Bilateral Environmental Agreements and Environmental Cooperation in the Mediterranean with Social Network Analysis

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Abstract

Why do some Mediterranean states ratify more Bilateral Environmental Agreements (BEA) than others? As in the well-known triadic friend-enemy metaphor, can the friends of the two states that have signed the BEA also sign a BEA with each other? It is crucial to understand this tendency of states to cope with environmental challenges through the networks of BEAs since an implication of this is the possibility of the degree of the willingness or reluctance of states to cooperate with regional environmental problems. This paper empirically analyzes these agreements signed by 21 Mediterranean countries through social network analysis. As measurements, the reciprocity and transitivity parameters are applied to understand how mutual interaction affects BEA preference of the states and whether BEA preferences spill over to other states by clustering. The results suggest that while geographical proximity between Mediterranean dyads makes normative convergence a plausible motive for environmental cooperation, bilateral regimes do not promote clustering effects for other states. Furthermore, states' motivation for BEA ratification may only focus on a particular environmental problem that they share within a specific area. Other distant states may abstain from a BEA since that environmental problem does not affect it to the same degree. Another implication is that states sign a BEA without any presupposition regardless of whether they have not shared commonality or not.

Keywords: Environmental cooperation, International environmental agreements, social network analysis, reciprocity, transitivity

Introduction

The Mediterranean is one of the most environmentally affected regions due to both direct human activities and the effects of climate change (Jeppesen et al. 2015). The IPCC Fifth Assessment Report (AR5), the most comprehensive climate change estimation analysis to date, identified that the Mediterranean is quite vulnerable to climate change, besides the region will experience various stresses and systemic failures. (IPCC 2013; UNEP 2017; Cramer et al 2018). Since environmental problems such as air pollution, climate change, and sea pollution are transboundary, regional, or global, countries may not achieve desired results by acting alone. One of the main obstacles facing countries today is collective action problems involving joint matters (Olson 1977; Underdal 2002).

Therefore, if the cooperation level is not enough, challenges continue to increase because of the anthropocene and climate change effects (Young 2017).

Countries have developed a wide range of international environmental agreements (IEAs) to facilitate working together on global environmental issues (Mitchell et al. 2003). While examining these environmental agreements networks of the Mediterranean countries, I realized that there are variations among these countries. For example, Slovenia and Croatia have signed more BEAs than Croatia and Italy, although they spatially share the same environment. Should South Mediterranean-Arabic countries have convergence? What are the sources of this variation? This study explores whether the motive of signing a BEA has a structural factor in a diversified multicultural region? Understanding the tendency of the states to environmental challenges through these networks is important because this might give implications that the willingness of the cooperativeness of the states to regional environmental problems. If there is clustering in this IEAs network, this may stem from a specific circumstance, which may not be relevant to environmental issues.

This paper is the first study to investigate the Mediterranean environmental challenges through social network analysis. To date, scholarship has mostly pointed out the factors of economic interactions, regime type, and domestic policy concerning why states sign IEAs (Andanova and Mitchell 2010; Kalbhen 2011; Besedes 2016; Andanova 2017). However, little is known about BEAs, and the cooperative behavior of the states, and it is not apparent why states build environmental bridges through IEAs. The findings contribute to the literature on environmental cooperation from a network perspective, and it may provide new insight into how exogenous factors affect the states' IEA preferences.

I empirically analyze the Bilateral Environmental Agreements (BEAs) signed by 21 Mediterranean coastal countries through social network analysis. Social network analysis is an appropriate tool to discover the environmental collaborations because states and their agreements are social structures that connect them. As evaluation criteria, I apply standard network metrics; centrality, clustering coefficients, density, and modularity among states. In addition, reciprocity and transitivity measures are used in the analysis to grasp how mutual interaction effects BEA preference of the states and whether BEA preferences of the state spill over to other states by clustering. The remainder of the article is structured as follows. The following section gives a brief overview of the literature relates to IEAs. The third section explains the theoretical framework and hypothesis of the study. Two different networks are introduced in the research design section: bilateral and trade networks. Conclusions are drawn in the final section.

International Environmental Agreements and IEA Database

IEAs are legal regulations that call on states to collaborate to solve global environmental problems and impose certain restrictions on the environmental activities of states in line with the specified purposes (Mitchell 2003). Montreal Protocol, Kyoto, subsequently Paris agreements are the most known global IEAs. Besides constituting a functional agent in the field of environmental

protection, international-regional and national developments revealed the distinctive feature of these agreements; to solve a common problem that is associated with all humans. First, it is necessary to clarify what is constituted by International Environmental Agreements (IEAs). Although the "convention" term is also used, some texts also accept “treaty." I used the agreements as generic “IEAs” term throughout paper. It is generally assumed in the literature that the agreements refer to the environmental problems, either the elements of the environment such as biodiversity, atmosphere, endangered plant and animal species, oceans, seas, and marine creatures) or some activities or substances that will affect the environment such as hazardous wastes, radioactive wastes, toxic substances-especially their international transport (Andanova and Mitchell 2010). Mitchell defines IEAs with three respects "International, Environment, and Agreement"; as is an "intergovernmental document intended as legally binding with a primary stated purpose of preventing or managing human impacts on natural resources" (Mitchell 2003 p.432). Throughout the paper, conceptually, I adopt this definition because states and their behavior in international arenas against environmental challenges can only be perceived when they sign an agreement binding for members. If the IEAs have no binding rules on signatory states, it would be difficult to measure their volunteer acts.

Having defined the IEAs, let us move on to Mitchell et al.'s IEA database, the most overarching and functional so far. The database allows researchers to systematically search with criteria such as type of agreement (Multilateral or Bilateral), texts, signature dates, subjects, lineage (2020). In this respect, considerable research variation can be generated through IEAs. There are over 1,300 MEAs, 2200 BEAs, 250 other environmental Agreements and include over 90,000 individual country memberships contingent upon these IEAs (Mitchell 2020; Solda 2020). The number of these agreements and membership of IEAs has been steadily increasing for two decades. The fact that the database is a frequently referenced resource in environmental regime studies reveal the importance of the database.

The factors that affect environmental cooperation

Several systematic reviews of IEAs have been undertaken to unravel why some countries cooperate more on environmental issues and others less. Besedes et al. (2016) empirically examine MEAs and question the economic factors determining countries' cooperation on multilateral environmental agreements. If so, liberal arguments that trade interdependence facilitates more cooperation between states is the case for environmental cooperation. Consistent with this assumption, economic and political interlinkages such as regional organizations, joint democracy facilitate transboundary environmental actions among states (Kalbhen 2011). Some scholars highlight domestic political, economic, and social factors associated with the state's environmental cooperation behaviors (Andanova 2017). Align with this inquiry, Brandi et al. found (2019) that states tend to adopt preferential trade agreements after IEA ratifications by enacting domestic environmental legislation. Overall, there seems to be some evidence to indicate that economic interests play an important role in the approval of BEAs.

Bilateral environmental cooperation is seen most on fisheries agreements since economic concerns, which stem from domestic pressures, push them to cooperate. Particularly, depletion of natural sources in a shared area can urge states to make rational decisions regardless of whether the partner is an enemy or a friend. Indeed, there is consensus among scholars that cooperation becomes meaningful and substantial when there is a set of conflicting and complementary interests regarding the solution of a problem (Keohane 1984; Stein 1982). Stein (1990) argues that even though states prefer unilaterally for optimal gains, they also need to cooperate to achieve outcomes protecting their interests besides avoiding unwanted outcomes, which is also known as dilemmas of common interest. Hønneland's (2010) finding is consistent with Stein's assumption. He investigates the enforcement cooperation within the fisheries sector between Norway and Russia. Although both are in a rival camp, they developed an effective fishing agreement after being confronted with extensive overfishing problems in the Barents Sea.

Another example can be observed in the Arctic Council organization in which the USA and Russia work together on the Arctic environment. Stadtfelt et al. (2017) examine the fisheries agreement derived by IEADB, showing that preliminary environmental governance starts with adjacent states that share a common geographic and economic area and then spreads to the all-region. Similarly using networks with global fisheries governance, Hollway and Koskinen (2016) argue how bilateral and multilateral relations are interrelated. Angeon and Bates (2015) use this method to grasp the sustainability of environmental governance of the states through vulnerability and resilience indexes. One implication from these studies is that IEA literature focuses on network analysis rather than statistical methods. One reason might be that network dynamics deeply affect cooperation relations (Hafner-Burton et al. 2009).

Such studies remain narrow in focus dealing only with particular problems. Mediterranean region, in this sense, is a more diversified region considering accommodation for many different cultures, blocs, and regimes. Besides, geospatial differences make bilateral cooperation infeasible. For instance, Spain and Egypt may not suffer the same environmental hazards. Then, it is plausible to expect that geographic proximity is a driving factor for BEAs.

Along these lines, scholars have developed theories that help explain why some states do not lean toward environmental cooperation. First, as systemic theories suggest that the anarchic nature of the international system prevents states from coming together because of mutual distrust, they have no incentive to solve common problems (O'Neill 2009; Enuka 2018). The second factor is the national will. The public puts pressure on the rulers since they do not have enough capacity to execute the necessary steps. Third, it is the interplay of national interests. It represents the barriers between national representatives and international actors during the bargaining process. Finally, Susskind (1994) points out global North-South, or developed-undeveloped countries clash is another challenge for non-cooperation because differences and priorities will vary between them at the bargaining table.

Theoretical Framework

As this paper's contribution relies on the empirical network investigation, the author tests hypotheses based on the existing literature and theoretical framework. An increasing number of studies have found that economic factors play an essential role between states when they commonly suffer environmental issues. Millimet and Roy (2015) investigate membership of WTO and MEA relations. Their results show that less developed countries ratify fewer MEAs. Indeed, protection and improvement of the environment will require a specific cost, and economic development is also an essential factor in adaptation (Jacobson and Weiss 1995, 8). However, this relationship should not be directly interpreted as the high level of adaptation of rich countries. In this area, Egger et al.'s (2011) findings are more promising in that since wealthier countries have more liberalized trade and investment policies, they are more lenient to sign toward multilateral environmental agreements. The relative burden of the agreement on the state is the most critical determinant in this matter. Even if the country's income level in question is high, the intensity of the regulated activity within the country and its importance for the country's economy can make the cost of adjustment unbearable. Besedes et al. (2016) apply two econometric methods to analyze the economic determinants of MEAs. They found that if states are economically significant and of similar economic size, have a mutual preferential trade agreement, and have high volume trade flows, they are more likely to establish MEAs because economic relations strengthen bonds and eliminate free-riding on environmental problems. Besides trade interdependence, more recent evidence also reveals the geographical proximity factor. Davies and Naughton's (2014) study investigated the contiguity to understand whether neighboring countries have greater incentives to cooperate than in distant countries. Their analysis evidenced that as neighbor states ratify MEAs, this creates a spill-over effect on its neighbors.

This paper applies reciprocity and transitivity metrics to understand the mutual co-sponsoring and spill-over effect of the BEAs network in the Mediterranean. Because reciprocity and transitivity play important roles in grasping the structural mechanisms underlying friendship network formation (Block 2015), Schafer defines reciprocity as "the increased likelihood of individuals to send ties to those from whom they receive a tie" (2010, 164), in other words, the tendency that if state A helps state B, then state B will help back to state A. I apply to trade interdependence between states to better understand this effect. Transitivity, the strategic consideration of a triangular relationship, basically describes the metaphor; "my friend's friend is my friend, and my enemy's friend is my enemy." Therefore, if two states have an environmental agreement, the probability of converging their other partners to each other will be high or low. These factors are also known as endogenous effects in inferential network analysis. Therefore, in the analyses, the below hypotheses will be tested.

H1: *The stronger the reciprocity through trade interdependence, the more likely states cooperate on environmental challenges.*

H2: *The stronger (positive) the transitivity network effect, the more likely states cooperate on environmental challenges.*

Research Design

Data sources and selection

This paper argues that as countries increase their membership through IEAs, they may increase collaboration because IEA membership proves their willingness for solutions and sensitivity to environmental problems. The author uses the IEA database project (2002-2020) created by Mitchell to test the hypotheses derived from theoretical explanations. For operationalization, all BEAs shared by 21 Mediterranean countries.[1] These agreements have been active since 1972 are disaggregated because there is conventional wisdom that international environmental governance began in 1972 at the United Nations Conference on the Human Environment (UNCHE) (Andanova and Mitchell 2010).

I generate two adjacency matrices to serve as initial conditions. The BEA matrix is taken from IEADB, and it is designed dyadically so that while nodes are states, edges are BEAs.[2] The edges are weighted by the number of BEA two states are engaged in. For example, while Lebanon *(ni)* and Syria *(nj)* have five IEAs between each other, the number of IEAs *(w)* is coded as five. Stadtfel claims that "Weighted effects are concerned with not only whether these elements matter for new relationships but also for the deepening of these relationships through multiple concurrent ties" (2017, 18).

The second network is the trade flow of dyads. It operationalized the sum of the logarithm of bilateral trade flows of two countries measured as the sum of both imports and exports from each other. Trade values are also weighted in the graph. All the data were analyzed through the Networkx package. As metrics and evaluation criteria, local and clustering efficiency, transitivity, reciprocity, centrality, modularity, and density measures are used. To better understand these metrics used in the analysis, they are briefly explained as follows.

Network metrics

Local and Global Clustering efficiency and transitivity

Local clustering coefficients measure the prevalence of triadic closure in a network. It is calculated as the fraction of dyadic states that are friends. For example, if Lebanon has 4 BEAs with other states (dc=4), then the total pairs of Lebanon's friends are friends (dc (dc -1)/ 2). This is also called the denominator. Now should be determined the total number of Lebanon's friends. If we assume there are 2 (triadic closure), so the local clustering coefficient is 2/6=1/3, which means that one-third of all the possible pairs of friends of Lebanon who could have BEAs, actually have BEAs.

[1] I used these countries in the analysis: Albania, Algeria, Bosnia and Herzegovina, Croatia, Cyprus, Egypt, France, Greece, Israel, Italy, Lebanon, Libya, Malta, Monaco, Montenegro, Morocco, Slovenia, Spain, Syria, Tunisia, Turkey.

[2] There are 57 dyads and 97 memberships in the BEA network.

$$C(i) = \frac{\#\text{ of pairs of neighbors of } i \text{ that are connected}}{\#\text{ of pairs of neighbors of } i}$$

While global or average clustering measures clustering degree on the whole network, not just one node as local clustering coefficient, transitivity is the percentage of open triads that are triangles or close triads. The main difference between these two parameters is the transitivity of more weights on the node, the most central node.

Modularity

In many networks of interest, scholars found some natural divisions in which those nodes have a particular characteristic (Newman 2006). This parameter mainly detects a community effect in a network. As Wagner et al. define, "A network of interactions is called modular if it is subdivided into relatively autonomous, internally highly connected components" (2007, 921). For example, in an urban demographic settlement network, if Afro-Americans, Hispanics, Asians, and whites each cluster in a certain area separately, this shows us a modularity feature in this network. Therefore, any autonomous, mainly separated with a specific betweenness node, can clue about modularity effect in the network.

Density

This metric is determined by its ratio of links to nodes in a network and measures how densely connected it is. By calculating the below formula, as the connection increases, density will be increase throughout the network. Put differently, as states increase their interaction with entities, so does their interaction density; states connect each other through membership in a network structure.

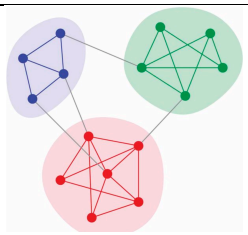
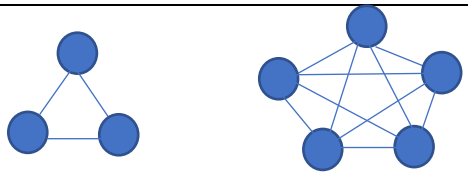
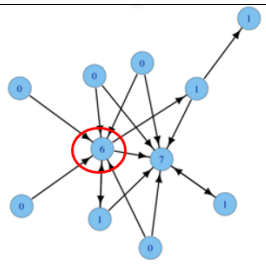
Potential connections = $\frac{n*(n-1)}{2}$ Network density= $\frac{existing\ connections}{potential\ connections}$

As seen in Table 1, higher edges of a node will mean higher density. In the same fashion, if the number of BEA's of the states increases, we will expect more density in the network.

Degree centrality

Centrality is one of the most applied conceptual tools for examining networks. A network identifies who the most crucial node (person, state, agreement) is (Everett and Borgatti 2003). Although there are different centrality metrics such as closeness, betweenness, and eigenvector, this paper deals with degree centrality because higher BEA means higher sensitivity to environmental problems. Degree centrality is measured by the number of edges of the node. If a state has 5 BEA agreements, its degree centrality is 5(d_c). If state A is a node that has the highest number node, then this gives clues to us that state A is the most cooperative state in a state network.

Table 1 Parameters of Network

Local and Global Clustering efficiency, and transitivity	 Triangles Open triads
Modularity	
Density	 Low density High density
Degree Centrality	

Results

Few things become evident in the BEA network in terms of degree centrality. The results that are obtained from network analysis suggest that France and Turkey are the most central countries because they are the countries that have the highest connections with others (Figure 1). This result may be explained by the fact that both are socio-economic and geographically at the central positions and regional power, which influence their proximities. When we look at the weighted values, the countries that shared the highest BEA are France-Morocco, Slovenia-Croatia, Syria-Lebanon, and Spain- France dyads. These are all either neighboring or geographically close countries if we pay attention. These results partly reflect those of Stadfelt et al. (2017), who also found a relationship between continuity and cooperation formation using dynamic network actor models.

Figure 1 Bilateral Environmental Agreements network in the Mediterranean

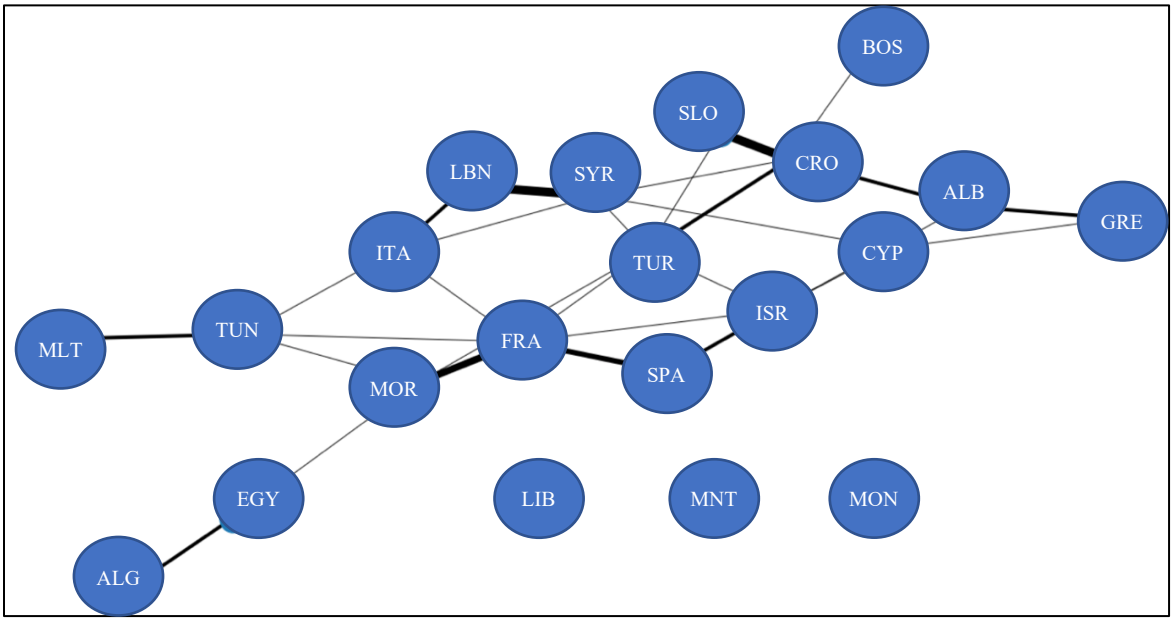


Table 1 reports local clustering coefficients results. As noted above, this metric measures the possible prevalence of triadic closure among states, for the sake of simplicity, whether the friends of friends are friends or not. As it is seen in the table, all the possible pairs of friends of Slovenia, Spain, and Lebanon who could be friends, are friends and one-third of all the possible pairs of friends of France, Israel, Italy, Morocco, and Tunisia who could be friends, are friends. Zero values do not have any triadic closure.

The global coefficient and transitivity are also measured to understand the tendency for agreements to form triangles or clustering in the whole network and whether the highest degree nodes have much more local clustering coefficients. The result suggests that the global coefficient (0.28) and transitivity are (0.26). That means most states have low local clustering coefficients and central states have low local clustering coefficients. In other words, neither local nor central states' partners do not create BEA triplets.

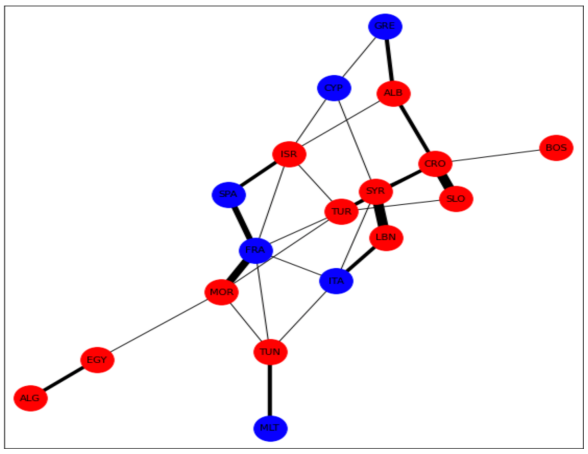
The Modularity parameter of the BEA network is found 0.34. The fact that this value is low compared to 1 means no communal-group effect. It was also analyzed by attributing various characteristics of the Mediterranean countries, such as NATO/ non-NATO countries, EU/ non-EU, East-West Mediterranean, and regime types. However, as seen in figure 2, no structural partition could be observed, suggesting similarities or differences. Hence, it can be concluded that there are only fewer BEAs (edges) within the module than we expect by chance.

Table 2 Local clustering coefficients of Mediterranean countries in BEA network

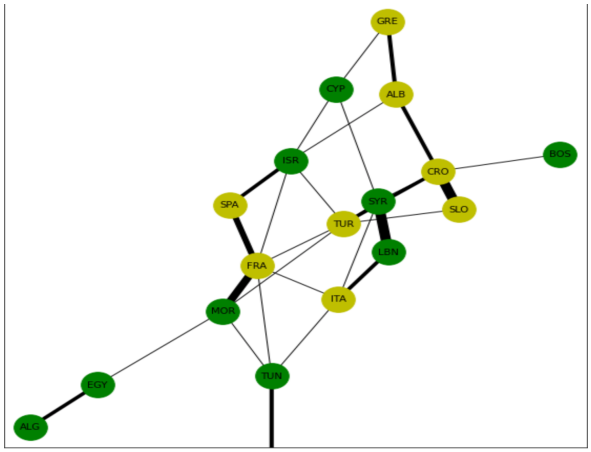
Mediterranean Countries	Degree centrality (d_c)	Denominator[3] ($d_c (d_c-1)/ 2$)	Nominator[4]	Local clustering coefficient[5]
Albania	3	3	0	0
Algeria	1	0	0	0
Bosnia and Herzegovina	1	0	0	0
Croatia	4	6	1	0.1666667
Cyprus	3	3	0	0
Egypt	1	0	0	0
France	6	15	5	0.3333333
Greece	2	1	0	0
Israel	4	6	2	0.3333333
Italy	4	6	2	0.3333333
Lebanon	2	1	1	1
Libya	0	0	0	0
Malta	1	0	0	0
Monaco	0	0	0	0
Montenegro	0	0	0	0
Morocco	4	6	2	0.3333333
Slovenia	2	1	1	1
Spain	2	1	1	1
Syria	4	6	1	0.1666667
Tunisia	4	6	2	0.3333333
Turkey	6	15	3	0.2

Figure 2 Bilateral networks by the community.

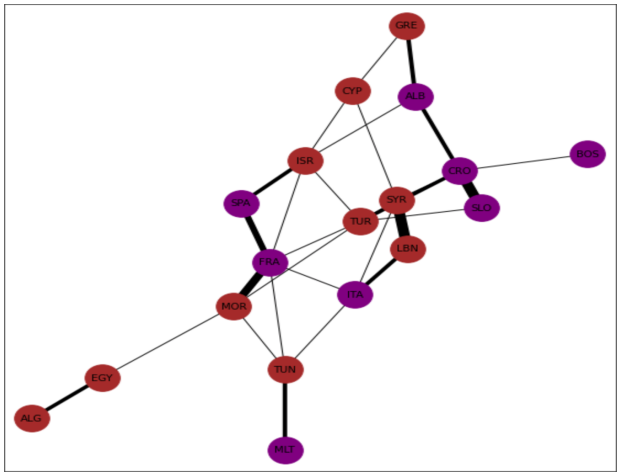
[3] The total number of pairs of a node's friends.
[4] The number of pairs of friends of a node who are friends with each other.
[5] Nominator/ Denominator.



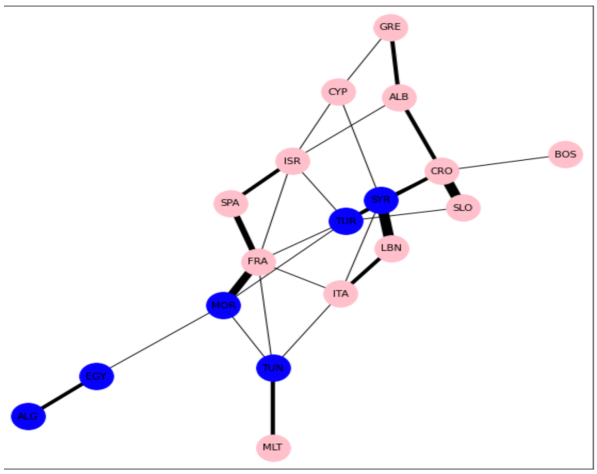
EU/ Others



NATO/ Non-NATO



West-East Mediterranean



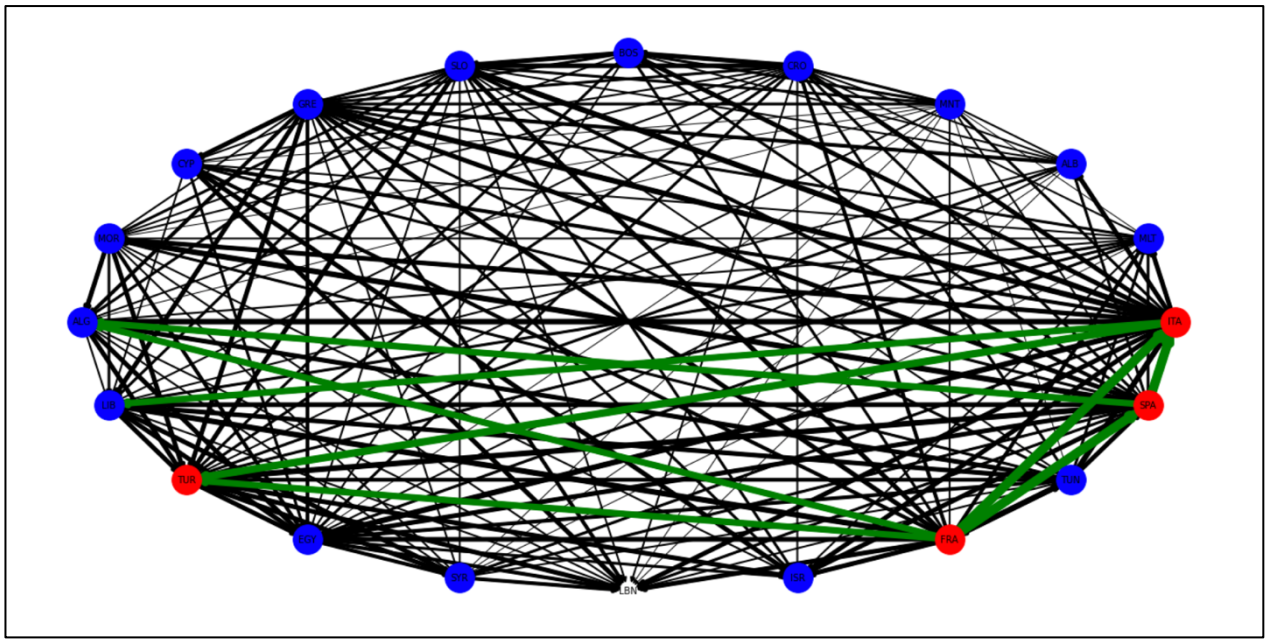
Democracies-Autocracies

Finally, the author examines whether BEA network density is low or high because if it is low, then this makes us consider that states do not connect each other densely through BEAs; there are some potential disconnections. The density value is 0.18, and this low density suggests that actual connections through the BEA network in the Mediterranean are quite lower than potential connections.

Figure 3 directed graph represents mutual trade networks among 21 Mediterranean countries. As this graph suggests only mutual relations, all nodes have the same centrality measures. For this reason, the network is designed as weighted. Weighted trade edges represent reciprocal trade volume as million USD. Green arrows, the thickest ones, indicate that most trades happen between France- Italy, France-Spain, Spain-Italy, and Italy-Turkey. There are several possible explanations for this result. While functionalist theory posits that trade vitalizes economic relations and disseminates to other areas (Haas 1961), regionalism theories emphasize geographic proximity as

the driver of trade blocs (Borzel 2016). It must be noted that BEAs barely have parallels with trade networks.

Figure 3 Bilateral trade network of Mediterranean states



Discussion and limitation

This study questioned the relation between environmental cooperation and behavior of ratification of BEA among the Mediterranean countries to understand why some states signed more BEA than others. The first hypothesis tested the reciprocity-tendency of mutual convergence by applying trade interdependence. While the countries with the most centrality are geographically close in the BEA network, some of these countries (France and Spain) have the highest trade volumes in the trade network. This result corroborates Davies and Naughton's (2011) IEA study that neighboring countries have greater incentives to cooperate than distant ones in the presence of environmental pollution. However, the reciprocity degree, mutual co-sponsoring, is relatively low in the Mediterranean BEA network.

Therefore, hypothesis 1 is rejected since higher trade partly promotes BEA establishment. This outcome is contrary to that of Besedes (2020), who found that more significant bilateral trade flows encourage them to establish bilateral agreements on environmental issues. One possible explanation for this discrepancy can be social constructive ideational factors in Mediterranean countries.

Transitivity, which is the second hypothesis, the author aimed at how two states' agreements have a diffusional effect on others, in other words, whether network dynamics drive bilateral cooperation across the Mediterranean and whether they encourage others for bilateral

environmental cooperation. The transitivity degree is 0.26, and the global clustering coefficient degree is 0.28. These low degrees mean that they do not create clustering triplets. Put differently, friends of friends do not establish a friendship. Therefore, we can say that the BEAs have no effects on others.

Furthermore, this study did not find a significant difference between groups when examining the modularity effect by analyzing NATO, EU, memberships West-East axis, and regime type differences. Overall, apart from reciprocity and transitivity discordances, the results related to economic factors and geographic proximity are likely to play an important role when regional states consider ratifying an environmental agreement, as in line with the literature.

Conclusion

This paper has underlined the importance of the relationship between bilateral environmental agreements and the cooperative behavior of the states. I have obtained satisfactory results showing that while higher trade partly plays a role for BEAs, this agreement between states does not spill over for their other partners across the Mediterranean. In other words, the fact that Slovenia and Croatia have many BEAs with each other does not urge Bosnia-Herzegovina or Montenegro or Serbia to establish BEAs among each other. Also, becoming a member of the EU does not attract others, or Arab states do not sign a BEA just because they have a shared identity. The most exciting finding from this study is that some states tend to sign BEAs with their neighbors. This is observed in France-Morocco, Syria-Lebanon, and Slovenia-Croatia.

Taken together, these findings highlight that states' motivation for BEA ratification may be only focusing on a particular environmental problem that they share within a specific area. Other distant states may abstain from a BEA since that environmental problem does not affect to the same degree. Another implication is that states sign a BEA without any presupposition regardless of whether they have not shared commonality or not.

A potential limitation regarding the methodology needs to be considered. There are limited BEA agreements that exist in the Mediterranean countries. Given the small sample size, caution must be exercised because this makes it difficult to generalize from relatively small samples. In addition, Mediterranean countries also have Multilateral environmental agreements, and the memberships to these agreements will allow us to understand another dimension of the tendency of environmental cooperation of the Mediterranean countries. Further research needs to examine the links between environmental agreements and the behavior of states through statistical applications. For instance, "the exponential random graph models (ERGMs) allow models to be built from a more realistic construal of the structural foundations of social behavior. Robins et al., 2007, 173). Overall, the findings of this study have many important implications for future practice.

Biography of Ozgur Kayaalp M.A. (Ph.D. Student)

Ozgur Kayaalp is a Ph.D. candidate at the Security Studies Ph.D. program at the University of Central Florida. He holds a Master of Arts degree in Maritime security, safety, and environmental management degree from Dokuz Eylul University in Turkey. Before starting his Ph.D., he worked as a warrant officer in the Turkish Navy and NATO for twenty years. He participated in national, UN, and NATO operations, exercises, international courses, and training. Ozgur is broadly interested in international relations and global environmental politics. In his studies, he adopts statistical methods, social network analysis, qualitative/ quantitative content analysis, critical discourse analysis as methodological approaches, his regional focus is widely on the Middle East, Mediterranean, and Eurasia. His current doctoral research focuses on three aspects of international cooperation. The first research investigates the correlates of regional cooperation and institutional building with multiple dyadic factors. Second research deals with rationalist and reflectivist accounts of regional cooperation. Finally, the third work builds upon the absence of regional cooperation in the Eastern Mediterranean, domestic factors, and populist leaders of the region.

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