agendas were discussed in terms of the cooperation history of 'One Health' and its implications. However, this result can be changed if the target organization and target period are different. In addition, the agendas through which CBD, FAO, and WHO have historically collaborated do not refer to all the cooperative agendas that the international community has participated in for the purpose of 'One Health'. For example, water management, which has a low degree centrality of 2 in this research, may become an important cooperative agenda after the present year, which has witnessed many floods. Nevertheless, since the top agendas identified by network analysis are also important cooperative agendas in real life, this study showed that the results of network analysis can act as useful indicators of which

agenda mediated the cooperation between the organization of interest during the period of interest.

International agreements do not occur in isolation. Whether it is scientific evidence or political events, the parallel events linked to each other facilitate the process or complicate matters [58]. The more complex the issue is, the more difficult it is to reach a consensus on its implementation. As seen from the analysis of the decision texts of international organizations, the international community shares several common agendas. However, the context in which the agendas appear (in this case, the decision texts) are different. Therefore, our contextual understanding of common agendas must be enhanced [59]. The United Nations Conference on Environment and Development evaluated international agreements according to the means through which the original agreement leads to the development of a new agreement [60]. Therefore, the degree of linkage of a convention or the extent to which it influences other conventions proves its effectiveness. Links to other issues also enhance its political and public profile.

Owing to the complex nature of the subject matter of the CBD, several events have influenced its negotiations, and the convention has affected other issues. Glowka et al. [61] mentioned three pieces of evidence to argue that the CBD is a framework convention: (1) it has created a structure that promotes continued international cooperation; (2) it fosters the basis for creating a more binding provision of loose legal content through its protocols; and (3) it builds upon existing agreements that target specific species, sites, or activities. The objectives of the CBD regarding conservation, sustainable use, and benefit sharing build upon pre-existing agreements, such as the Convention on Migratory Species, the Ramsar Convention, and the Convention on International Trade in Endangered Species of Wild Fauna and Flora. However, the CBD goes beyond conservation and addresses non-traditional issues, such as access and benefit sharing based on genetic resources, the use of, and access to, biotechnology as a subject of negotiation, and an agreement that deals with all the issues in this field in a complex manner.

Reinforcing the aspect as a framework convention that can be used to understand the decisions of all three organizations responsible for an individual axis of One Health can create an alternative that can help us move towards an agreement that solves real problems in the future. To this end, membership sharing between the three organizations, including the national delegates of different ministries, should be promoted. Corporations in the productive sector, crucial participants, and beneficiaries of biodiversity—as noted in the introduction to this paper—should officially participate in the establishment of the objectives, timelines, and implementation reviews.

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