Mapping Seascapes of International Environmental Arrangements in the Coral Triangle

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Abstract

The Coral Triangle Initiative on Coral Reefs, Fisheries and Food Security (CTI), adopted recently in response to the degradation of coastal and marine environments in the Southeast Asia-Pacific’s Coral Triangle, emphasises the need for using existing international and regional fora to promote implementation. Large-scale marine initiatives, including the CTI, very often must contend with a remarkably complex institutional system. This raises the question of whether and how such complexity can be conducive to marine resources management. To answer this question, this paper aims to better understand the governance context in which the CTI was established (i.e., map governance fragmentation/complexity), and explore how such a context may support the implementation of the CTI goals (i.e., examine normative interplay). To conduct this examination it uses an objective method that allows users to view and explore institutional arrangements through a network approach. By documenting the system of existing institutions in the Coral Triangle, the study shows that the Coral Triangle governance system is illustrative of those of international environmental governance. It involves multiple policy domains, and features different institutional arrangements and variability in terms of geographical scope and main subject matter. Such a system is complex and fragmented, marked by jurisdiction and functional overlaps. The paper suggests interplay management, such as inter-institutional learning and enhancing institutional synergy, as a promising process to promote inter-institutional coordination.

Keywords: governance architecture, international environmental agreements, inter-institutional coordination, large-scale systems, Coral Triangle Initiative

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1. Introduction

Ocean problems increasingly are marked by massive decline in ecosystem health and resource conditions [1]. A recent report by the World Resources Institute warns of a “global coral crisis” with 75% of coral reefs currently in danger from overfishing, pollution and climate change. If these threats persist, scientists estimate that more than 90% of reefs will be at risk by 2030 and nearly all reefs will be at risk by 2050 [2]. At the centre of this “global coral crisis” is the Coral Triangle, a region in Southeast Asia and the Pacific regarded as the world’s epicentre of marine life diversity and a global hotspot for conservation. In response to the degradation of coastal and marine environments in this region, the Coral Triangle countries have recently adopted a large-scale intervention, namely the Coral Triangle Initiative on Coral Reefs, Fisheries and Food Security (CTI).

Similar to the CTI, action at large scales is regarded as critical to maintain and restore the health of the ocean [3, 4, 5]. Large-scale marine areas (e.g., Marine Ecoregions, Seascapes, Large Marine Ecosystems, and Regional Seas Programs) have been widely used as a preferred way to define areas for ecosystem-based management [3, 6, 7, 8]. Examples of these large-scale marine areas include the Papuan Bird’s Head and Sulu-Sulawesi Sea Seascapes; the Caribbean Sea, Indonesia Sea and Gulf of Mexico LMEs (among 16 LMEs programs implemented globally); and the Antarctic, Baltic and the Pacific Regional Seas (among 18 Regional Programs across the world) [7]. Currently, there still seem to be considerable impetus for establishing large-scale marine areas for management and conservation. For instance, the Pew Environment Group’s Global Ocean Legacy program expect to see soon New Zealand approve a 630,000 km² protected area in the Kermadec Islands, and Australia a 900,000 km² area in the Coral Sea [9].

Challenge of international governance

Large-scale marine areas very often must contend with a remarkably complex institutional system [10, 11, 12, 13] – in this paper, institutions or institutional arrangements are defined as systems of formal and informal rules, decision-making procedures, and programs that govern the behaviour of social and political actors [14, 15]. Exacerbating the challenge of understanding marine governance is that it often involves a number of parallel transnational institutional arrangements (e.g., bi- and multilateral agreements) that are maintained by different social and political actors. These arrangements are in general fragmented, in that they tend to address issues separately that are inherently interdependent (e.g., fisheries, coral reefs, biodiversity, climate change) [6, 16, 17]. In fact, fragmentation is an ubiquitous phenomenon of international relations [18, 19]; it very often arises from incremental processes of institutional design that are decentralised and barely planned [19]. It is estimated that more than 1,000 multilateral environmental agreements currently exist globally [20]; and, on average, more than 20 new such agreements are adopted every year [21].

Many of these agreements have evolved independently; have different geographic and issue scopes and feature different patterns of codification, institutionalisation and cohesion [19]. As a result, the siloed approach in which these agreements are developed can create overlaps (between agreements), which in turn give rise to both challenges and opportunities for governance [10, 22, 23, 24, 25].

Navigating such governance systems is critical in coping with challenges (e.g., inconsistencies) and capitalising on opportunities that complexity and fragmentation may render. This in turn, requires
developing a better understanding of the institutional arrangements comprising governance systems. Governance system – also known as governance architecture [see e.g., 19] – is a key topic of exploration in the field of (global) environmental governance, and has been identified as a major long-term research challenge. Only very recently scholars have begun to investigate multiple institutions simultaneously and their interactions, as opposed to studies that have traditionally focused on a single institution or on interactions between a couple of institutions [18, 19, 26, 27, 28, 29, 30].

Research problem
The inherently complex landscape of international environmental governance raises the question of whether and how such complexity can be conducive to marine resources management in large-scale marine systems. The paper begins to explore this question focusing on the Coral Triangle as a case, given its importance as a global conservation hotspot and the considerable momentum gathered around regional governance in the region. The objectives of this paper are two-fold. First, to understand better the governance context in which the CTI was established (i.e., map governance fragmentation), and explore how such a context may support the implementation of the CTI goals (i.e., examine normative interplay). Second, to demonstrate a method that objectively allows users to view and explore institutional arrangements through a network approach.

The paper provides a systems view to explore the existing international environmental arrangements that apply to various issues in the Coral Triangle (e.g., marine protected areas, fisheries, ecosystem-based management, climate change), and help determining which international environmental arrangements relate to the goals of the CTI and to what extent (i.e., normative interplay based on shared issues [31], as discussed later). Together these analyses may help identify potential coordination opportunities between the extant international arrangements that are typically focused primarily on a single issue (or limited number of issues) of concern and the CTI.

This paper is outlined as follows. Section 2 describes the Coral Triangle and introduces the recently established CTI, which serves as the basis of this investigation. The subsequent section presents the conceptual background and the methods used. In Section 4, the results of the exploration of arrangements that apply to the Coral Triangle are presented. Section 5 follows with a discussion of the results, and options for inter-institutional collaboration. The paper concludes by highlighting some limitations of this project and future research directions.

2. The Coral Triangle Initiative
The Coral Triangle is an archipelagic region of approximately 5.7 million km² (roughly half the size of the United States) encompassing the seas of Indonesia (central and eastern), Malaysia (Sabah), the Philippines, Timor Leste, Papua New Guinea and the Solomon Islands [32] (Figure 1). The significance of the Coral Triangle in terms of marine biodiversity is outstanding; as mentioned above, the region is regarded as the epicentre for marine life biodiversity and abundance. It contains 76% of all known coral species, 37% of all known coral reef fish species, 53% of the world’s coral reefs, the greatest extent of mangrove forests in the world, and spawning and juvenile growth areas for important
commercial fisheries. In addition, coastal and marine resources provide benefits to the economy of all Coral Triangle countries, and over 120 million people in the region depend directly on these resources for income, livelihood and food security [33]. However, marine and coastal resources in the Coral Triangle are under significant and increasing threat. The region sits at a crossroads of rapidly expanding populations, economic growth and international trade. Increasing pressures on marine and coastal resources, including over-fishing, unsustainable fishing practices, land-based sources of marine pollution, coastal habitat conversion, and climate change are of great concern [2, 34].

Figure 1: Map of the Coral Triangle region (after [35, 36]).

The Coral Triangle Initiative on Coral Reefs, Fisheries and Food Security (CTI) – an intergovernmental agreement between Malaysia, Philippines, Indonesia, Timor Leste, Papua New Guinea and Solomon Islands – has been adopted as an attempt to reverse degradation of coastal and marine environments and pursue a more sustainable use of natural resources in the Coral Triangle. The CTI seeks “...to address threats to the marine, coastal, and small island ecosystems within the Coral Triangle region, through accelerated and collaborative action, taking into consideration multi-stakeholder participation...” [37]. A Regional Plan of Action was adopted in May 2009 when the leaders of the six member states signed the Leaders’ Declaration with support from various donors and international NGOs (including the governments of the United States and Australia, the Global Environment Facility, the Asian Development Bank, the Nature Conservancy, Conservation International, and the World Wide Fund for Nature).
The Regional Plan of Action is a core element of the CTI. It comprises a legally non-binding document setting out the core goals, targets and actions of the CTI for a ten-year period. Its main goals include the designation of priority seascapes, implementation of ecosystem approach to fisheries management and other resources, establishment of networks of marine protected areas, coordination of climate adaptation action, and the protection of threatened species (Table 1). The Regional Plan of Action is regarded as the overarching strategy for the national action plans developed by each CTI member country.

Table 1: Goals and targets of the Coral Triangle Initiative [33].

<table>
<thead>
<tr>
<th>GOAL 1: Priority Seascapes Designed and Effectively Managed</th>
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<tbody>
<tr>
<td>Target 1: Priority Seacape designed, with investments plans completed and sequenced by 2012</td>
</tr>
<tr>
<td>Target 2: Marine and coastal resources within all priority seascapes sustainably managed by 2020</td>
</tr>
</tbody>
</table>

**GOAL 2: Ecosystem Approach to Management of Fisheries (EAFM) and Other Marine Resources Fully Applied**

Target 1: Strong legislative, policy and regulatory frameworks in place for achieving an ecosystem approach to fisheries management by 2012

Target 2: Income, livelihoods and food security in an increasingly significant number of coastal communities across the region improved through a new sustainable Coastal Fisheries and Poverty Reduction Initiative (“COASTFISH”) by 2020

Target 3: Effective measures in place to help ensure exploitation of shared tuna stocks is sustainable, with tuna spawning areas and juvenile growth stages adequately protected by 2020

Target 4: A more effective management and more sustainable trade in live-reef fish and reef-based ornaments achieved by 2020

**GOAL 3: Marine Protected Areas (MPAs) Established and Effectively Managed**

Target 1: Region-wide Coral Triangle MPA system (CTMPAs) in place and fully functional by 2020

**GOAL 4: Climate Change Adaptation Measures Achieved**

Target 1: Region-wide early action plan for climate change adaptation for near-shore marine and coastal environment and small island ecosystems developed by 2012 and implemented by 2015

Target 2: Networked national centres of excellence on Climate Change Adaptation for marine and coastal environments are established and in full operation by 2013

**GOAL 5: Threatened Species Status Improving**

Target 1: Improved status of sharks, sea turtles, seabirds, marine mammals, corals, seagrass, mangroves and other identified threatened species by 2020

The CTI goals comprise issues of international concern that have also been pursued by other international environmental arrangements in the region and globally. Some long-standing multilateral arrangements in the Coral Triangle have explicitly focused on specific aspects of coastal and marine resources [33]. In this regard, the Regional Plan of Action emphasises that the CTI should be aligned with international and regional commitments under relevant multilateral arrangements, and use existing fora to promote implementation. Principle no. 5 of the Regional Plan of Action states that the “...CTI goals and activities should be supportive of international and regional commitments already made under relevant legal instruments and multilateral processes...” [33:8]. Similarly, the CTI Leaders’ declaration affirms that “...cooperation of the CTI-CFF [Coral Triangle
Initiative on Coral Reefs, Fisheries and Food Security] shall... [take] into consideration the relevant multilateral, regional and bilateral environmental agreements...” [37:2]. Building on existing governance arrangements and moving towards the inter-institutional collaboration prescribed by the CTI Regional Plan of Action and the Leader’s Declaration will require the understanding of the extant governance system in which the CTI is implemented, as well as how the existing institutional arrangements relate to the CTI objectives.

Given the complexities of the Coral Triangle and its CTI, the Coral Triangle represents an appropriate case to explore the governance of large-scale marine systems at the international level. Because the CTI is in its formative stages, this study may prove timely in informing the initiative’s implementation. In addition, the findings from this study may also prove useful to other jurisdictions involving fragmented institutional settings where large-scale marine areas are used in conservation and management efforts.

3. Conceptual basis

Efforts to understand the causes of environmental problems (e.g., degradation of marine resources) and to devise responses to these problems have increasingly involved the concept of institutions (or institutional arrangements), in particular resources and environmental regimes. In large-marine systems, as discussed previously, these institutions very often form complex governance systems [10, 11, 13]. For example, the Coral Triangle governance system includes several environmental institutions. The CTI member states are signatory to several international environmental agreements covering conservation, development, climate change, trade, and maritime sovereignty. These include a number of regional agreements within Southeast Asian countries, within Pacific countries, and between the two geopolitical sub-regions. The complexity of the governance system in the Coral Triangle is compounded by the involvement of non-state actors, supporters such as NGOs, international donors and development agencies, the private sector, scientists and conservationists [12].

The notion of institutional interplay is key to understanding the relationship between international environmental arrangements. Interplay refers to situations when the contents, operation or consequences of one institution are significantly affected by another [22, 23, 24, 31]. Stokke [31] distinguishes three types of interplay in terms of regime effectiveness: (i) utilitarian, when interplay results in changed costs or benefits of behavioural options addressed by the target institution; (ii) ideational, when learning processes entail one institution support the effectiveness of another by drawing political attention to the issues addressed by the target institution; and (iii) normative, when an institution may confirm or contradict the norms upheld by another institution, and thus affecting its normative impact. Normative interplay, the focus of this analysis, is conceptualised in this paper in terms of ‘shared issues’ between the CTI and the other international environmental arrangements that apply to Coral Triangle.

Interplay is a fact of life; however, their extent and significance are functions of the density of institutions in a society, i.e., the higher the number of institutional arrangements, the more likely are the number of interactions among those institutions. Many interactions take the form of overlaps, i.e., unintended effects resulting from action designed to affect other ends. These linkages very
often arise from functional interdependencies among the issues and activities covered by multiple arrangements, institutions based on cross-cutting premises or principles, or effort of actors to create competing institutions to follow their own objectives [22].

The concept of institutional interplay is used in this paper to explore the system of international environmental arrangements in the Coral Triangle. This concept allows the analysis of situations in which a governance area (in this case, marine governance) is subjected to multiple and interacting institutions. As discussed above, because governance systems are comprised of distinct parts that are far from being fully linked and integrated, fragmentation is pervasive [27]. In this regard, the concept of interplay also entails the examination of overlaps and gaps across international environmental arrangements. In addition, no institution operates in isolation; therefore, the performance of the CTI – like any other institutional arrangement – will depend not only on its own features but on its interactions with other arrangements that have overlapping functions and jurisdictions. Attempts to improve governance performance will necessarily require strategically managing institutional interactions in order to enhance synergies and minimise inconsistencies [22, 23, 24, 25, 31].

4. Materials and methods

This paper seeks to undertake an analysis of the extant governance system in the Coral Triangle by visually exploring a compilation of international environmental arrangements in how they relate to the CTI objectives. The analysis was conducted using a method developed in Ekstrom [29] and presented in Ekstrom and Lau [30] and Ekstrom et al. [26]. It graphically displays the results of text analysis in network diagrams, assisting in the identification of arrangements related to the CTI objectives. This method has the capacity to generate quick and easy access to baseline information on institutional arrangements within the different issue matters and jurisdictions. Furthermore, the technique assists in the analysis of key interactions across jurisdictions, such as fragmentation and overlaps. It has been applied elsewhere, e.g., the California Current LME to analyse institutional fit and fragmentation of ocean governance [29, 38].

The identification and collection of documents pertaining to international environmental arrangements took place between July and November 2010. Three criteria were used to ensure consistency when determining the inclusion or exclusion of documents for the compilation: (1) the jurisdiction of the CTI member countries framed the geographic scope (Figure 1, above), and arrangements should apply to one or more of the CTI member countries; (2) management of marine resources and the main objectives of the CTI (as per CTI Regional Plan of Action) comprised the issue scope; and (3) types of documents included treaties, conventions, declarations, action plans and memoranda of understanding. The documents were identified and gathered primarily from the ECOLEX database (http://www.ecolex.org) and the Environmental Treaties and Resource Indicators (ENTRI) database (http://sedac.ciesin.columbia.edu/entri/) by searching each of the CTI countries in these databases.

Two hundred documents were identified and 190 analysed (10 documents could not be converted from PDF to TXT, the format required for the analysis). It is important to note that while the database may not be comprehensive, it provides a sample of the diversity of the international
environmental arrangements that apply to the management of marine resources in the Coral Triangle region. In addition, the compilation could be expanded in the future.

The text analysis was conducted in MINOE 1.1, a software tool to analyse documents as they relate to the management of ecological systems [39]. It was used to underscore the normative interplay [31], conceptualised in terms of ‘shared issues’, between the CTI and other international environmental arrangements comprising the database. The analysis consisted of counting the number of times key terms appeared in the compilation of documents. The term frequency was used as a proxy indicator of normative interplay, i.e., the extent to which the documents related to the CTI goals. For this purpose, a list of key terms representing topics of interest was created (Table 2). The topics of interest represent the five goals of the CTI (i.e., priority seascapes designed and effectively managed, ecosystem approach to management of fisheries and other marine resources fully applied, marine protected areas established and effectively managed, climate change adaptation measures achieved, and threatened species status improving [Table 1, above]). Food security is a key component of the CTI and was also included in the text analysis. The term count produced a list of documents relating to each topic and term frequency of the document compilation. Network diagrams were produced using NetDraw 2.098 [40] based on the term-document tables generated in MINOE. Thirty three documents out of the 190 collected did not return hits in the term count. These documents included those relating to organisational arrangements (e.g., statutes and decision mechanisms) rather than addressing specific environmental issues. Nevertheless, they were kept in the database because they may prove useful in a future and in depth qualitative exploration of the Coral Triangle governance system.

<table>
<thead>
<tr>
<th>Topic of interest</th>
<th>Term used to represent topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seascapes</td>
<td>seascape* ecoregion* &quot;ecosystem region&quot; &quot;ecosystem regions&quot; &quot;regional sea&quot; &quot;regional seas&quot;</td>
</tr>
<tr>
<td>Ecosystem Approach</td>
<td>&quot;ecosystem approach&quot; &quot;ecosystem management&quot; &quot;ecosystem-based management&quot; &quot;ecosystem-based approach&quot;</td>
</tr>
<tr>
<td>Marine Protected Areas</td>
<td>&quot;marine protected area&quot; &quot;marine protected areas&quot; &quot;marine reserve&quot; &quot;marine reserves&quot; &quot;marine park&quot; &quot;marine parks&quot; &quot;marine sanctuary&quot; &quot;marine sanctuaries&quot; &quot;protected area&quot; &quot;protected areas&quot;</td>
</tr>
<tr>
<td>Climate change adaptation</td>
<td>&quot;climate change adaptation&quot; &quot;adaptation to climate change&quot; &quot;adaptation measures&quot; &quot;adaptation to the impacts of climate change&quot; &quot;adaptation to the effects of climate change&quot; &quot;adaptation activities&quot; &quot;adaptation strategies&quot; &quot;adaptation strategy&quot; &quot;adaptation response&quot; &quot;adaptation responses&quot; &quot;adaptation option&quot; &quot;adaptation options&quot;</td>
</tr>
<tr>
<td>Threatened Species Status</td>
<td>&quot;threatened species&quot; &quot;species threatened&quot; &quot;species endangered&quot; &quot;endangered species&quot; overfish* overexploit* &quot;depleted stock&quot; &quot;depleted species&quot; &quot;stock depletion&quot; &quot;endangered fauna&quot;</td>
</tr>
<tr>
<td>Fisheries</td>
<td>fish*</td>
</tr>
<tr>
<td>Food security</td>
<td>“food security”</td>
</tr>
</tbody>
</table>

In addition, a qualitative analysis of selected documents was undertaken to gain insights on functional overlaps, i.e., arrangements covering two or more of the topics investigated and inter-institutional coordination arrangements (e.g., MoU).
5. Results

The overall institutional setting in the Coral Triangle, as it relates to the CTI objectives, included arrangements involving one or more of the CTI member countries. These arrangements were adopted over the last several decades, between 1948 (e.g., Agreement Establishing the South Pacific Commission) and 2010 (e.g., Memorandum of Understanding on the Conservation of Migratory Sharks and some CITES Resolutions) (Figure 2).

![Temporal distribution of documents](image)

**Figure 2:** Temporal distribution of documents.

The international environmental arrangements that comprise the Coral Triangle governance system is depicted in the form of network diagrams (e.g., Figure 3). Each document/arrangement (e.g., treaty, convention, MoU, action plan, declaration) is represented in the network diagrams by a circular or triangular node. Lines link the documents to square nodes representing each of the CTI member country that has adopted those documents. Circular nodes represent legally binding arrangements and triangular nodes represent non-binding arrangements, each of which comprised approximately 50% of the documents analysed. Red nodes represent arrangements that are regional in scope (72%) and dark blue nodes represent arrangements with a global scope (28%).
Several groupings of arrangements were identified in terms of participation of CTI member countries (Figure 3). Arrangements including all CTI member countries (with exception of Timor Leste in a few cases) (G6) are mostly global in scope and legally non-binding such as the Agenda 21, UN Millennium Declaration, FAO Code of Conduct for Responsible Fisheries, and the Copenhagen Accord. Exceptions in this grouping in terms of legal status included the Convention on Biological Diversity (CBD), Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), UN Convention on the Law of the Sea, and the UN Framework Convention on Climate Change, which are legally binding. This grouping also included the CTI Regional Plan of Action and the CTI Leaders’ Declaration, which are regional in scope.

Other arrangements concerning most of the CTI member countries included those involving Indonesia, Philippines, Solomon Islands and Papua New Guinea (G4a). These are mostly binding regional arrangements; many of them adopted under the Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean. Arrangements in the G4b grouping included Malaysia, Philippines, Indonesia and Papua New Guinea. They comprised mainly non-binding regional arrangements adopted as part of the Asia-Pacific Economic Cooperation (APEC). APEC arrangements included documents pertaining to Ocean-related Ministerial Meetings and a number of declarations (e.g., Sydney APEC Leaders’ Declaration on Climate Change, Energy Security and Clean Development, where the CTI was welcomed). Grouping

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1 Indonesia is a cooperating non-member to the Convention.
G4b also included arrangements pertaining to the Ramsar Convention on Wetlands of International Importance.

Grouping G3, which included Malaysia, Philippines and Indonesia, comprised a number of arrangements adopted under the Association of the Southeast Asia Nations (ASEAN) (e.g., Bangkok Declaration on the ASEAN Environment, ASEAN Ministerial Understanding on Fisheries Cooperation, ASEAN Agreement on the Conservation of Nature and Natural Resources), and several resolutions and recommendations by the Indian Ocean Tuna Commission adopted between 1998-2010.

There were also arrangements involving just one or two of the CTI member countries. For example, the Convention of the Southern Bluefin Tuna (CSB), which Indonesia is a member (G1a), the International Whaling Commission (IWC) resolutions that apply to the Solomon Islands (G1b), and arrangements involving Papua New Guinea and Solomon Islands (G2), such as bi-lateral agreements on border arrangement, administration of special areas and bi-lateral relations, plus multilateral arrangements involving Pacific nations (e.g., those under the Pacific Regional Environment Programme [SPREP], South Pacific Community [SPC], and South Pacific Forum Fisheries Agency Convention).

In sum, the diagram showed a great deal of variability in terms of geographic scope for the arrangements examined, resulting in gaps in spatial cover since most of the arrangements did not apply to all CTI member countries (e.g., CSB and IWC each applying to a single CTI member country). Concurrently, there are also overlaps when arrangements governed some aspect of the same issue in the same geographical area. The overall situation can also be characterised as one of misfit between the geographical scope of (most of the) arrangements and the boundaries of the Coral Triangle. The effectiveness of institutional arrangements will depend, to some extent, on the match between the characteristics of these arrangements and those of the biophysical system to which they apply. Therefore, the arrangements analysed are likely to be more effective in supporting the CTI goals, as they best match the biophysical characteristics of the Coral Triangle [22, 41].

Several topic issues relating to the objectives of the CTI were covered, to different degrees, in the documents analysed. Fisheries, the topic with most coverage, were identified in 69% of the documents. The coverage of the other topics varied between 23% for threatened species and 7% for seascape (Figure 4).
Multiple dimensions of the institutional arrangements as they relate to each issue topic analysed are displayed in Figure 5a-g. Relative frequency of each issue topic is represented by the size of the node. Large nodes indicate high frequencies of topic references; nodes representing arrangements for which there is no reference for a given term are not shown in the diagram, however, lines connecting arrangements to countries remain in place.

The network diagrams show multiple dimensions of information not readily captured by other forms of representation [26]. These diagrams show numerous arrangements covering each of the topic of interest. Because of the large number of arrangements comprising the governance system of the Coral Triangle, and the apparent limited coordination between them, the potential for inconsistencies is high. Such inconsistencies may occur in terms of unrelated institutions, core norm conflicts and major actors supporting different institutions [19, 22].

The diagrams also show arrangements covering two or more of the topics investigated. For example, the objectives of the FAO Code of Conduct for Responsible Fisheries include ‘promot[ing] the contribution of fisheries to food security and food quality...’ (Article 2 [f]) [42]. Some of the resolutions by the Indian Ocean Tuna Commission (IOTC), another example, seek to reduce the impacts of fisheries on threatened species such as sea birds (IOTC Resolution 10/06) and sea turtles (IOTC Resolution 09/06) [43]. The UN Convention on Migratory Species of Wild Animals (CMS) covers impacts of fisheries and climate change on migratory species, which include threatened species of fish, whales, sea birds and sea turtles. These instances of functional overlap arise from governance arrangements addressing separate but interdependent issues – e.g., fisheries, food security, ecosystem-based management, marine protected areas, seascapes and climate change are linked in biophysical and/or socioeconomic terms. Interactions between arrangements addressing interlinked
issues are expected to mutually affect each other’s performance, with potential for both synergies and conflicts [22]. This is discussed in the next section in more detail.

5A: Fisheries.

5B: Threatened species.
5C: Food security.

5D: Marine Protected Areas.
5E: Ecosystem approach.

5F: Climate change adaptation.
5G: Seascape.

Figure 5: Mapping multilateral arrangements relating to the Coral Triangle Initiative. Institutional arrangements (circular and triangular nodes) are linked with lines to CTI member countries that have adopted these arrangements. Circular nodes represent arrangements that are legally binding and triangular nodes those legally non-binding. Dark blue nodes represent arrangements that are global in scope; and red nodes represent regional arrangements. Relative frequency of the issue topic is represented by the size of the node.

6. Discussion

The Coral Triangle governance system is illustrative of those of international environmental governance. It involves multiple policy domains featuring different institutional arrangements, geographical scope, and main subject matter (e.g., fisheries, biodiversity, climate change, food security). The governance ‘seascape’ is one of complexity and fragmentation, marked by jurisdiction and functional overlaps.

Fragmentation in the Coral Triangle – and other large-scale marine systems, which, likewise, are expected to show fragmented governance systems – has important implications for governance performance. Fragmentation may be understood as beneficial when overlap and redundancy generate opportunities for policy experimentation, innovation and learning; reinforce the effectiveness of the institutions involved through interaction; and enhance adaptation and levels of cooperation [22, 23, 25]. On the other hand, highly fragmented governance systems can undermine institutional effectiveness when overlap and redundancy result in inconsistencies and conflicts [19].

Navigating the fragmented governance system of the Coral Triangle will require addressing and improving institutional interaction and its effects, as a means to minimise conflict and create
synergies [23, 25, 31]. Interplay management [25, 31] or interlinkages [sensu 23] may prove promising given the (apparent) compatibility of the CTI objectives with those of the international environmental arrangements analysed, and the existence of significant overlap of issue areas. A general first step towards interplay management may involve fostering cognitive interaction, i.e., promoting inter-institutional learning and assistance, and enhancing institutional synergy of overlapping institutions [25].

Promoting inter-institutional learning and assistance consists of developing and maintaining communication channels between the CTI and relevant institutions for exchanging information and, ultimately, promoting learning. Learning, in this case, also involves feeding knowledge about useful policy models and best practices available in other institutions into the CTI decision-making process [25]. This kind of interplay management would include, for example, the participation and reporting of the CTI Secretariat to meetings of other international institutions, regular sharing of data and information in matters of common interest, and consultative meetings with other secretariats and organisations. In fact, these mechanisms are common practice among many international environmental arrangements. In the Coral Triangle, for example, the International Union for Conservation of Nature (IUCN) and Pacific Regional Environmental Programme (SPREP) have an agreement that provides for reciprocal participation in relevant meetings of each organisation [44]. Likewise, a memorandum of cooperation between the Ramsar Secretariat and SPREP provides for the preparation of mutually relevant documents for each other’s major meetings, and consultation and exchange of information between these entities [45]. These mechanisms also help creating opportunity for inter-institutional assistance, which could be specifically fostered by analysing and identifying potential for assistance (including access to scientific platforms and financing) to the CTI by other institutions [25].

Mechanisms for information exchange and learning may eventually evolve into joint activities and even joint decision-making, enhancing synergy among overlapping institutions. Enhancing institutional synergy may also involve promoting the diffusion of the CTI goals and activating institutions with complementary or similar objectives in support of the CTI implementation [25]. Examples of mechanisms to promote synergy between institutions in the Coral Triangle include agreements that provide for promoting accession to and implementation of conventions [45]; development of joint work plans, programs and activities [44, 46]; coordination of research, training and public awareness [45]; collaboration in research efforts [47, 48]; promoting harmonisation and compatibility of activities relating to monitoring, control, surveillance and enforcement [48]; provision of scientific services; data collection and analysis [49]; development of joint financial mechanisms [e.g., 46]; and promoting compatibility of policy decisions [45]. Establishing joint liaison groups between secretariats is another mechanism to promote institutional synergy. For example, the Biodiversity Liaison Group consists of representatives of five biodiversity-related conventions (i.e., CBD, CITES, CMS, Ramsar Convention, and the World Heritage Convention) and works towards enhanced cooperation among these conventions [23].

In sum, promoting inter-institutional learning and assistance, and enhancing institutional synergy may improve institutional effectiveness by helping meet common objectives and institution’s supporting provisions, improving robustness (i.e., capacity to take changes, learn and adapt), compliance and monitoring, and increasing cost-effectiveness. The mechanisms of institutional
interaction discussed above, despite lacking appropriate legal mandates, play an important role in attempting to reduce fragmentation [23]. They may provide relevant experience (learnings and best practices) upon which the CTI could draw in eventually developing the inter-institutional collaboration called for by its Leader’s Declaration and Regional Plan of Action. However, managing the interaction of various independent sectoral governance systems in the Coral Triangle – similar to other large-scale systems with transnational jurisdiction – would involve significant transaction costs [25]. The challenge for the CTI would be developing the capacity to effectively engage with other institutions and organisations, which include appropriate mandate and adequate human and financial resources. Oberthur [25] warns that “...it cannot be taken for granted that inter-institutional coordination will always be required, effective or, in view of the considerable transaction costs involved, most efficient”. Therefore, any attempts to coordinate the CTI with other institutions should be considered cautiously and strategically, with particular attention to opportunities featuring widely-shared goals, political support from influential actors, strong commitment and organisations capable of coordinating efforts. An analysis of the potential for synergies and cost-effectiveness with relevant international institutions may prove beneficial, if the CTI is to exploit inter-institutional collaboration in implementing its goals.

7. Limitations and future directions

This study demonstrated a method to map fragmentation/complexity of international environmental arrangements applying to various issues (e.g., marine protected areas, fisheries, ecosystem-based management, climate change) across the Coral Triangle, and explore normative interplay (‘shared issues’) among these arrangements in how interactions may support the CTI goals. The study generated baseline information to help identifying opportunities to exploit the extant international environmental arrangements in promoting implementation of the CTI. It discussed interplay management, such as inter-institutional learning and enhancing institutional synergy, as a promising process to promote inter-institutional coordination.

Beyond the scope of this study was determining to what extent the existing international environmental arrangements are effective, including the capacity of signatory countries to comply with them; and the mandate, human and financial capacity, and willingness of their secretariats (or responsible organisations) to foster collaborative links with other organisations. In addition, the study focused primarily on international environmental arrangements; however, international arrangements pertaining to trade and development domains are known to significantly affect environmental governance [22, 23, 24]. Future studies that may prove beneficial to further improving the understanding of the potential for inter-institutional collaboration in the Coral Triangle include those aiming to explore other forms of interactions (e.g., legal coherence and forms of inter-institutional learning), identify the potential for cross-sectoral learning based on objectives, norms and actors; understand the governance conditions that enable interplay; identify different degrees/types of fragmentation (e.g., synergistic, cooperative and conflictive [19]); explore the interaction between environmental and non-environmental arrangements, and understand the role of agency and actors in promoting interplay management.
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References

[Manuscript Version]

[33] CTI Secretariat. Regional action plan of action. Interin Regional CTI Secretariat; 2009.
[37] Leaders Declaration. Coral Triangle Initiative leaders' declaration on coral reefs, fisheries and food security. Manado; 2009.
[45] Ramsar/SPREP. Memorandum of cooperation between the Ramsar secretariat and the Pacific Regional Environmental Programme. 2006.
[49] WCPFC/SPC. Revised memorandum of understanding between the Commission for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean and the Secretariat of the Pacific Community 2009.