COASTAL ECONOMY OF RIO GRANDE DO SUL: MEASUREMENT AND SECTOR STRUCTURE

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Abstract: This paper analyzes the geographical and economic characteristics of the coastal zone of the state of Rio Grande do Sul. From then on, it is estimated an Input Output Matrix Interregional for the coast of the state in the year of 2015. The contribution of this research to the literature is in the quantification of a part of the gaúcha economy in an updated way, which will help in the elaboration and implementation of specific public policies for the municipalities of the coastal zone. The results indicate that the region has a 9.1% share of the GDP of Rio Grande do Sul and that the economic profile of the region is related to activities of agriculture, livestock, forest production, fishing, aquaculture; trade; repair of motor vehicles.
Keywords: Economy of the Coastal Zone, Economy of the Sea, Input-Output Matrix, Rio Grande do Sul.

1. Introduction

The aim of this study was to estimate an Input-Output Matrix (IPM) to quantify the sectoral profile of the coastal region of Rio Grande do Sul, and then calculate the impact multipliers for income, employment, production and taxes, production chains and other indicators. According to data from the Ministry of the Environment (2021), the coastal zone of Rio Grande do Sul (ZCG) is made up of more than 30 municipalities, in addition to Lagoa dos Patos (RS), which covers an area of approximately 265 kilometers.

Data from the Brazilian Institute of Geography and Statistics (IBGE, 2020) shows a population of approximately 1,488,819 people in the ZCG, which represents 13.03% of a total of 11,422,973 inhabitants in Rio Grande do Sul. It also has beaches and Conservation Units, which indicate the availability of environmental resources in the region (Taim Ecological Reserve, Lagoa dos Patos and Lagoa Mirim).

The contribution of this work lies in quantifying a specific geographical and environmental segment of the regional economy in relation to the sea, presenting concepts of the coastal economy and the sea, as well as its participation in the Gross Domestic Product (GDP) and its dominant activity. It should be noted that these issues are still little explored in the national empirical literature, so this work seeks to fill this gap.

2. Literature Review

Brazil's coastal zone covers 8,500 km in 17 federative units, with more than 400 municipalities spread from the south (Santa Vitória do Palmar/RS) to the north (Oiapoque/AP) (MMA, 2021a). Coastal and marine ecosystems have a structure of ecosystem services distributed into provisioning services, support services, regulation services and cultural services. There is an interdependence between the use of the sea's ecosystem services and their sustainable use, known as the blue economy.

In turn, the blue economy can be defined as the range of economic sectors and related policies that determine the use of sustainable ocean resources. According to the World Bank (2017), the blue economy includes established traditional ocean industries such as fishing, tourism and shipping, but also new and emerging activities such as offshore renewable energy, aquaculture, seabed extractive activities and marine exploration, biotechnology and bioprospecting.

2.1 International empirical evidence

Barbier (2012) studied spatial models of Coastal Ecosystem Services (SEC), given the options of preservation and development. Among the conclusions, the analysis shows that, in the case of a seafront that is valued in relation to environmental services, and given the condition of constant marginal rents, the transformation of the landscape should take place further inland. These valued coastal areas will determine what the transformation scenario will be and where this conversion should be located.

The search to define a strategic framework for the Azores Region in relation to ocean governance was the motivation for Paramio's research (2012). For the basis of the study, different concepts and tools were sought, such as the Principle of Sustainable Development, Ecosystem-based Management, Integrated Coastal Zone Management and Marine Protected Areas. The results indicated the need for a classification of development priorities with strategic guidelines, with a view to a future strategic basis for the Azores Sea region.

Using the same input-output tool, Morrissey and O'Donoghue (2013) analyzed the contribution of the marine economy, in this case the Irish economy, in national and regional terms. Through intersectoral links, the authors recognized that marine sectors affect the sector itself, as well as other productive sectors, and that this panorama is very important for decision-making aimed at economic growth. Therefore, in the input-output matrix for 2007, ten sectors were disaggregated and the result was that three sectors with values greater than 1 were identified in backward linkages, i.e. they have the profile of buyer sectors. And only 1 sector with a value greater than 1 in the forward linkages, i.e. it is demanded by the other sectors, considering the economic impacts. In summary, the backward and forward linkages of the maritime economy indicate the sector's low level of productive linkage in the country.

2.2 National empirical evidence

Mehvar et al. (2018) researched SECs and reviewed their quantification in various parts of the world. The study showed that coral reef and mangrove areas are more valued and, conversely, seagrass beds have less economic value. In this context, tourism and other recreation are factors in the valuation of SECs. Presenting a summary of coastal wetlands and the aforementioned SE, it was noted that local and regional studies do not usually quantify SECs.

Gonçalves, Oliveira and Johnston (2019) carried out an innovative study on the economic profile of the coastal region of southern Rio Grande do Sul and estimated a regional IPM in an attempt to understand the region's productive structure based on analysis indicators for the year 2011. The results showed that activities related to forestry production, port activity and agribusiness are highly representative of the region's economy.

Corroborating the bibliographic analysis of concepts and strategies, Pereira (2020) indicates in his study that the blue economy is the way to guarantee the economic and environmental efficiency of ocean-based production activities in the long term. Through extensive bibliographical research, the author demonstrated the environmental impacts caused by ocean-based production activities and the economic effects generated by these impacts. He concluded that strategies such as expanding and improving economic analysis and instruments, diversifying and innovating financing mechanisms and strengthening governance of the marine space are fundamental to achieving a long-term blue economy.

3. Defining the coastal region of RS

The Brazilian Coastal Zone was enshrined in the 1988 Federal Constitution within a list of geographical areas and biomes considered to be national heritage - art. 225, § 4 - alongside the Atlantic Forest, the Serra do Mar, the Mato Grosso Pantanal and the Amazon, which has the legal effect of expressly expressing the special interest of the whole nation in its protection, this "protection" being understood as a binding obligation of preservation and sustainable development (Coastal Action Manual of the Federal Public Prosecutor's Office).

The coast of Rio Grande do Sul, from Torres in the north to the mouth of the Chuí Stream in the south, is made up of a broad coastal plain some 620 km long and up to 120 km wide, where a system of sandy barriers traps a gigantic lagoon system (the Patos-Mirim lagoon complex) and a series of other bodies of water that are isolated or interconnected with the sea through narrow, shallow channels (Villwock, 1994).

MMA Ordinance No. 34, of February 2, 2021, which approves the updated list of municipalities covered by the land strip of the Brazilian coastal zone, defines the region described in figure 1 below as the Coastal Zone of Rio Grande do Sul.
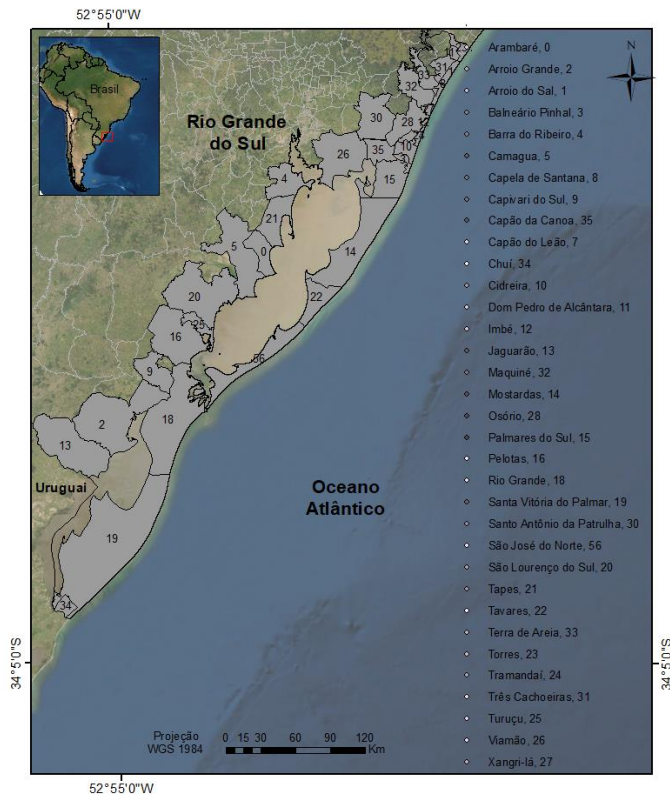
Figure 1: Coastal zone of Rio Grande do Sul

According to data obtained from the IBGE (2020), the ZCG, with 1,488,819 inhabitants, has 13.03% of the state's total population. Among the 10 fastest-growing municipalities in RS are 7 in the coastal zone, such as Balneário Pinhal, Cidreira, Tramandaí, Imbé, Xangri-lá, Capão da Canoa and Arroio do Sal. The municipalities that directly face the sea in Rio Grande do Sul are Arroio do Sal, Balneário Pinhal, Capão da Canoa, Cidreira, Imbé, Mostardas, Osório, Palmares do Sul, Rio Grande, Santa Vitória do Palmar, São José do Norte, Tavares, Terra de Areia, Torres, Tramandaí and Xangri-lá.

The state has the Patos Lagoon, which is 265 kilometers long and covers an area of approximately 10,144 km², with direct links to other hydrographic regions in the state. And the Mangueira Lagoon, 123 kilometers long and covering a total area of 800 km², which begins in the municipality of Santa Vitória do Palmar. The beaches of RS are frequented by many visitors who come to the resorts and tourist areas during vacation and leisure periods.

The frequent use of these spaces has been of growing importance to the economy of coastal municipalities. Along with this growth comes worrying aspects, such as erosion processes, which diminish the beauty of the environment, the space available for leisure and subject the population to the risk of flooding. In addition, the presence of garbage and untreated domestic effluent detracts from the scenery.

4. **Results and discussions**

The effects of variations in final demand on the economy were measured using the input-output model. This section will present the results found for the Gaucho Coastal Zone economy for 2015. Based on the multipliers, the key sectors of the economy will be analyzed, including the forward linkage indices and the backward linkage indices. The multipliers for the open model are then studied and, finally, the generators and multipliers are analyzed.

4.1 Regional Results

As can be seen in table 1, the sector that includes agriculture, livestock, forestry, fishing and aquaculture, has the highest percentage share in the coastal GVA (gross value added) of Rio Grande do Sul: 18.67%, followed by trade; repair of motor vehicles and motorcycles with 15.55%. In third and fourth place are real estate with 9.22% and education with 8.02%, respectively.

Tabela 1: Valor adicionado bruto da ZCG (Zona Costeira Gaúcha)

Sector	Percentage share %
Agriculture, livestock, forestry, fisheries and aquaculture	18.6797%
Extractive industrie	0.1793%
Food products	2.3877%
Machinery and equipment	0.6543%
Machinery and equipment	5.6285%
Electricity and gas	1.5994%
Water, sewage, waste management and decontamination activities	0.5573%
Construction	4.5203%
Trade; repair of motor vehicles and motorcycles	15.5578%
Transportation, storage and mail	3.8220%
Accommodation and food services	1.4756%
Information and communication	1.5357%
Financial, insurance and related services	3.9204%
Real estate activities	9.2242%
Scientific, professional and technical activities	6.4435%
Administrative activities and complementary services	1.9217%
Public administration, defense and social security	2.9045%
Education	8.0278%
Human health and social services	7.2150%
Arts, culture, sport and recreation	0.0027%
Other service activities	1.1685%
Domestic services	2.5739%

Source: Prepared by the authors, 2015 IPM results.

Agriculture is of great importance to the entire economy of Rio Grande do Sul and, as we have seen, to the economy of the coastal zone as well. Numerous segments derive from it and it has an influence on exports. According to the IBGE (2020), soybeans, the main agricultural product, showed growth in production, as did cattle and milk, and a record grain harvest was recorded in 2015.

With regard to forestry production, the ZCG's economic, social and environmental pillars are also supported by the planting of forests. This sector is responsible for generating direct and indirect jobs, from planting, through the transportation and logistics sectors, to the processing industry and finally to the market. The growing movement of this sector at the Port of Rio Grande stands out.

In the analysis of the study carried out by Gonçalves, Oliveira and Jhonston (2019), the results indicated that the southern coast of RS is extremely dependent on activities linked to forestry production (wood products and the manufacture of chemicals and resins) and activities related to the naval industry (other transportation equipment), which denotes the importance of investment in this region of the ZCG.

The sectors related to commerce; repair of motor vehicles and motorcycles; and real estate activities are also important in the composition of the GCCZ's GDP, resulting, among other factors, in the creation of jobs linked to commerce and service activities that are expanding to cater for leisure tourism and weekend tourism, as well as the growth of civil construction.

Table 2 highlights in bold the key sectors of the GIZ economy for 2015. One of the key sectors mentioned above is the importance of industry in Rio Grande do Sul. Industry should be a target for investment because it brings in strong foreign exchange through exports and because it has a high added value.

Table 2 - Linkage index of the regions

Region	RS Coast		Rest of Brasil	
Sector	I.Front	I.Through	I.Front	I.Through
1	1,1377	0,8317	0,9988	1,0195
2	0,7422	0,9703	0,9141	1,0770
3	0,8868	1,2063	0,8858	1,4420
4	0,7719	1,3590	0,9372	1,2604
5	**1,4528**	**1,1624**	**2,6308**	**1,2978**
6	**1,1689**	**1,0909**	**1,2451**	**1,3195**
7	0,7924	0,9416	0,6837	0,9504
8	0,9622	1,0620	0,8113	1,0800
9	1,6526	0,9257	1,4532	0,9242
10	**1,3435**	**1,0835**	**1,3547**	**1,1051**
11	0,8014	1,0856	0,7218	1,0989
12	0,9404	1,0776	**1,0823**	**1,0030**
13	1,1310	0,9708	1,2172	0,8942
14	0,9639	0,7601	0,8047	0,6654
15	1,8000	0,8858	1,4155	0,9428

16	0,9860	0,8726	1,0317	0,8222
17	0,7428	0,9704	0,6596	0,8506
18	0,7634	0,8033	0,6367	0,7709
19	0,7569	0,9168	0,6335	0,9130
20	0,7202	1,3426	0,6308	0,9531
21	0,7628	0,9611	0,6515	1,0100
22	0,7198	0,7198	0,5999	0,5999

Source: Prepared by the authors, 2015 IPM results.

Table 2 shows that sectors (5), (6) and (10) have forward and backward linkage indices greater than one, and are therefore key sectors in the GIZ economy. Among the forward linkage indices, the following sectors stand out: (5) Other manufacturing; (10) Transportation, storage and mail; (6) Electricity and gas, in relation to the coast of RS. And in the rest of Brazil, the same sectors (5), (10), (6), plus (12) Information and Communication, are the highlights in terms of the forward and backward linkage index.

According to Kwak et al. (2005), industries can play a supporting role to other sectors, referring to the forward linkage effect, or encourage other industries, in the case of backward linkage. The sectors with the highest indices highlighted above show that these sectors have the greatest linkages and are more likely to offer goods or services to others in the economy. As far as the electricity and gas sector is concerned, the Osório Wind Complex is the largest wind complex in Latin America. And Santa Vitória do Palmar is also home to the Campos Neutrais wind complex, which, together with Chuí and Hermenegildo, forms another large wind complex and projects Rio Grande do Sul's electricity sector onto the international energy market.

With regard to the backward linkage indices for the RS coast, i.e. sectors that demand from others, the following stand out: (5) Other manufacturing; (6) Electricity and gas; (10) Transportation, storage and postal services; (12) Information and communication, which total the highest indicators. These sectors have stronger links, values greater than 1, so they are important buyers of inputs from other sectors of the economy.

4.2 Multiplicadores e geradores

Multipliers can show which sectors have the greatest impact on production, employment and added value, making it important for economic planners to make decisions on public policies that help regional development (Porsse, Haddad, Ribeiro, 2004).

Table 3: Generators and Multipliers in the Gaucho Coastal Zone

Indicator	Generator		Multiplier	
Sector	GVAB	GEMP	MVAB	MEMP

1	0,9659	3,9536	1,2048	1,8096
2	0,6090	6,8046	1,0242	1,0191
3	0,2139	2,8076	1,7100	1,5956
4	0,1061	1,3673	1,1924	1,1523
5	0,6176	6,1499	2,8181	2,8734
6	0,6108	2,5092	1,7052	3,4875
7	0,7378	8,3368	1,0812	1,0974
8	0,7302	5,8054	1,3493	1,4927
9	1,1827	13,4351	1,7324	1,5848
10	0,8429	9,3508	1,7467	1,6399
11	0,5277	7,6166	1,1380	1,0777
12	0,6436	4,1359	1,3165	1,4002
13	0,9109	4,7375	1,4591	2,3742
14	1,0396	1,3659	1,1019	4,1825
15	1,3796	8,8677	1,7892	2,7761
16	0,9639	18,9304	1,2284	1,1034
17	0,6116	12,1682	1,0210	1,0099
18	0,8987	5,5380	1,0382	1,0640
19	0,7502	5,2471	1,0503	1,0509
20	0,0139	0,6641	1,0084	1,0015
21	0,6605	3,6985	1,0480	1,0789
22	1,0000	0,0344	1,0000	1,0000

Source: Prepared by the authors, 2015 IPM results.

Table 3 shows the multipliers for production, gross value added and employment for the economy of the ZCG and RB. This table shows that for every R$1 million more in final demand in the Machinery and Equipment sector, there is an increase of R$1.8879 in this sector.

The ZCG sectors with the highest production multipliers are: (4) Machinery and Equipment (1.8879); (20) Arts, Culture, Sport and Recreation (1.8651); (3) Food Products (1.6758); (5) Other Manufacturing (1.6147). It can thus be seen that the Gaucho coast's economic development includes activities related to the purchase and sale of machinery. The table also shows that tourism-related activities are included in this context.

With regard to gross value added multipliers, table 3 shows the results for the GIZ economy. The sectors with the highest multipliers are: (5) Other manufacturing (2.8181); (15) Scientific, professional and technical activities (1.7892); (10) Transportation, storage and post (1.7461); and Trade, repair of motor vehicles (1.7324). So, if final demand increases by R$1 million, the added value for sector (5) will be R$2.8181; for sector (15) R$1.7892 and for sector (10) R$1.7467.

With regard to employment multipliers, these make it possible to measure job creation in each sector of an economy. Table 3 shows that the sectors (14) Real estate activities (4.1825); (6) Electricity and gas (3.4875); (5) Other manufacturing (2.8734) and (15) Scientific, professional and technical activities (2.7761) have the highest values.

Table 3 shows that the sector (16) Administrative activities and complementary services, has the highest rate: 18 jobs. This means that the shock of R$1 million invested in the sector stimulates the creation of 18 jobs. This is followed by (9) Trade; repair of motor vehicles and motorcycles - 13 jobs; (17) Public administration, defense and social security - 12 jobs and (10) Transport, storage and postal services - 9 jobs.

The first two sectors mentioned above are major buyers of inputs from other sectors of the economy. These sectors include: activities related to non-real estate rentals; selection, agency and rental of labor; travel agencies, tour operators; surveillance and security activities; building and landscaping services; administrative support services.

The GIZ region also has an important generator of jobs in sector (10). This sector includes: land, water and air transportation; warehousing and auxiliary transport activities; mail and other delivery activities. Of particular note here is the important transport logistics involved in the ports of the ZCG, i.e. transportation by road, through Lagoa dos Patos, for the purpose of port handling, which indicates the importance of generating employment and income.

The entire GIZ is well diversified in its production structure, with not just one key sector, but the entire production chain is important in generating jobs. As Oliveira (2016) shows, there is an immensity of possibilities for the exploitation of ocean generation and, for this, priority must be given to updated data, the promotion of technical and scientific development and public policies aimed at the ocean energy market.

4.3 Interregional and intraregional results

Table 4 shows that the sectors (5) Other manufacturing (0.8627), (6) Electricity and gas (0.8177) and (3) Food products (0.8107) have the highest indices for inter-regional results in the GCZ. These sectors, according to the results found and compared only with the results for the rest of Brazil, would have a greater propensity to demand and supply goods or services between them. In this sense, the three highest indices found for RB are (3) Food products (2.4037); (6) Electricity and gas (2.1996); (5) Other manufacturing (2.1633).

Table 4: Breakdown of the intraregional and interregional production multiplier

Region	RS Coast			Rest of Brazil		
Sector	Intraregional	Inter-regional	Total	Intrarregional	Inter-regional	Total
1	1,1557	0,2212	1,3768	1,7009	1,6993	1,7009
2	1,3483	0,4161	1,7644	1,7963	1,7952	1,7963
3	1,6767	0,8107	2,4874	2,4096	2,4037	2,4096
4	1,8885	0,7750	2,6635	2,1025	2,1010	2,1025
5	1,6155	0,8627	2,4781	2,1652	2,1633	2,1652
6	1,5161	0,8177	2,3337	2,2016	2,1996	2,2016

7	1,3083	0,2686	1,5769	1,5850	1,5842	1,5850
8	1,4756	0,3955	1,8711	1,8014	1,8002	1,8014
9	1,2862	0,2369	1,5231	1,5414	1,5406	1,5414
10	1,5055	0,4580	1,9635	1,8433	1,8422	1,8433
11	1,5088	0,5295	2,0383	1,8342	1,8318	1,8342
12	1,4972	0,3260	1,8232	1,6727	1,6720	1,6727
13	1,3487	0,2340	1,5828	1,4910	1,4906	1,4910
14	1,0559	0,0351	1,0910	1,1093	1,1092	1,1093
15	1,2306	0,1301	1,3607	1,5723	1,5716	1,5723
16	1,2123	0,1479	1,3602	1,3711	1,3706	1,3711
17	1,3483	0,3096	1,6579	1,4184	1,4179	1,4184
18	1,1160	0,1040	1,2199	1,2854	1,2850	1,2854
19	1,2737	0,2056	1,4794	1,5228	1,5219	1,5228
20	1,8655	0,6317	2,4971	1,5894	1,5887	1,5894
21	1,3353	0,3131	1,6484	1,6847	1,6837	1,6847
22	1,0000	0,0000	1,0000	1,0000	1,0000	1,0000

Source: Prepared by the authors, 2015 IPM results.

Comparing the interregional results of the sectors in the GCZ with the values found for the sectors in the rest of Brazil, it can be seen that sectors (5), (6) and (3) are in 4th, 2nd and 1st place respectively. Sector (3) Food products, is a sector with high sales power for RB, as far as interregional results are concerned.

Table 4 shows that the sectors (4) Machinery and equipment (1.8885); (20) Arts, culture, sport and recreation (1.8655); and (3) Food products (1.6767) have the highest indicators in terms of intra-regional relations in the GIZ. These sectors are more sensitive to trade within the region, i.e. an investment in sector 4, for example, has a more significant positive impact on the GCCZ.

According to the intra-regional results, the sectors that most structure the economic dependency base in the GCCZ are related to activities such as the production of machinery and equipment, mainly agricultural; activities related to the arts, linked to cultural and environmental heritage; and sports, recreation and leisure activities; as well as activities that include food products.

Based on the estimation of the RS Coast and Sea IPM, we sought to understand the economic profile of the GIZ for 2015. The analysis indicators showed results for the sectors that had the greatest impact on the region's economic development through their activities and job creation. It was observed that the sectors with the greatest share in the composition of the GVA of the GCZ were: (1) Agriculture, livestock, forestry, fishing, aquaculture (18.68%) and the sector (9) Trade; repair of motor vehicles and motorcycles (15.56%).

The income and employment multipliers indicated that the sectors (5) Other manufacturing and (14) Real estate activities stood out in this regard. The production

multipliers showed the (4) Machinery and equipment and (20) Arts, culture, sport and recreation sectors as having the greatest impact on the region's economy.

Using the forward linkage indices, which show the sectors that sell the most, and the backward linkage indices, which show the sectors that buy the most, the following sectors were defined as key sectors in the GIZ: (5) Other manufacturing, (6) Electricity and gas and (10) Transportation, storage and mail, which are considered to be the sectors with the highest degree of linkage with the others in the region. The data shows the great importance of agriculture, but there is a growing industrial relevance in the coastal zone. The energy issue is confirmed by the potential for generating energy through wind, which is present on the coast of Rio Grande do Sul and is currently of great importance in diversifying the Brazilian energy matrix.

Looking at the results from a regional perspective, we highlight the importance of the micro-regions in the north and south of the GCZ, where the offshore wind sector and the Rio Grande port and industrial complex are located. The investment scenario for the Naval Hub in the city of Rio Grande has been promising for at least 20 years, since work began on the platform in 2005. The southern region of the state and an entire supply chain experienced an increase in sectors, for example, in 2013, at the height of shipbuilding, Rio Grande employed 24,000 workers in its naval center. This took the municipality from 9th to 4th place in the list of Rio Grande do Sul's GDP.

5. Final considerations

The importance of discussions on the economy of the sea since the launch of the UN's 2030 Agenda (Decade of the Oceans) gave rise to the motivation for this work, since the scenario of the coast of RS has sometimes been widely studied in terms of its geographical aspects, but with regard to its economic reference values there is little to be found in terms of the characteristics and quantification of the CGZ.

The study of the coastal zone region is important for specifying the strategic sectors of the economy and serving as a basis for planning and decision-making for regional and local benefit. The CGZ has an important share of the Transportation and Storage sector, with the ports on the south coast standing out, such as the Port of Rio Grande, with its industrial and logistics complex, which has consolidated the municipality in the top ranks of the Rio Grande do Sul GDP.

Another segment driving the development of the coastal region of Rio Grande do Sul is the electricity and gas sector, especially the large wind farms installed on the coast of Rio Grande do Sul, from Santa Vitória do Palmar to Osório, which bring an important economic and sustainable structure to the region, known as clean energy. Renewable energy from renewable sources is growing a lot and with economic potential it can fill many spaces and

reduce the fossil energy source because in the last twenty years it has been developing and generating jobs and income through sustainable growth in the region.

In order to achieve a sustainable economy, growth and development must take place within the framework of sustainability. Through the industries that are already operating and that they incorporate a system for restoring ecosystems that have already been damaged and that management is interconnected and dominates all the knowledge in the various segments that are part of the GZ, so that we can achieve an efficient transition from a pure economy of the sea to an economy of the blue sea.

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