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By Thauan Santos & Andrea Bento Carvalho

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Keywords: *economy of the sea, maritime clusters, regional development, blue economy, brazil.*

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"Blue is the New Green": The Economy of the Sea as a (Regional) Development Policy

Thauan Santos [α] & Andrea Bento Carvalho [σ]

Abstract- This paper has as main objective to propose the economy of the sea as a (regional) development policy in "maritime countries" by nature. To this end, we begin by analyzing the evolution of the economy of the sea concept, understood as an analytical tool that can play the role of strategic (regional) development policy. To make it possible, we analyzed the cluster theory (maritime), highlighting particularities of its governance, nature, and performance. We then narrow the dialogue between the theoretical framework and regional development, presenting some key variables that can contribute to the analysis and evaluation of different cases of maritime clusters, suggesting it as a model to make such a development policy feasible. Taking the case of two maritime clusters in Brazil (Rio Grande, and Rio de Janeiro), we create and analyze the Herfindahl-Hirschman index (HHI) based on the number of employees of the municipalities facing the sea using official data of the Annual List of Social Information (RAIS), having as base year 2018. This proxy may be used as a guide to promoting both clusters, evaluating the current scenario and, at the same time, indicating potential sectors to be developed or encouraged in both cases. Through this economy of the sea perspective, the sea can be explored, needs to be managed and must be protected.

Keywords: economy of the sea, maritime clusters, regional development, blue economy, brazil.

I. Introduction

Since the second half of the 20th century and particularly after the 1970s, raises concerns about the environment and the climate, the "green" perspective progressively replaces the old "gray" one (infrastructure, asphalt, and smoke). With the turn to the current century, there is a significant paradigm shift towards the "blue" paradigma. Hence, despite the confusion about what these colors represent in terms of ideology and politics, it is possible to argue that in the 21st century, some academics, agencies, politicians, and environmentalists are trying to re-brand and reframe it suggesting that "blue is the new green."

In 2007, Seele associates the term "blue" with the humanitarian variable in which some companies tried to spiff up their public image linked to the United Nations (UN), taken as a moral authority; in this case, the association was due to the color of the UN logo and flags, as well as because of blue helmets of the UN-troops. In 2008, The New York Times released an opinion piece stating that "blue is the new green," again in the face of a narrower view with a focus on the use and access of water as a resource. In the following decade, Ido and Shimrit (2015) expanded the notion of "blue" in their analysis, associating it with an ecological enhancement of concrete based coastal and marine infrastructure (CMI).It is precisely in line with this last perception that this paper reinforces that "blue is the new green," considering a broader spectrum of coastal and marine economy, infrastructure, and ecosystems – often associated with the "Blue Economy."

> "Pauli named the "Blue Economy" not only in reference to the oceans, but primarily in the idea that "blue is the new green," in the sense that the blue economy, unlike the green one, must be profitable in itself, because Nature is both a waste-free industrial system and still a cheaper, leaner, more effective one than ours." (Aberkane, 2016: 285).

Opposing the green color, Pauli (1995) analyzed business toward sustainability and stress the role of industrial clusters of the twenty-first century. From some case studies, the author stated that new clusters might reshape (i) industrial policies, allowing governments at local and regional levels to create new jobs; and (ii) corporate strategies, impacting partnerships, research and development (R&D) programs, acquisitions, and new startups, as well as mobilizing investments especially in infrastructure. In line with Pauli's perspective (2010, 2015), this paper will focus on the economic and social benefits and impacts of promoting sectors directed associated with the sea, associating them with regional development policy.

Despite being aligned with the author's perspective regarding the quantification of impacts and the relevance of clusters, our proposal uses the concept of Economy of the Sea as a baseline. We propose to assess the particularities of maritime clusters through a methodology based on (i) a theoretical-conceptual discussion; and (ii) the Herfindahl-Hirschman index (HHI). At first, we contributed to the literature to tie frameworks that initially had little dialogue: economy of the sea, (maritime) clustering, and regional development, proposing a more general theoretical framework. Then, we briefly present the construction history and analyze the activities incorporated into two Brazilian cases of maritime clusters: (i) Rio Grande (extreme south of the country), which has existed since 2009, but which has been changing recently; and (ii) Rio de Janeiro (southeastern region of the country), whose official launch took place in the second half of 2019. The

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number of employees of the municipalities facing the sea using official data of the Annual List of Social Information (RAIS), having as base year 2018, is the base for HHI values.

The analysis of the Brazilian case makes perfect sense, since about 20% of the country's population, production, and formal jobs are related to the economy of the sea (Carvalho, 2018). Precisely because these clusters are currently taking place in the country, our analysis is justified because these are relevant and current events for the Brazilian economy, requiring further analysis and studies. Also, the conjuncture of low economic growth coupled with the high rate of national unemployment demands responses from the Brazilian State capable of mobilizing employment and income to stimulate strategic sectors of the economy, taking advantage of sectorial, local, regional and/nationals features that the country has.

Therefore, this paper aims to propose the economy of the sea as a (strategic and analytical) policy of regional development through the maritime cluster (model).The analysis of the concentration of economic activities in these two case studies will not only allow a diagnosis conducive to the identification of industries and sectors potentially benefited by the cluster model but above all, to map them and propose public policies to encourage their development.

II. The Economy of the Sea, Maritime Cluster, and Regional Development

Once the paper aims at first to provide a theoretical contribution to the specialized literature, this section will be divided into two parts. In the first subsection, we explain the concept of the economy of the sea (understood as an analytical and strategic tool capable of contributing to the formulation of public policies), tying it to the cluster theory, particularly that of maritime clusters (understood as a model by which the economy of the sea can be used as a public policy vector). In the second subsection, we narrow the dialogue between the theoretical framework presented and regional development, briefly presenting how development theory has evolved since the 1940s, noting the increase in the range of themes and the relevance of the regional focus. Finally, we show some key variables that can contribute to the analysis and evaluation of different cases of maritime clusters – including those that will be presented and analyzed in the next section.

a) The economy of the sea and maritime cluster

Covering more than 70 percent of the Earth's surface, water provides different resources (i.e., food, minerals, raw materials, employment, leisure, energy) to support and to deal with the pressure of the global population growth rate, in addition to enabling different economic activities (i.e., fisheries and aquaculture, seabed mining, maritime transport, cruising, offshore exploration, and hospitality).Despite the recognized pressure on the sustainability of natural resources, there is a vast and hopeful future since only 5% of the seabed has been mapped and photographed.

As briefly presented in the introduction, there is a conceptual confusion between the terms "green" and "blue," which also extends to "the blue economy" and "the economy of the sea" (Santos, 2019). In general, the use of "blue" indicates a way of thinking and doing business in the context of sustainable development, direct opposing to the used term "green," therefore not limited to the sea, coast, and ocean. On the other hand, the concept of "economy of the sea" is a more precise one, specific to each country, and limited to activities directly, and indirectly related to the seas (Carvalho, 2018). Nevertheless, the understanding of what the economy of the sea is has changed a lot in the last century, expanding the range of sectors, actors and associated policies.

The concept of "economy of the sea" seems to have been mentioned academically for the first time by Danish marine biologists Joh Petersen and Boysen Jensen (1913), when evaluating the sea-based on the animal life of the sea-bottom and highlighting the role of phytoplankton in the sea economy. In the 19th century, the economy of the sea was not considered an area of knowledge (what persists in some regions), and its contributions came from the biological sciences. Clarke (1935), professor of biology at Harvard University, has the first publication made with "economy of the sea" in its title; however, as well as the others of the period, the author associated the sunshine to the nutrition of plants and animals in the sea – therefore still focusing on discussions in the area of biology. Shortly afterward, Jones (1965) is one of the few authors who foresee the relevance of the economy of the sea, using it also in the title of his publication; particularly analyzing the biochemical characteristics of living marine organisms, the microbiologist concludes his paper by stating that it is a "young science" full of questions to be answered.

Probably due to (i) much of the discussion associated with the economy of the sea comes historically from the biological sciences; (ii) having interfaces with so many established areas and sub-areas in Economic Science; and (iii) allowing studies of different methodological nature, there is still no standardized method for classifying it even in the JEL (Journal of Economic Literature) classification system. Consequently, the studies end up spreading out, making it difficult to consolidate a group of professionals and researchers on the topic – since in the JEL system there is no mention of the terms "marine," "maritime," "blue," "river," "sea," "ocean," "coast" or "offshore" (Santos, 2019).

Thus, because we do not necessarily focus on approaches such as biological (marine economy), port and shipping (maritime economics), sustainable and

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natural resource management (blue economy), we will use the concept of the economy of the sea in our analyzes. It can be understood as the area of economic science responsible for identifying and measuring economic sectors directly and indirectly related to resources and activities in/from the sea (Carvalho, 2018), corresponding to an analytical tool capable of contributing to the formulation of public policy. Hence, through this perspective the sea can be explored, needs to be managed, and must be protected.

The economy of the sea is therefore not just an area of economic studies, but must be understood as an analytical tool. Also, our main argument is that it serves as regional development policy, given the range of stakeholders involved in its sectors and segments. However, it is necessary to propose a model by which the economy of the sea can serve the purpose of public policy, which led us to consider the cluster theory.

Marques(2015) narrows the relationship between "economy of the sea" and "clustering," highlighting the relevance of cooperation between different associated stakeholders (states, levels of government, universities, private sector, and civil society). According to Porter (1998:3), cluster may be understood as "geographical concentrations of interconnected companies and institutions in a particular field," linked by mutual and complementary characteristics (Porter, 1999), where firms can compete and cooperate among themselves (Porter, 2000).

Andriani et al. (2005) claim that these are systems of localized economic activity and innovation in and between firms, allowing to raise productivity, competitiveness, and economic growth, as well as being able to change based on five main dimensions: proximity, input-output links, knowledge/innovation, governance, and embeddedness. The authors stress some principles related to cluster approach, such as (i) its development maybe measured in a longer-term perspective, given its life-cycle; (ii) its measure shall consider both qualitative and quantitative performances; and (iii) in some cases, its focus should be on some product families, instead of on industrial sectors.

Given existing endowments and socioeconomic conditions, clusters tend to appear spontaneously – which does not mean that they cannot be stimulated and supported by different (public) policies. Notwithstanding, there is no consensus on this point since De Langen (2002) states that its delimitation is constructed, rather than natural. In any case, taking advantage of local, regional or even national particularities (e.g. proximity between firms; shared and specialized labor; knowledge transfer; business networks and relationships; infrastructure and support services), it is possible to create incentives and conditions to attract some firms, being necessary to consider issues such as access and capital provision, skills development, and specific risk conditions.

The geographic reach of clusters ranges from a city or state, covering a country or even nearby countries. They allow a powerful set of tools for analysis, formulation, and implementation of policies to increase the effectiveness of economic development strategies (João, 2008). Therefore, local-regional policies must reinforce collective and shared actions, fortifying higher-level political efforts.

Nevertheless, Pitelis and Pseiridis (2006) point out that the economic literature has given little attention to clusters of small firms, claiming to be responsible for positively impacting the productivity of these small companies, especially about infrastructure, human resources, institutional arrangements, and innovation. Evaluating the case of small and medium-sized enterprise (SME) clusters, Niya (2010) argues that they play an essential role in promoting regional and global economic growth and improving industrial competitiveness.

However, although it is very much associated with Porter's publications, the notion of clustering of firms and regional development is by no means new, dating back in Marshall's (1890, 1919) works on industrial districts. Since the very end of the 19th century, the author was the first one to identify the advantages arising from the territorial agglomeration of companies in the same industry. In this way, the aim was to form a key industry (or key industries) in a given region, to transform them into market leaders (if possible, internationally) and to make them drivers of the development of that region (Amaral Filho, 2001). Thus, it retrieves some traditional concepts from the theory of economic development such as "growth pole" (Perroux, 1955), "concatenated effects" (Hirschman, 1958) and "export-base theory" (North, 1990).

Ergo, it is clear that "clusters come in many types, sizes, and origins, and there is a wide array of cluster definitions." (Fløysand et al., 2012: 948). Feser (2009: 363) reinforces this argument arguing that:

> "Perhaps the only universal point of agreement in the increasingly vast literature on industry clusters is that there is no agreement on how clusters should be defined or how the relationships between firms and industries that generate purported productivity or innovation advantages to clustering should be bounded, classified, and subjected to systematic analysis."

Within the scope of this paper, it is important to stress that "the cluster concept can be usefully applied to study the clustering of maritime activities" (De Langen, 2002: 209). This is especially true for countries "maritime by nature," as is the case in Brazil – to be analyzed in detail in the next section. The author identifies four agglomeration economies that attract firms to cluster: a joint labor pool, a broad supplier and customer base, knowledge spillovers, and low

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transaction costs. As a consequence, we understand maritime clustering as a relevant element for the mobilization between the public and private sectors in the achievement of strategic objectives associated with the sea (Marinha do Brasil, the official website).Thus, the "economy of the sea" and the "maritime cluster" do not compete, since cluster comes close to a "model" – given its more normative nature. We then propose the maritime cluster (model) to enable the economy of the sea (analytical and strategic policy)to promote regional development.

b) Regional development and public policies

Without aiming to make a historical discussion about the concept of development, this subsection seeks to narrow the previously presented dialogue on the economy of the sea and maritime cluster with the theoretical (regional) development discussion, suggesting its interfaces with public policies. Therefore, to understand the state of the art of regional development theory, we will briefly present the evolution of the debate from the second half of the last century, especially highlighting the contributions of the 1980s and 1990s to the advancement of regional perspectives. To this end, *Figure 1* summarizes the theoretical debate from the presentation of a timeline covering the period 1940-2015. Next, *Figure 2* shows how to evaluate clusters, taking into account three main variables (governance, nature, and performance).

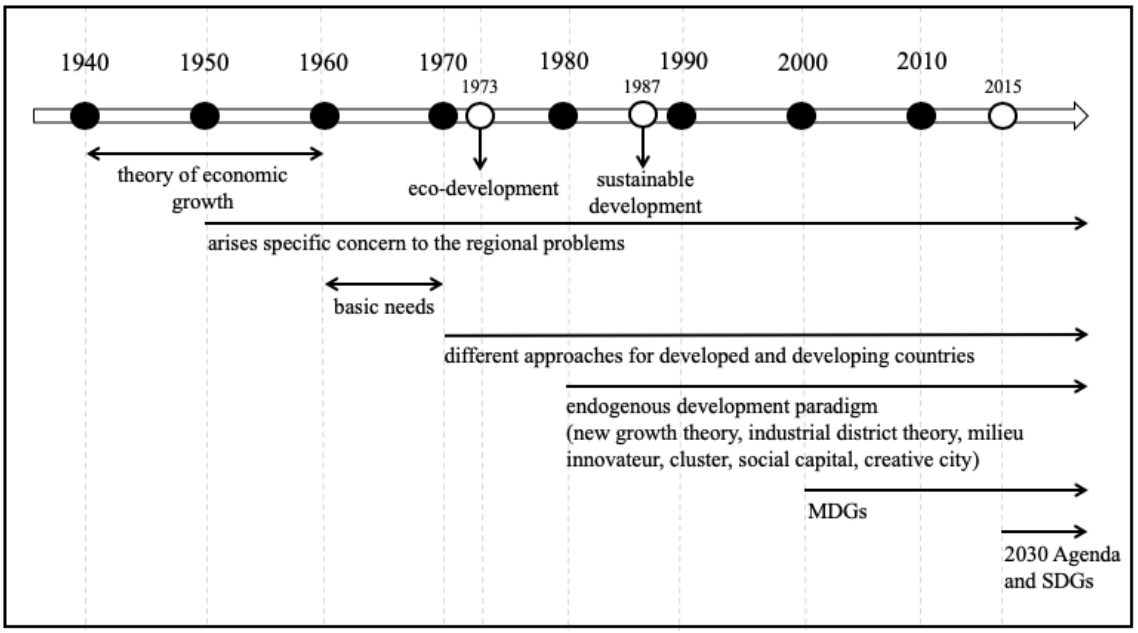

Figure 1: Summary of the main theories of economic development (1940-2015)

Until the mid-20th century, the classic economic growth model predominated, whereby growth originates from the accumulation of capital. In this model, the explanation for regional/local development was confused with that of national development itself. Thus, the 1940s and 1950s focused on (re)industrialization, growth, and modernization, particularly after the adversities after World War II (WWII), being marked by contributions from Nurkse, Rosenstein-Rodan, Harrod-Domar, Solow and Lewis, for example. From the 1950s, comes a specific concern with regional problems (Bellingieri, 2017).

The 1960s focus on ensuring basic needs, suggesting structural transformations. Authors like Rostow, Gerschenkron, Huntingtonand Myrdal stand out in the period. From the 1970s onwards, the planet's survival became the new development paradigm (Sachs, 2000), and in 1973 emerged the concept of eco-development. In parallel, there is an effort to differentiate approaches between developed and developing countries, due to the structural nature of these countries and their insertion in international trade, with authors such as Furtado, Prebisch, Sunkel, Frank, Singer and Hirschman. Besides, "there were discussions on the proper role of state intervention and market-led development, as well as inward-looking and outward-oriented development strategies" (OECD, 2018:146), highlighting Krueger, Bhagwati and Chenery's contributions.

In the 1980s, emerged the endogenous development paradigm, which argued that development would not be determined by the functioning of free-market forces or by territorial planning policies originating from the central power, but by aspects intrinsic to the local – opening room for regional territories and local authorities to adopt active development policies. This paradigm presents different approaches, such as new growth theory, industrial district, *milieu innovateur*, cluster, social capital, creative

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city (Bellingieri, 2017). In parallel, from 1987 onwards, the sustainable development paradigm was created.

Therefore, it is possible to argue that from the 1980s onwards, the local/regional emerges as the new protagonist of development, interpreted in a broader and more complex way. Between the 1980s and 2000s, development policies had a greater focus on macroeconomic stability influenced by the Washington Consensus, highlighting the work of Williamson, Lucas, Romer, Sen, Adelman, and Sachs.

From the end of the 1990s and even more from the 2000s, the emergence of the endogenous development paradigm emphasizing bottom-up approaches brought regional/local development back as a relevant theme. However, as already indicated, it should be noted that local development is not synonymous with municipal development (Bellingieri, 2017).

From the turn of the century, the discussion on the development started to focus on goal-based strategies. In 2000 and 2015, respectively, the Millennium Development Goals (MDGs) and the Sustainable Development Goals (SDGs) became relevant as a guide for targets and results, suggesting specific areas and strategic segments. Therefore, from these two global agendas, we will highlight its potential on the economy of the sea and maritime clustering.

In 2000, a global response started with the MDGs. Totaling eight goals, MDG 7 dealt on ensuring environmental sustainability, focused mainly on life on land; however, target 7.b aimed to protect terrestrial and marine ecosystems, addressing, for example, protected coastal areas and overexploitation of fish (UN, 2015).

In 2015, the 2030 Agenda led to the establishment of the SDGs, which came into force as of January 1, 2016. With 17 interconnected goals, the 2030 Agenda and, in particular, the SDG 14 have a broader perspective on the sustainable use and management of oceans, maritime resources, and related ecosystems for sustainable development. Therefore, the 2030 Agenda provides a new impetus to the mandates of clean, healthy, productive and resilient oceans, as well as related marine resources, which were promulgated in the results of major summits and conferences (UNCTAD website).

However, SDG 14 will require robust international cooperation and coordination to protect the oceans and preserve fish and other marine resources from being achieved. This is mainly because the current governance of the oceans and fisheries is characterized by a myriad of international and regulatory agreements, often implemented in a disjointed manner by a variety of agencies (UNCTAD, 2016). When it comes to 2030 Agenda, it is not only SDG 14 that deals with issues related to the sea and the ocean.

The evolution of the theory of economic development focused on regional approaches has not only broadened the range of actors and sectors but is also in line with the current SDG agenda in force. Thus, it is possible to understand and analyze maritime clusters based on variables and themes included in this agenda, putting local and regional approaches together with the national objectives of different countries. However, given the fact that "maritime clusters evolve over time in terms of the composition of maritime services provided and actors represented" (MIPC, 2013: 3), it is possible to evaluate them in different ways. Although its driving forces may have different nuances, and the literature states that its performance should be measured in value-added, *Figure 2* shed light on how to evaluate clusters taking into account three main areas.

Governance	Nature	Performance
• Political support and stability • Public policies and instruments • Banking support and financing • Equipment and infrastructure suppliers • Public organizations • Universities • Industry associations • Private initiative and investors • Presence of SMEs and start-ups • Nongovernmental agencies • Civil society	• Entry and exit barriers • Presence of scale economies • Economic specialization • Number of sectors involved • Heterogeneity among companies • Existence of common suppliers, customers and complementary resources • Proximity • Knowledge spillovers (dissemination and sharing) • Quantity and quality of jobs • Encouraging entrepreneurship • Emergence of new opportunities	• Trust among actors • Level of cooperation, internal competition and networking • Intensity of transactions • Labour pool • PPPs • Presence (or not) of a leader firm Improved efficiency and productivity • Commitment to sustainability • Creation of new start-ups and entrants • Product, process and/or technology development • R&D and innovation • Increase or decrease of skilled workers • Processes of representation or identification • FDI attraction

Figure 2: Key variables to assess cluster governance, nature, and performance

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Based on the literature review of cluster theory and the historical analysis of the theory of (regional) economic development, we do not propose to present a closed model for analyzing maritime clusters. On the contrary, considering the particularity of the different cases that exist in the world and the various cases in the same country, we present the main variables that can analyze each case, based on its governance, nature, and performance. This is because evaluating clusters is not only the sum of the performance of the business units in the cluster, but depends on many factors such as social, economic and institutional features. Indeed, what we propose it that the maritime cluster should be the driver of (local, regional and national economic) development, being a strategic policy to boost networking, innovation and competitiveness.

III. Brazilian Maritime Cluster Cases

This section will briefly present two Brazilian maritime clusters, highlighting some characteristics of these regions, its history, and its spatial location. Brazil is a federative republic located in South America and has 7,367 km of coastline (the 16th largest in the world) bathed in the east by the Atlantic Ocean – however, it increases to 9,200 km if we consider the ridges and coastal indentations.

According to the Brazilian Institute of Geography and Statistics (IBGE), the country has 8.5 million km^2 (5th largest country in the world), an estimated population of 210.1 million people in 2019 (6th largest population in the world), gross domestic product (GDP) of R$ 6.9 trillion in 2018 (8th largest economy in the world), human development index (HDI) of 0.761 in 2018 (79th in the world ranking), and is composed of 26 states, 5,570 municipalities and, the 1 Federal District. *Figure 4* shows Brazil's map, highlighting states, and their capitals.



Figure 4: Brazil's map, highlighting states and their capitals

Given the economic crisis that the country has been experiencing since 2016, different initiatives have been carried out to promote the country's economic growth. The following subsections will present how the states of RS and RJ seek to rebuild their economic dynamics by generating employment and income from the cluster strategy, particularly encouraging economic activities, directly and indirectly, related to the sea.

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a) Rio Grande case

The State of Rio Grande do Sul (RS) is located in the southern region of Brazil and has 497 municipalities. With a population of 10.7 million people in 2019 (5th largest in the country), area of 281.7 thousand km^2 (9th largest Brazilian state), GDP of R$ 423.2 million in 2017 (4th largest in the country), it has nominal income per capita household monthly income of R$ 1,705.00 (3rd largest in the country) and HDI of 0.746 (6th best in Brazil). Not corresponding to the state capital (Porto Alegre), the municipality of Rio Grande has an estimated population of 211.0 thousand people in 2019 (2.0% of the state's population), an area of 2,708 km^2 (almost 1% of the territory), GDP per capita of R$ 44,014 (100th in the state ranking), it has an average monthly salary of formal workers of 3.5 minimum wages in 2017 (7th highest in the state) and municipal HDI (MHDI) of 0.744 in 2010 (667th in the country's municipal HDI ranking). *Figure 4* shows the geography of the state of RS, detailed by municipalities, and highlighting the Rio Grande one.



Figure 4: RS's map, highlighting the municipality of Rio Grande

In comparison with the national economy, the coastal municipalities of the state of RS incorporated 2% of the population and generation of wealth. 2005 dates back to the beginning of negotiations for the implementation of projects aimed at the naval and offshore pole of Rio Grande, with the bidding process for the construction of the dry dock to build platforms for Petrobras. Thus, the spatial deconcentration of the Brazilian naval industry served as a driving factor for industrial development and technological innovation in the region, important factors in the formation of productive arrangements and clusters (Carvalho, 2011; Carvalho et al., 2016). When "taking over" the Rio Grande port site and planning and implementing a naval pole on it, mobilizing state companies like Petrobras and large national and international private companies, "the Brazilian state sets in motion, in the words of Claude Raffestin (1993), its spatial practice, induced by a system of actions or behaviors that translates into a territorial production that intervenes node, network and rings" (Carvalho, 2011: 24).

The naval and offshore pole of Rio Grande, by articulating and integrating production chains spatially distributed in different regions of Rio Grande do Sul, in the country and even abroad, set in motion horizontalities and verticalities, continuities and discontinuities in motion, mobilized by syntagmatic actors. Given these projects, in 2013, the *Arranjo Produtivo Local (APL) do Polo Naval e de Energia do Rio Grande e Entorno* is consequently launched, an initiative of the *Agência Gaúcha de Desenvolvimento Industrial* (AGDI) and *Universidade Federal do Rio Grande* (FURG) with many companies associated.

Although of regional scope, the spatial configuration of the APL was structured in the municipality of the Rio Grande, headquarters of the port. Since 2015, several factors compromised the sustainability of the naval and offshore pole of Rio Grande, from the national crisis to corruption scandals, culminating in the demobilization of the naval pole and, consequently, the weakening of the Local Productive Arrangement (LPA – "APL" in Portuguese) that still it was

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in the process of structuring. However, 2019 marked the effort for a return to LPA activities, starting to be configured in Maritime LPA, including the sectors of waterway navigation, port operations, logistics, fishing, and aquaculture, among other issues.

b) Rio de Janeiro case

The State of Rio de Janeiro (RJ) is located in the southeastern region of Brazil and has 92 municipalities. With an estimated population of 17.3 million people in 2019 (3rd largest in the country), an area of 43.8 thousand km^2 (24th in the ranking of Brazilian states), GDP of R$ 671billion in 2017 (2nd largest in the country, after São Paulo), it has a nominal monthly household income per capita of R$ 1,689.00 (4th highest in the country) and HDI of 0.761 (4th best in the country). Being the capital of the State, the municipality of Rio de Janeiro has an estimated population of 6.7 million people in 2019 (38.7% of the state's population), an area of 1,200 km^2 (2.7% of the state's territory), GDP per capita of R$ 51,776 (14th in the state ranking), has an average monthly salary of formal workers of 4.1 minimum wages in 2017 (2nd highest in the State) and MHDI of 0.799 in 2010 (45th in the country's municipal HDI ranking). *Figure 5* presents the geography of the State of RJ, detailed by municipalities, and highlighting the Rio de Janeiro one.

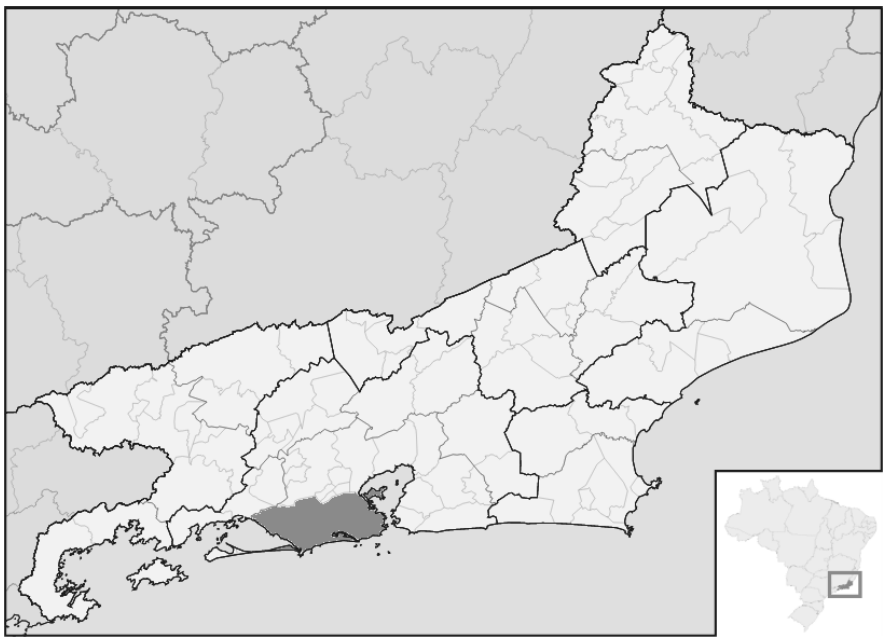

Figure 5: RS's map, highlighting the municipality of Rio de Janeiro

In comparison with the national economy, the coastal municipalities of the state of RJ stand out both in the population (5.7%) and in the generation of wealth (8.6%). The greater weight of these municipalities in the national economy is due to a large number of coastal municipalities (25) and the activities of the extractive industry and tourism, highly developed on the coast of RJ (Carvalho, 2018; Santos and Carvalho, 2020).

Given these figures and data, in November 2019 the Rio de Janeiro Naval Technological Cluster Association (Naval Technological Cluster) is launched, an initiative of the companies *Empresa Gerencial de Projetos Navais* (Emgepron), *Nuclebras Equipamentos Pesados S.A.* (Nuclep), *Amazônia Azul Tecnologias de Defesa S.A.* (Amazul) and*Condor Tecnologias Não Letais*. The location in the city of RJ is due to the proximity to reference centers of education, research and training in Brazil, such as the Military Institute of Engineering (IME), the Federal University of Rio de Janeiro (UFRJ), the Alberto Luiz Coimbra Institute of Graduate Studies and Engineering Research (COPPE), the Federation of the Industries of the State of Rio de Janeiro (FIRJAN), Social Service of Industry (SESI), National Service for Industrial Learning (SENAI), Brazilian Micro and Small Business Support Service (SEBRAE), Brazilian Naval War College (EGN), in addition to the Rio de Janeiro Navy Arsenal (AMRJ).

In general, the Naval Technological Cluster has as strategic focus (i) the promotion of the regional domestic market; (ii) the expansion of the foreign market; (iii) densification of business chains with different sectors of the economy (public, business, financial institutions, and research); (iv) the education and training of personnel; (v) the innovation and technology; (vi) the valorization of the local identity; and (vii) the environmental sustainability. Not limited to the municipality of Rio de Janeiro, it considers its regional surroundings, adding the municipalities of Niterói, Magé, Duque de Caxias, São Gonçalo, Guapimirim, and Itaboraí.

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Among its priority axes, there are initially production chains related to military and merchant naval construction and repair, generating incentives to the economy of the sea (e.g., tourism, gastronomy, port activities, and other offshore activities), and to strengthen the export platform defense industrial base (Caiafa, 2019).Before its launch, it is noteworthy that the cluster had a strong inclination towards the defense area, which is still reflected in the companies that make up the association.

Thus, the aim is to take advantage of the local potential of RJ to help the growth of the local maritime industry. The RJ cluster has great potential for success, given that the region concentrates most of the activities of the Brazilian Navy (MB) and that it already has two active centers: (i) Sepetiba Bay, with the submarine program (Prosub); and (ii) Guanabara Bay, which concentrates more than ten construction and repair yards; also, the presence of the AMRJ above stands out. On November 21, 2019, in Rio de Janeiro, the 1st International Seminar was held addressing the theme, precisely tying the concepts of the economy of the sea, and maritime cluster – just like proposed in the theoretical-conceptual framework of this paper.

IV. Quantitative Analysis

This section initially introduces the methodology used in the quantitative analysis and then analyzes the data and proposes recommended policies associated with each case. In the first subsection, we show its formula, how to evaluate its results and why we use the Herfindahl-Hirschman index (HHI) to assess the concentration for maritime clusters. The second subsection respectively analyzes the case of the clusters of Rio Grande do Sul (RS) and Rio de Janeiro (RJ), having as base year 2018 and having the HHIs elaborated based on the number of employees of the municipalities facing the sea of the two states from the official data of the Annual List of Social Information (RAIS).

a) Methodology

The analysis method uses a concentration index known and widely used in economic literature and the analysis of competition economic policy, especially because it establishes a conceptual link between the market structure and its performance (Cooper, 2007) – fully aligned with the proposed cluster assessment presented in the *Figure 2.* Albert Hirschman created the index in 1945 and Orris Herfindahl reinvented a calculation formula in 1950, thus becoming known as the Herfindahl-Hirschman index (HHI). *Equation 1* presents the calculation of the index (Hoffman, 1998):

$$HHI = \sum_{i=1}^{n} S_i^2 \qquad (eq.\ 1)$$

where:

n = total number of firms

S_i = share of *i-th*firm of the total market

The HHI is a statistical measure of concentration, calculated from the sum of the squares of the firms in the sector under analysis in relation to the total. In contrast to the concentration ratio (CR), HHI takes into account the relative size of firms by squaring each company's share, so that the higher the index, the greater the concentration in the market. Thus, "as firm share is calculated on a scale between 0 and 100, the HHI ranges from close to zero (a very large number of firms with very small market shares) to a maximum value of 10,000, in which a single firm holds a monopoly." (de-Ramon and Straughan, 2017: 32).Consequently:

$$HHI < 1{,}000 \rightarrow \text{not concentrated}$$

$$1{,}000 \leq HHI \leq 1{,}800 \rightarrow \text{moderately concentrated}$$

$$HHI > 1{,}800 \rightarrow \text{highly concentrated}$$

Similar to what we propose in this article, Viederyte (2016) suggests the use of HHI in the clustering attributes identification. Carvalho et al. (2017) use HHI to analyze naval pole in Brazil. Ramos (2013) does the same in the Brazilian high education system, while Tonin et al. (2019) use HHI to evaluate the Brazilian regional banking sector. Thus, although the index was created to measure the concentration of firms in a given market, this methodology has been used in other contexts that use the same notion of (de)concentration.

b) Data analysis and policy implications

To calculate the Herfindahl-Hirschman Index (HHI) of the clusters presented in the previous section, we use as a proxy for the concentration of the number of employees of the municipalities facing the sea using official data of the Annual List of Social Information (RAIS), having as the base year 2018. The analysis of economic activities followed the aggregation of the National Classification of Economic Activities (CNAE) 2.0, which is the classification officially adopted by the Brazilian national statistical system and by the Brazilian federal agencies that manage administrative records, aggregating activities into 21 sections (first level of aggregation).For the municipalities of the Rio Grande and the Rio de Janeiro, the analysis took into account more disaggregated levels, considering 673 different classes of economic activities (fourth and penultimate level of aggregation). For more details, see *Annex1.*

Table 1 shows the HHI and the concentration level of the municipalities facing the sea in the state of Rio Grande do Sul (RS). It is noteworthy that although the state has 497 municipalities, only 16 are coastal municipalities (3.2%).

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Table 1: HHI ranking of the municipalities facing the sea in the state of RS

Municipalities	HHI	Level of concentration
Cidreira	3.680,70	High
Chuí	3.511,87	
Balneário Pinhal	3.262,24	
Tavares	3.134,31	
Imbé	3.076,81	
Arroio do Sal	3.041,31	
Xangri-la	2.553,62	
Santa Vitória do Palmar	2.504,56	
Terra de Areia	2.212,05	
Mostardas	2.135,43	
Palmares do Sul	2.045,78	
São Jose do Norte	1.905,29	
Capão da Canoa	1.686,27	Medium
Osorio	1.555,80	
Torres	1.518,69	
Rio Grande	1.155,10	

Twelve municipalities facing the sea (Cidreira, Chuí, Balneário Pinhal, Tavares, Imbé, Arroio do Sal, Xangri-la, Santa Vitória do Palmar, Terra de Areia, Mostardas, Palmares do Sul, São Jose do Norte) have high concentrated HHI (*HHI*> 1,800). According to the proposed classification, the municipalities with the highest concentration rates have higher HHI values in the service sector, more specifically: trade, repair of motor vehicles, and motorcycles; public administration, defense, and social security. It is worth mentioning that the municipalities of Mostardas and Santa Vitória do Palmar, in the extreme south concentrate workers almost exclusively in the sector of agriculture, livestock, forestry production, fishing and aquaculture, reflecting the productive structure of the state, which is strongly agricultural.

Still, according to *Table 1*, it is also noticed that four municipalities (Capão da Canoa, Osório, Torres, Rio Grande) present moderate concentration indices (1,000 ≤*HHI* ≤ 1,800), with higher HHI values in the services and industry sector, namely: public administration in general; transformation industry; trade, repair of motor vehicles and motorcycles. The municipality of Rio Grande stands out, having the Maritime Local Productive Arrangement (LPA), which has a contingent of workers in areas similar to the LPA, such as construction of boats and floating structures; manufacture of machinery, equipment and apparatus for transporting and lifting loads and people.

Paying attention to the other municipalities in the state of RS, which have extremely concentrated rates (*HHI*> 1,800), *Figure 6* shows the region of the mountain range, with activities related to the manufacturing industry and public administration, defense and social security.

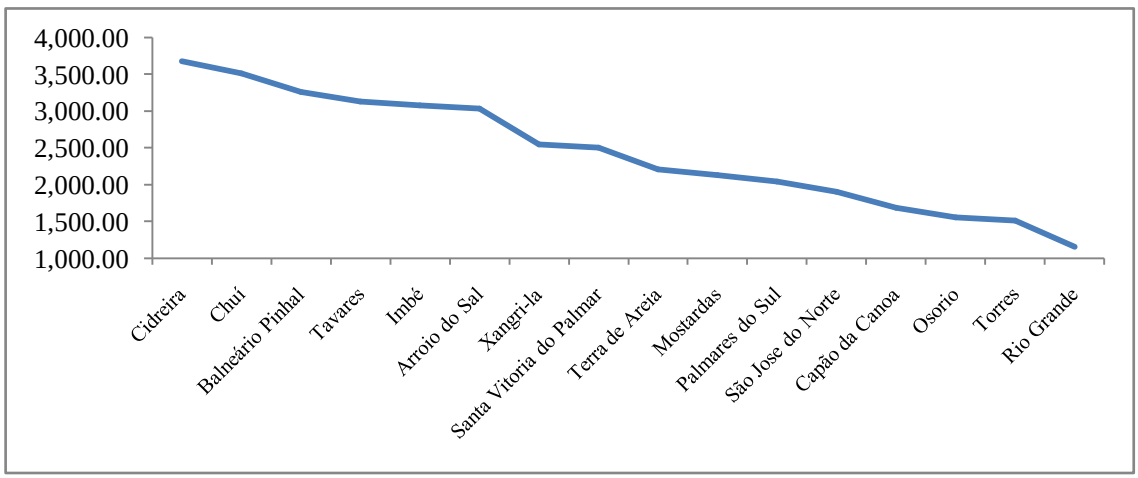

Figure 6: HHI of the municipalities facing the sea in the RS

Municipalities facing the sea of RS have slightly more diversified economies (especially when compared to the case of RJ to be presented below), even in the face of a scenario of high concentration that the state presents. These are smaller municipalities on the coast (differently from RJ) and less economically relevant than

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other municipalities in the state of RS (given the importance of economic activities in the interior). In this way, municipalities in the mountains have a high share of tourism, the manufacturing industry, and the metal-mechanical chain, rivaling the economic relevance of other municipalities facing the sea in the state. Notwithstanding, it is possible to expect that the smaller economic weight of these municipalities tends to reverse, taking advantage of policies and stimuli from the Rio Grande cluster.

Regarding the state of Rio de Janeiro (RJ), *Table 2* shows the HHI of the municipalities facing the sea in the state. Although the state has 92 municipalities, only 25 are coastal municipalities (27.2%).

Table 2: HHI ranking of the municipalities facing the sea in the state of RJ

Municipalities	HHI	Level of concentration
Carapebus	5.931,61	High
Quissamã	4.435,49	
São Francisco de Itabapoana	2.983,46	
Mangaratiba	2.841,37	
Casimiro de Abreu	2.553,86	
Guapimirim	2.400,51	
Armação de Búzios	2.290,73	
Arraial do Cabo	2.224,74	
Saquarema	2.092,14	
Marica	1.997,88	
Araruama	1.743,62	Medium
Cabo Frio	1.782,24	
Magé	1.779,78	
Paraty	1.764,20	
São João da Barra	1.677,79	
Itaboraí	1.537,93	
Itaguaí	1.529,83	
São Gonçalo	1.503,43	
Duque de Caxias	1.492,47	
Rio das Ostras	1.482,19	
Campos dos Goytacazes	1.461,01	
Angra dos Reis	1.264,60	
Niterói	1.087,93	
Rio de Janeiro	1.061,68	
Macaé	1.029,57	

Ten municipalities facing the sea (Carapebus, Quissamã, São Francisco de Itabapoana, Mangaratiba, Casimiro de Abreu, Guapimirim, Armação de Búzios, Arraial do Cabo, Saquarema, Marica) have high concentrated indexes (*HHI* > 1,800), in which the service sector stands out (public administration, defense, and social security). Still, two municipalities stand out in the specialization of activities (*HHI* > 4,000). In this sense, we can argue that employment in these municipalities is concentrated in a few sectors, having a relatively specialized productive structure.

Still according to *Table 2,* it is also noticed that seven municipalities (Araruama, Angra dos Reis, Cabo Frio, Magé, Paraty, São João da Barra, Itaboraí, Itaguaí, São Gonçalo, Duque de Caxias, Rio das Ostras, Campos dos Goytacazes, Niterói, Rio de Janeiro, Macaé) presented moderate concentration indexes (1,000 ≤ HHI ≤ 1,800), with higher HHI values in the services and industrial sector, such as public administration in general; transformation industry; trade, repair of motor vehicles, and motorcycles; and restaurants, and other establishments. It is noteworthy that the municipality of Itaguaí, which has a large contingent of workers in the manufacture of heavy boiler works, reflecting the manufacturing activities for the shipbuilding industry and which are currently part of the scope of the Naval Technological Cluster of RJ. In these municipalities, employment is more concentrated and the productive structure is not specialized (being more diversified).

Paying attention to the other municipalities in the state of RJ, which have extremely concentrated rates (*HHI* > 4,000), we highlight three (one is located in the north of the state and the others in the mountain region). The highest HHI values are essentially linked to the services and industrial sector, namely: public administration, defense and social security; and manufacturing industry.

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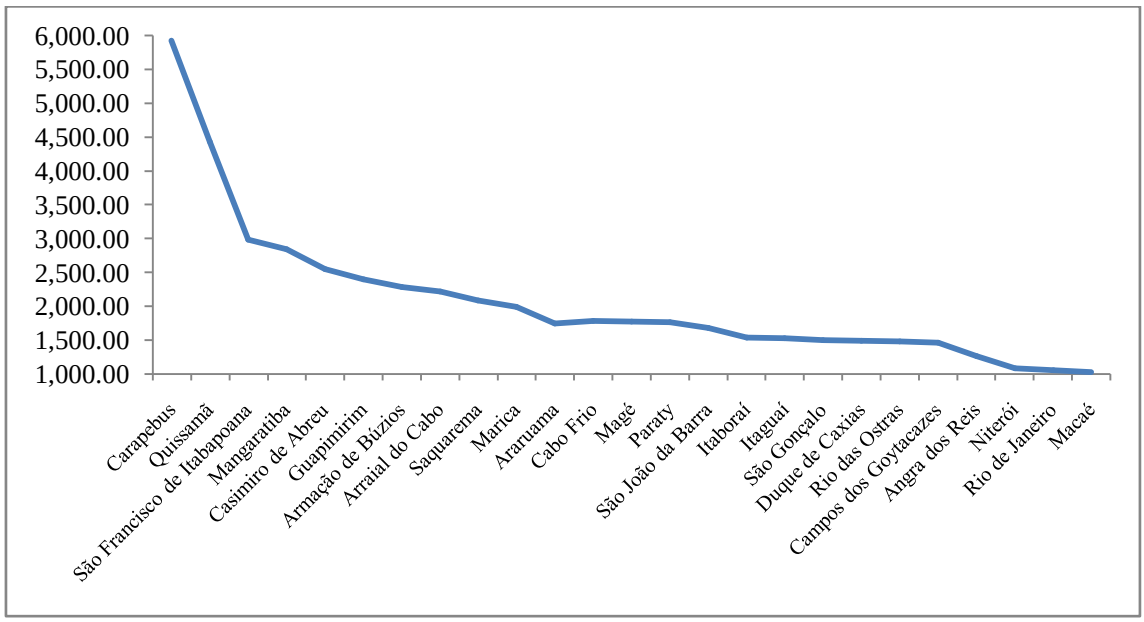

Figure 6: HHI of the municipalities facing the sea in the RJ

The municipalities facing the sea of RJ are larger (compared to the weight of municipalities facing the sea in the RS economy), constituting municipalities that are really relevant to the state, and highly concentrated in the service sectors (mainly tourism and related activities). It stands out, for example, the capital (Rio de Janeiro), which is a municipality facing the sea and a megalopolis, therefore being almost absent from the list of municipalities of medium concentration, since by, its nature, it has different economic activities and, consequently, significant decentralization of activities and work.

V. Conclusions

We argue that "blue is the new green" in the sense that the term "blue" is currently used as a flag of a political-ideological nature that seeks to engage and mobilize society in general in the cause of sustainability (which also includes maritime themes, but is not restricted to them). In this way, it can be understood as a way of thinking and doing business in the context of sustainable development, corresponding to a broader and vague notion. From the analysis of the historical evolution of the economy of the sea concept, it was concluded that it is a more precise one, specific to each country, and limited to activities directly and indirectly related to the seas. Therefore, it corresponds to the area of economic science responsible for identifying and measuring economic sectors directly and indirectly related to resources and activities in/from the sea.

As the economy of the sea can be understood as an analytical and strategic tool capable of contributing to the formulation of public policies, we have tied it to the maritime cluster theory – understood as a model by which the economy of the sea can be used as a public policy vector. In fact, the "economy of the sea" and "maritime cluster" do not compete since cluster comes close to a "model" while the economy of the sea is the "analytical and strategic policy" itself. Linking this conceptual discussion with economic development, we highlighted that the regional focus begins in the 1950s, gains strength after the 1980s, and, from the 21st century on, the discussion on the development started focusing on goal-based strategies. Therefore, the analysis of the evolution of the economic development theory focused on regional approaches has not only showed the broader range of actors and sectors, but that is also in line with the current SDG agenda in force.

Since Brazil can be understood as a "maritime by nature" country, we considered the economic crisis context that the country has been experiencing since 2016 to stress how it has been developing maritime clusters to promoting the country's economic growth. We analyzed the creation, and objectives of the Rio Grande cluster (located in the state of RS) and the Naval Technological Cluster (located in the state of RJ) and, from a methodological point of view, we used the Herfindahl-Hirschman index (HHI) to analyze the spatial concentration of some activities (using the number of employees of the municipalities facing the sea).

Using variables in Figure 2 to evaluate both clusters analyzed, it is necessary to consider: (i) in the RS case: related maritime services, such as tourism, gastronomy, port activities; and (ii) in the RJ case: services and production chains (not only final sectors themselves). Therefore, in both cases services, and public administration stand out as main areas where we found medium or high labor concentration. This proxy may be used as a guide to promote both clusters. It is

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worth noting that both clusters also benefit from local characteristics, such as proximity to reference centers of education, research and training in Brazil, as well as past experiences (Rio Grande case) or neighbors (Rio de Janeiro case) to take into account.

Proportionally, the state of RJ has more municipalities facing the sea (27.2%) than RS (3.2%). However, the extension in terms of km of coastline in RS exceeds that of RJ. At the same time, it was noticed that the municipalities facing the sea of RJ are larger and more relevant to the state, being highly concentrated in the service sectors (mainly tourism and related activities). On the other hand, the municipalities facing the sea in RS do not correspond to those larger and more relevant to the state's economy, either because the state is formed by many small municipalities, or because the municipalities in the interior are very economically relevant. The mountain region stands out, with tourism, transformation industry, very strong metal-mechanical chain in the state of RS, rivaling other parts of the state.

The degree of concentration of the municipalities of the Rio Grande and the Rio de Janeiro is medium, due to the size of the municipality and because they have several activities developed. In the case of RS, the Rio Grande Naval Offshore Pole (not the LPA created from it), which included shipyards, Petrobras orders, supply industries, and industries that were operating on the docks at the port of Rio Grande, boosted the state's economy and helped to promote the municipal economy, placing it among the most relevant in the state. Thus, the municipality ends up projecting itself with the naval and offshore pole, but with the suspension of orders by Petrobras and with the crisis, the naval pole breaks down (leading to the fall of the municipality's economic relevance).

In the case of RJ, municipalities facing the sea, such as Rio de Janeiro and Macaé, had a heavy concentration associated with oil, being very much affected by the fall of the oil barrel and the economic crisis. Therefore, it is possible to infer that these events promoted the deconcentration of activities in RJ, given the national crisis and the fall in formal jobs, deconcentrating the state's economic activities.

Hence, although clusters tend to appear spontaneously, it does not mean that they cannot be stimulated and supported by different (public) policies. Considering both case studies analyzed in this paper, the identification of activities and economic sectors in both states can take advantage of sectors already concentrated to give the initial starting point of the activities of these clusters. If there is a current lack of labor in these respective sectors (related to the *nature* of each of the maritime clusters), it is necessary to design and stablish public policies capable of promoting the creation and consolidation of *governance* favorable to the development, and *performance* of these clusters. Through this perspective (economy of the sea), the sea can be explored, needs to be managed and must be protected.

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Annex 1: CNAE 2.0, detailed by section, divisions and denomoniation

Section	Divisions	Denomination
A	01-03	AGRICULTURE, LIVESTOCK, FOREST PRODUCTION, FISHING, AND AQUACULTURE
B	05-09	MANUFACTURING INDUSTRIES
C	10-33	TRANSFORMATION INDUSTRIES
D	35-35	ELECTRICITY, AND GAS
E	36-39	WATER, SEWAGE, ADMINISTRATION OF RESIDUES, AND DECONTAMINATION
F	41-43	CONSTRUCTION
G	45-47	TRADE, REPAIR OF MOTOR VEHICLES, AND MOTORCYCLES
H	49-53	TRANSPORT, STORAGE, AND MAIL
I	55-56	ACCOMMODATION, AND FOOD
J	58-63	INFORMATION, AND COMMUNICATION
K	64-66	FINANCIAL, INSURANCE, AND RELATED SERVICES ACTIVITIES
L	68-68	REAL ESTATE ACTIVITIES
M	69-75	PROFESSIONAL, SCIENTIFIC, AND TECHNICAL ACTIVITIES
N	77-82	ADMINISTRATIVE ACTIVITIES, AND COMPLEMENTARY SERVICES
O	84-84	PUBLIC ADMINISTRATION, DEFENSE AND SOCIAL SECURITY
P	85-85	EDUCATION
Q	86-88	HUMAN HEALTH, AND SOCIAL SERVICES
R	90-93	ARTS, CULTURE, SPORTS, AND LEISURE
S	94-96	OTHER SERVICE ACTIVITIES
T	97-97	HOUSEHOLD SERVICES
U	99-99	INTERNATIONAL ORGANISMS, AND OTHER EXTRATERRITORIAL INSTITUTIONS

Source: IBGE.

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