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Wind Power on the Brazilian Northeast Coast, from the Whiff of Hope to Turbulent Convergence: The Case of the Galinhos Wind Farms

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Abstract: The convergent narrative which proposes an energy transition, aiming to replace fossil fuels with renewable energies, has in wind power technology a viable option that can consolidate this view. Brazil produced 14.8 GW of wind powered energy in 2019, 85.7% of this total in the Northeastern region. Social and environmental fragilities of local communities, overlooked an exclusionary planning, have led to opposition movements against wind farm implementation. This study aims to assess how the arrival of wind power dialogues with the demands of the communities living in the projects' vicinities, as well as repercussions on institutional, socio-economic and environmental developments. A case study was conducted with regard to the Galinhos' community reaction to the arrival of wind power. First, public domain narratives were evaluated, in order to ascertain the different perceptions from the social actors involved in the process. Next, the community's vision was assessed regarding expectations and fears, created by the existence of the wind farm, before and after its implementation. The perception was that the wind farm did not change the population's socioeconomic conditions and environmental issues require appraisals by the accountable bodies. In this scenario, the materiality of the narrative that justifies wind farm expansion in the Brazilian northeast was assessed.

Keywords: Galinhos; wind power; opposition; perception; invisibilization

1. Introduction

The favorable environment for the development of renewable energy sources, particularly wind power technology, has led to an extensive conformation process of the energy industry which goes beyond technical advances and their developments. It also responds to interests and disputes created within the system itself. Based on the structure that shaped the energy sector, and understanding the variables that influence and reinforce this structure, it is possible to unveil the articulated logic of elements intrinsic to the technological, economic, institutional, political, social and environmental factors that determine the opportunities and obstacles to an actual expansion of complementary renewable technologies in the energy market.

Advances in systems using wind power technology, based on an inexhaustible source, presenting an already mature technological base, are visible. Conversion efficiencies, associated to technology, grow at increasing rates, ensuring a better use of these resources.

The economic costs of wind power have been decreasing consistently in recent years, making this a competitive alternative to fossil fuels. Its adoption also overcomes the strict logic of the cost-benefit analysis, supposedly by adding socio-environmental gains.

In Brazil, the attractiveness of expanding the wind-powered energy share in the national energy matrix is surprising. According to the Brazilian Wind Atlas [1], an estimated potential of 143.47 GW is noted, suggesting an annual output of 272.22 TWh, with average winds of 7.0 m/s, requiring an area close to 71,735 km^2, the equivalent of only 0.8% of the national territory. With 164 GW of installed capacity at the end of 2018, the Brazilian electrical matrix is predominantly hydroelectric—60.3%—, with thermoelectric 24.5%, wind power 9.1%, and other 6.1%. In an eventual use of all the Brazilian wind potential presented in Atlas, this would account for 90% of all installed capacity. In terms of energy supply, taking as reference the year 2018, in which the national electric system offered 535 TWh, this use would account for 51% [2,3].

The use of this vast potential necessarily requires socio-economic and environmental assessments, as: (i) in the social sphere, they interfere with the dynamics of communities located in the implementation areas and their surroundings; (ii) in the economic sphere, governmental demands, financing, subsidies, tax exemption, infrastructure improvements, institutional and regulatory adjustment among other; (iii) in the environmental sphere, power generation always creates some kind of impact. The challenge lies in determining the extent of this damage, computing their costs, and internalizing them fairly and rationally in the determinant matrix of their prices, in the substantive freedoms sense, as identified by Sen [4].

The expansion of wind farms in Brazil, after an initial stage of mapping wind potential and implementing their first uses, began facing challenges inherent to socio-environmental demands, such as changes in the regulatory framework, possible threats to natural and cultural heritages and negative reactions the communities settled around the wind farms. Thus, understanding the local population dynamics and their perception concerning the benefits and damages resulting from these ventures enables investors and public entities, responsible for project planning, to improve their management and licensing models, in order to reduce potential environmental and social constraints originating from wind farm implementation.

In general, previous studies on wind farm installations are mainly based on the analysis of technical and economic project feasibility. Neglecting the importance of the local community's perception can, in extreme situations, render investments unviable. This is relevant, in the light of the projected wind power participation in the energy matrix, reaching at least 20% of the future installed capacity in the next 10 years in Brazil [5].

Considering that, during wind farm implementation on the Northeastern Brazilian coast, its announcement to society sold this kind of energy production as highly accepted and attractive in the social, economic and environmental dimensions, this study aims to assess which forms of wind power production technology dialogues with the surrounding communities demands, as well as the derived repercussions on institutional, socioeconomic and environmental plans.

The objective of this article is to assess the process of wind energy implantation in the municipality of Galinhos, located on the coast of Northeast Brazil. It consists in a case study based on the reaction movement of the inhabitants of Galinhos to the arrival of wind farms in this town and its surroundings. Initially, a documentary research surveying public domain narratives enabled assessments on the different perceptions of those involved in the process. A field survey was then carried out with the Galinhos population, by applying questionnaires, consisting in the first significant reaction of this type from a local community in Brazil, aiming to determine the community's perception regarding expectations and fears created by the wind farms' very existence, before and after their implementation.

The article is composed of six sections: Section 1—Introduction, with general information about the context of wind energy; Section 2—The whiff of hope, which briefly describes the process of expanding wind energy in the world, and in Brazil in particular, with emphasis on the Northeast region; Section 3—Methodology, which describes the procedures used to delineate the study, namely the documentary research as a support to the ex-ante analysis of the movement of reaction of the residents to the arrival of the parks, and field research with the application of questionnaires with the population of Galinhos, six years after the implantation of the wind farms in the municipality, as a way to verify the materialization of the concerns and expectations of the residents due to the arrival of the wind farms; Section 4—Ex-ante analysis: turbulent convergence, discusses reaction movements to the arrival of wind farms in the world and Brazil, characterizes Galinhos as the empirical field of research, identifies the perceptions of the agents involved, as residents, investors, public managers and judicial system, and finally regards studies on the socio-environmental issues in Galinhos and about that themes; Section 5—"Ex-post analysis: community perception after the consolidation of the wind farm", describes the field research developed and presents the results of the application of the questionnaires, in the technological, environmental, and socioeconomic and cultural dimensions; Section 6—Conclusions, summarizes the results of the ex-ante analysis and the ex-post diagnosis.

2. The Whiff of Hope

Wind has been harnessed throughout history to produce mechanical energy, with the most noteworthy applications consisting of sailing and grain grinding. During the Industrial Revolution, the intense use of fossil fuels resulting from the growing industrial output and demand and, later transportation services, drove wind power to a secondary plane [6].

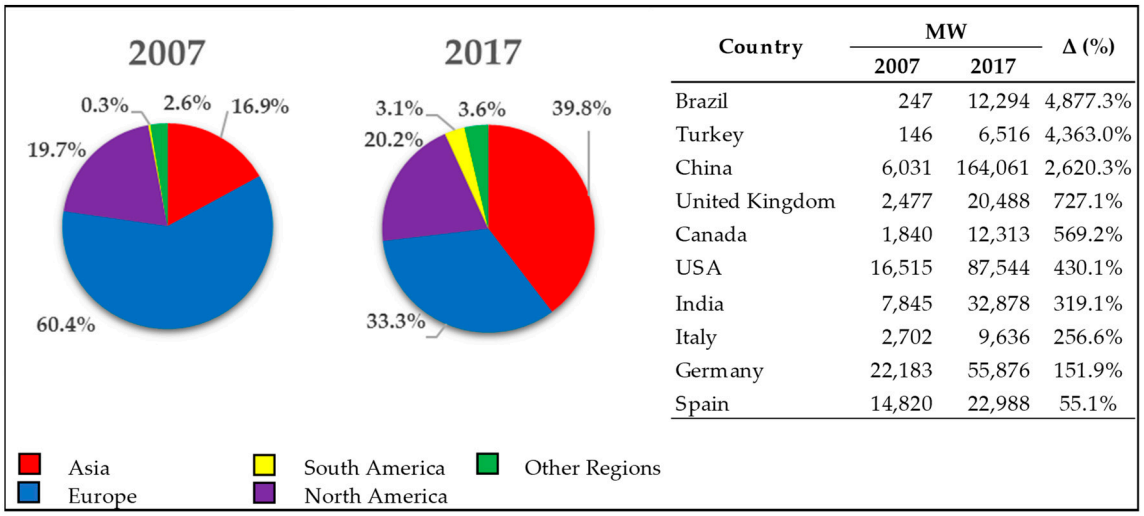
The 1973 oil crisis and the difficulties associated with nuclear power—large scale accidents and geopolitical intercurrences—created conditions which allowed the promotion of new wind power technology research and development. In the following decades, concerns on the environmental damage caused by industrial activities became more relevant and accelerated the development of such technologies.

In this context, also driven by scenarios crediting a strong contribution to the increase in the planet's average temperature due to anthropogenic activities, the results of higher CO_2 concentrations in the atmosphere—a process known as global climate change—the USA and Europe, seeking to reduce dependence on fossil fuels, experienced a strong wave of investments in wind power technology [7].

Based on government incentives, the wind power market was structured to seek increasingly powerful turbines and the creation of interconnected wind farms. This market and production structure resulted in an installed capacity of 87.54 GW in the USA and 171.24 GW in Europe in 2017. In Asia, where India comprised 32.88 GW and China 164.06 GW and, to a lesser extent, in Latin America and Africa, wind power gained momentum in the 21st century [8].

Figure 1 displays the evolution of the wind power installed capacity from 2007 to 2017, per region. A spillover movement is noted directed towards Asia, notably India and China, but also Turkey in Eurasia and Brazil in South America. In this time frame, the presence of wind farms grew significantly in Brazil, Turkey and China. Thus, currently, approximately half of the wind farms are located off the US-Europe axis.

Therefore, the urgency to overcome technological, geopolitical and environmental barriers has led wind power technology, among other renewable energy sources, to become a form of energy generation appropriate to the new global reality, which demands environmental awareness, accessibility and economic viability. In this context, in a world where many innovative solutions are economically, environmentally or socially unviable as alternative energy, wind power technology is inserted as a virtuous whiff of hope for sustainable development, linked to economic expansion possibilities which can be reconciled with environmental preservation [9].



Country	MW		Δ (%)
	2007	2017	
Brazil	247	12,294	4,877.3%
Turkey	146	6,516	4,363.0%
China	6,031	164,061	2,620.3%
United Kingdom	2,477	20,488	727.1%
Canada	1,840	12,313	569.2%
USA	16,515	87,544	430.1%
India	7,845	32,878	319.1%
Italy	2,702	9,636	256.6%
Germany	22,183	55,876	151.9%
Spain	14,820	22,988	55.1%

Figure 1. Evolution of wind power installed capacity (MW), per region, over a 10 year timeframe. Source: Adapted from [6,7].

Wind Power in Brazil

The 2001 electric sector crisis, a result of poor nationwide planning for this sector, did not promote the expansion of the traditional energy sector, becoming a hallmark for wind power in the country. Rosa [10] argues that a decrease in the hydrological cycle and the lack of investments in expanding the power supply have led to electrical power rationing in Brazil, whose electricity supply is heavily based on hydroelectricity.

Even before the 2001 crisis, a Brazilian regulatory adaptation was stipulated, targeting renewable source power supplies, and wind in particular. To do so, a regulatory structure was created, opening the power generation market to the private sector, creating incentives for power generation from renewable sources [11].

The Incentive Program for Alternative Energy Sources—PROINFA—, created by Law No. 10.438/2002 and amended by Law No. 10.762/2003 [12,13], reinforced by the Energy Development Account, was instrumental in increasing the participation of independent electrical power producers using renewable sources. It reached 54 contracted wind projects, totaling 1422.99 MW, 56% in the Northeast region, comprising 34 wind farms in total. The states of Ceará—CE—and Rio Grande do Norte—RN—received 87% of the projects' installed capacities destined to the region [11].

After PROINFA's incentive stage, renewable energy sources, with the exception of hydroelectricity, were included in power supply auctions. From 2009 to 2018, 19 auctions were conducted for wind farm contracting and building. Of these, 17,925 MW of wind power were contracted with operations projected to begin up to 2024, 38% of which in RN and CE, 30% in Bahia, 11% in Piauí and 10% in Rio Grande do Sul. Thus, about 90% of the contracted wind power supply, up to 2024, will be concentrated in five Brazilian states, four of them in the Northeastern region [3].

Figure 2 illustrates the surprising expansion in the global use of wind power technology, which has expanded over five-fold, with installed capacity rising from 93.55 GW in 2007 to 513.94 GW in 2017. It also indicates the Brazilian evolution in this scenario from 2006 and onwards. From 2014 to 2017, the growth of new facilities surpassed previous trends, increasing 36% per year in this period. The Northeastern region has become attractive to wind power production, accounting for 85% of the installed capacity in the country as of November 2018 [8,14].

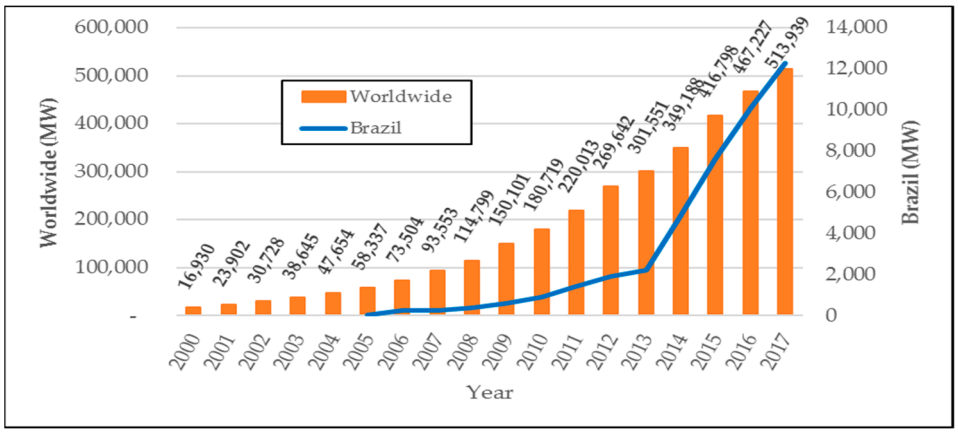
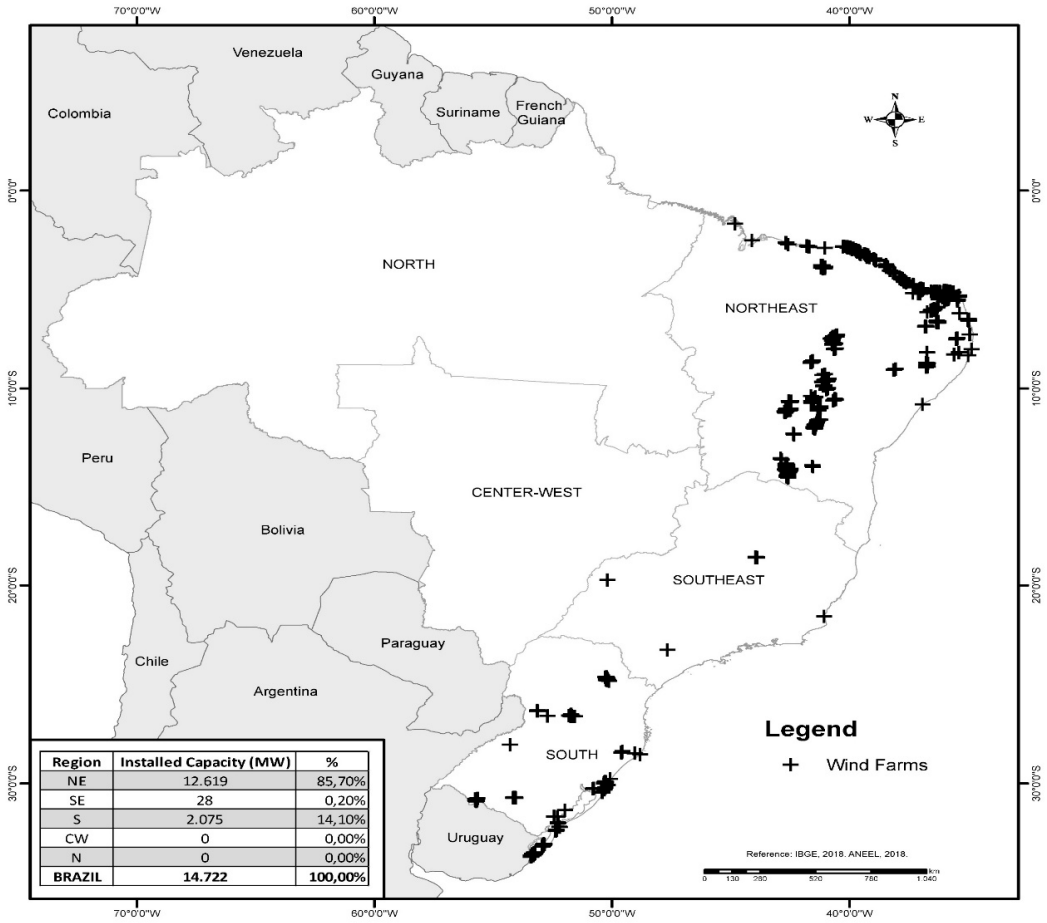


Figure 2. Evolution of wind power installed capacity (MW) in Brazil and Worldwide. Source: Adapted from [6,7].

RN and CE play a prominent role in the wind power expansion process. Together, they account for 42% of the installed capacity in Brazil, and half of the capacity installed in the Northeast. The installed capacity in RN reached 3.72 GW at the end of 2018, comprising 27% of the entire installed capacity in Brazil. Present in 21 RN municipalities, three of them concentrating 45% of the total installed capacity in the state, wind farms already make up the landscape, influencing resident lives, production structures and government actions [3]. Figure 3 shows the distribution of wind farms in Brazil by geographic region.



Region	Installed Capacity (MW)	%
NE	12.619	85,70%
SE	28	0,20%
S	2.075	14,10%
CW	0	0,00%
N	0	0,00%
BRAZIL	**14.722**	**100,00%**

Figure 3. Distribution of wind farms in Brazil by geographic region. Source: elaborated by the authors.

The infrastructure resulting from the wind farms under study consists of access roads for their construction and maintenance, which does not allow them to be considered a benefit to the community, despite the use by some residents.

It is planned to install a water desalination equipment for the treatment and supply of drinking water to the residents, planned for 60 L per day per family, resulting from the negotiation between the owners of the parks and the community, as a socio-environmental counterpart to the issues raised by it.

3. Methodology

The present study is of an applied nature, with an exploratory trend observed in its initial phase, when information was sought out in order to define the surveyed topic, set the objectives and guide the approach. Subsequently, it presents a descriptive phase, in which facts were observed, recorded, analyzed, classified and interpreted [15]. Concerning research delimitation when investigative techniques are applied, a case study approach was chosen [16].

Such an approach is in line with the study objective, as it applies several research techniques, justified by the obtained information's nature and diversity, and due to the context, is both current and specific, yet connected to the reality of other wind farms located in the region [17]. The research follows the trail of other studies on community reactions to the installation of wind farms in Brazil and in other countries [18–21].

We sought access to information channels concerning how wind farms are received in academic publications, government and private institutions and other sources. An empirical study was necessary, considering the difficulties in obtaining data and information regarding the study object. We also sought to map the community's perception regarding social, economic, environmental and cultural aspects. The Galinhos community was selected for incorporating certain predicates such as: dune location on the coastal strip-similar to that registered in other areas that received wind farms; home to a delicate coastal ecosystem; and a population consisting of fishers, who transitioned, along with their descendants, to tourist activities, and reacted to the arrival of the wind farms, organizing itself around a movement called "Eólicas sim, nas dunas não!" ("Wind Power yes, not in our dunes!" in a free translation) [22,23].

Initially, we sought to carry out a documentary research contributing to understanding the different perceptions from the social actors at the time of the wind farm implementation in Galinhos. Thus, the publicly spread narratives, expressed by market agents, governmental agents, responsible for legal compliances and management of the standards related to the environmental quality control and maintenance in RN, and, in a prominent way, the community's concerns, were evaluated. From these narratives, an ex-ante representative picture, capturing the social actor perceptions was constructed.

The ex-post analysis was performed by applying questionnaires to households in the urban centers of Galinhos and Galos, by random sampling, statistically representative of the residents. Based on the 332 urban households of the municipality [24], a simple random sample with n = 120 questionnaires was selected, at a 95% confidence level, an error margin of 8.5% and a 50% heterogeneity percentage. A total of 59.2% of the respondents were female and 40.8% were male. 50.8% range from 25 to 60 years old, 36.7% were younger than 25 and 12.5% were over 60. Regarding schooling, 44.2% had not completed elementary school, 28.3% had completed high school, and 8.3% had higher education. Concerning family income, 56% reported receiving up to one minimum wage and, regarding occupation, 11% were students, 21% performed domestic services, 10% were retired, and 11% unemployed. The remaining 47% stated that they are engaged in horse buggy driver, fisher, civil servant, general worker or merchant activities.

The questionnaires aimed to understand the population's perceptions on the existence of the wind farms and to measure, from ex-ante expectations and fears, how these materialized or not ex-post. The questionnaires were structured in three dimensions: (i) technological; (ii) environmental; and (iii) socioeconomic and cultural.

The technological dimension aimed to capture the community's level of knowledge regarding the adoption of renewable energy technologies, with emphasis on wind energy. The aim was to verify if the installation of a wind farm next to the community was able to universalize the concept of this technology among the community.

The environmental dimension aimed to identify the community's perception on possible environmental impacts linked to the wind farm. It included concerns regarding lookdown fish, turtles, birds, vegetation reduction, dune destruction, harmful noise pollution and landscape changes.

Finally, the socioeconomic and cultural dimension, sought to map the repercussions of the wind farm implementation on social dynamics, its cultural repercussions and impacts on the local economy. In order to do so, community perceptions were investigated regarding possible benefits from wind farm implementation, impacts on employment rate, tourism and trade, and changes in the infrastructure, way of life, cultural traditions and violence.

The ex-ante analysis sought to identify the concerns and expectations of residents of Galinhos, regarding the arrival of the wind farms to the municipality. It consisted of the analysis of the perceptions of residents, investors, public managers and agents of the judiciary, with the aggregation of results of studies done in the region and in the theme in question. The ex-post analysis, carried out six years after the installation of the wind farms, sought to identify in the aspects raised in the ex-ante analysis which materialized, and which did not. Then, a summary of perceptions prior to the installation of the wind farms and six years later shows which narratives represented by the concerns and expectations confirmed or not. Intends to contribute with recommendations to better conduct investors and public managers in future energy use in similar conditions.

4. Ex-Ante Analysis: The Turbulent Convergence

Ideas favorable to wind power expansion register some conflicts arising from multiple interests, on the part of its stakeholders. Those ideas, supported by what Bauman [25] denotes a constructed consensus, where common sense adopts the truth and gives wind power technology a positive character, a whiff of hope with potential to harmoniously equate divergent interests between international energy production and sustainability [26].

This convergent narrative requires investigation as to its coherence and the perceptions of communities settled near such undertakings. These populations are often invisible during the design, installation and operation processes, as the case of the Brazilian Northeast, with emphasis on the RN, who occupy areas marked by low socio-economic development. These are projects developed by outsiders for the benefit of third parties [23].

When measuring the acceptance of wind power arrival in different regions worldwide, good receptivity to new projects is noted at first. Such behavior may, in the first instance, be credited to the global call for the expansion of renewable sources. However, when these projects are actually implemented, harmonious acceptance may not occur [27].

Worldwide social, economic and environmental conflicts involving local communities and wind power expansion projects have been recorded. Some have contributed to the suspension of certain projects and conditioned activity changes, while some projects, despite community opposition, did not undergo under considerable changes.

On the coast of Massachusetts, in the US, a proposed large offshore wind farm with 130 turbines, a total of 420 MW of installed capacity, found strong and organized opposition from the community, which rejected the plant's installation in its surroundings because it understands that it would compromise the landscape [28].

At King Island, Australia, the proposed implementation of a 600 MW wind farm, while following the general guidelines for good practices, such as community engagement during the implementation process, faced opposition by residents as a result of mismatches in the dialogues between the entrepreneur, government and community, given the uncertainties regarding the community's socioeconomic sustainability. The conflict led the entrepreneur to abandon the project [21].

At Isthmus of Tehuantepec, in Mexico, wind farms which take advantage of the excellent wind quality, contributed little to improve the population's already unfavorable social and economic indicators. Problems such as low land values, asymmetry in the relationship between communities, companies and the government, frustration with wind farm socioeconomic effects and environmental problems, created a setting conducive to the structuring of opposition movements, which still resist, denouncing the implementation process in the region [20,29]. Studies have also discussed oppositional reactions to wind farm implementation in Ontario, Canada [30–32].

Empirical studies have been carried out in order to understand the reasons wind power is widely accepted in general, but presents local acceptance problems, or even opposition, usually by communities inhabiting surrounding wind farm areas. The name NIMBY has been used to explain these reactions, but studies such as those carried out by Devine-Wright [33] and Wolsink [34] demonstrate that this is a misleading, imprecise and pejorative form which has been used to disqualify local opposition to wind farms. Concepts such as area identity and attachment, technocratic planning conception, which Wolsink [27] identifies as decide-announce-defend—DAD—, are elements used to explain opposition to wind farms. DAD and the social gap concept [35] aid in understanding the distancing of communities where wind farms are installed concerning social command structures.

Examining the wind power implementation planning process, Gorayeb [36] point to differences in the opposition between countries. In the global "north", opposition is complex, and analyses emphasize the excluding planning process and landscape impacts. In the global "south", the physical and economic marginalization of those affected by the undertakings is prevalent.

In Brazil, negative socio-environmental conflicts related to wind farms have been reported. Brannstrom [18,37], Gorayeb [36,38] and Traldi [39] expose impacts of different orders experienced on the Northeastern Brazilian coast:

(i) Nature commodification and privatization of common goods;
(ii) Land disputes, land price increases and legal land ownership insecurity;
(iii) The appropriation of traditional territories and disrespect for the community way of life;
(iv) Dune flattening and soil property modification;
(v) Burial of ponds, lakes and other hydrological bodies;
(vi) Deforestation of native vegetation, reduction of arable land, as well as plant and animal extractivism, increasing food security risks for traditional coastal populations;
(vii) Resident mobility restrictions, who are rendered unable to move freely through their own territories;
(viii) Risks from simplified environmental licensing, favoring the occupation of environmentally sensitive areas;

Brannstrom [37] identified four areas in RN and CE where wind farms were implemented and socio-environmental conflicts were recorded, as follows: Ponta do Tubarão State Sustainable Development Reserve—RDSEPT—in Macau-Guamaré; Galinhos; the Xavier Community; and the Cumbe Community. The study also pointed out two situations in Brazil with social acceptance regarding wind farm implementation: Itarema and Osório.

Galinhos, located on the coastal area in the northeastern semi-arid region dunes, serves as a reference for assessing similar coastal areas and mangroves, regarding traditional communities presenting low HDI. In Brazil, wind farms installed in areas with such characteristics represent 72% of the total, with 26% of the farms located 5 km from the coast and 46% of the facilities located up to 25 km from the coast [37].

4.1. The Galinhos Community

Officially incorporated in 1963, the municipality of Galinhos originated from a fisher village which used lookdown fish as the basis of their sustenance. It is located on the north Atlantic RN coast, occupying 342,215 km^2, at 05°05'27.6'' S and 36°16'30.0'' W. As of 2018, the resident population was estimated at 2726 inhabitants, 51.6% male and 48.4% female, with half the population below 24

years old [24]. Its two main urban centers concentrate 57% of the population and are connected to the mainland by a sandy isthmus. Thus, the 719 ha peninsula is bathed to the north by the Atlantic Ocean and to the south by a sea stretch. Such an isolation causes the local population to behave as islanders, as virtually every economic and sociocultural exchange in Galinhos is performed by boat.

Tourism, fishing, salt extraction, aquaculture and the public sector are the main Galinhos economy activities. The nine inns and hotels are the base for touristic activity, which spreads over to other sectors. Fishing, in addition to its own commercial dynamics, acts as a complement to touristic activities. Salt extraction also plays an important role in the municipality's economy. Shrimp farming accounts for 15% of the state production, which is the largest national shrimp producer, totaling 15,434 t in 2017 [40,41]. With an HDI of 0.564, Galinhos is one of the Brazilian municipalities with the lowest HDI, among the lowest in RN, placed 156th among the 167 municipalities in the state. The dimension that contributes most positively to the HDI is Longevity, at 0.723, followed by Income, at 0.578, and Education, at 0.429 [42]. Despite 22.1% of the population being employed, 48.8% have a monthly nominal per capita income under $\frac{1}{2}$ a minimum wage [24].

Two health facilities and seven educational facilities are located in the area. A total of 99.3% of the households have electricity. A rudimentary water supply system based on individual wells or rain water collection, added to the influence exerted by the seawater, compromises drinking water quality and access. In addition, wastewater is disposed directly into the ground, with no waste collection system, reinforcing poor basic sanitation conditions [43].

4.2. Wind Farms Rei dos Ventos I and III

The wind farms Rei dos Ventos I and III belong to the Brasventos consortium, comprising 24.5% from Furnas; 24.5% from Eletronorte; and 51% from J. Malucelli Construtora. The wind farm Rei dos Ventos I is located at 05°06'3.23'' S and 36°12'07.4'' W and comprises 35 ECO 86 ALSTOM wind turbines, 80 m in height and 86 m in rotor diameter, with a unit power of 1.67 MW and total power of 58.45 MW, throughout 669.09 ha, presenting 14 access routes, with a width of 10.50 m and a total length of 16.6 km.

Wind farm Rei dos Ventos III is located at 05°07'7.79'' S and 36°09'47.5'' W, adjacent to Rei dos Ventos I. It comprises 36 ECO 86 ALSTOM wind turbines, 80 m in height and 86 m in rotor diameter, with a unit power of 1.67 MW and total power of 60.12 MW throughout 512 ha, presenting 13 access routes, with a width of 10.50 m and a total extension of 12.8 km.

The wind farms span the northern region of the RN, near Galinhos, and are accessed through the BR 406 and RN 402 highways. Figure 4 displays the region location.

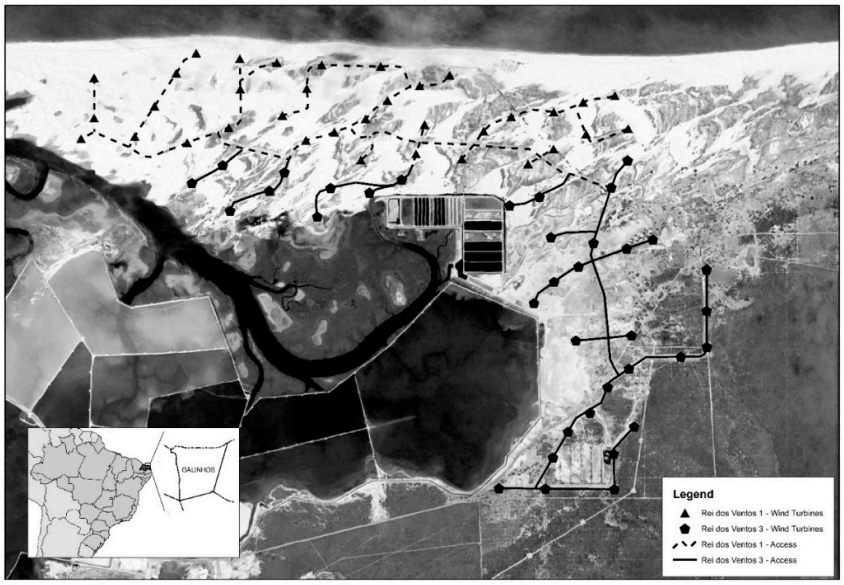


Figure 4. Galinhos location. Source: elaborated by the authors.

4.3. "Wind Power Yes, Not in Our Dunes!"

The wind power production at Galinhos began with the A-3/2009 auction, the first exclusive auction for wind power sources, with commercial operations starting as of 1st July 2012 under an exploration contract for 20 years [44]. A total of 71 projects won the concessions, 63 of them located in the Northeast region and 23 in RN. Of these, two of them were to be installed in Galinhos: wind farms Rei dos Ventos I and III.

Previous studies in the region were prepared by Brasventos, as proof of economic and environmental viability, leading to the application for a Previous License request to IDEMA, a state environmental agency, on 21 May 2008. Only on November 2011, when the environmental report was handed over to the city council, did the Galinhos population became aware of the projects to be installed in a dune area occupying 1181 ha. Given that the installation of wind farms at Dunas do Capim—a Galinhos tourist attraction—would affect tourist activity, residents mobilized, aiming to be considered in the decision-making process regarding the use of the Dunas do Capim area.

The community's organized movement culminated in public hearings. In addition to the high participation of the local population, Brasventos, IDEMA, IBAMA—a federal environmental agency—and the State Public Prosecutor's Office were present, and the population's refusal to accept the wind farms installation on the dunes was made clear. The residents' proposal was to reallocate 22 wind turbines, and the entrepreneurs only accepted the reallocation of five towers.

The community's unprecedented movement, in defense of their territory, led to their organization into several associations, such as buggy, horse buggy, boaters and fisher, among others. In January 2012, the community campaign gained a larger dimension, as it became known by both local and national press, with repercussions also noted in the international press and on the Internet.

4.3.1. Community Perception

The community of Galinhos indicated a widespread fear that the wind farms would damage tourism and artisanal fishing in the municipality, which several professionals depend on, such as boaters, buggers, fishers, tourist guides, merchants, among others. Tourism is peculiar in Galinhos, as access to the city is carried out predominantly by boat and almost no cars exist in the city. Thus, daily life resembles that of insular territories.

The wind farm implementation proposal surprised the residents and, therefore, no preparation or discussion between the business consortium and the government with the community during the planning stage occurred. The placement of the wind towers in the dunes was determined as impacting the natural landscape, making it more appropriate to relocate them to the mainland, in more stable areas. According to the president of the Galinhos buggers association, "the community's claim is for stopping wind turbine implementation in the dunes. We want to preserve the area the way it is today and we also want to turn it into an Environmental Protection Area." [45].

Since IDEMA issued the Park Installation License ignoring the residents' appeal, organized in the movement "Wind Power yes, not in our dunes!"; as well as appeals from community and class associations, from the State Tourism Council—CONETUR—and from the State Public Prosecutor's Office, to seek an alternative for the project location, this solidified a perception already established by the residents that this particular public environmental agency and, on a larger scale, the state government acted as "wind-power lobbyists" [46].

Even in this adverse context, the movement "Wind Power yes, not in our dunes!" was able to articulate itself, using the Internet, in a movement similar to the one registered at the Flecheiras community in Ceará, where an oppositional movement towards the implementation of wind farms in dunes was also observed.

The movement carried out several activities, with the symbolic embrace of the Dunas do Capim achieving national repercussion. They also delivered a petition containing about 600 signatures to the state's governor on 30 January 2012 [47]. This document exposed the population's concerns, arguing that the undertaking:

(i) Would sand the sea stretch, compromising fisher livelihood;
(ii) Would compromise the dunes dynamics and bury mangroves;
(iii) Would damage archaeological sites in the area;
(iv) Would pose risks to birds migration and compromise sea turtle spawning;
(v) Would compromise free access to areas owned by the Union, preventing dune tourism and leisure activities.

The residents' affective memory, especially in the elderly, is also pointed out, due to the memories of the serious environmental crime committed in the area in 1986, when, due to mangrove drowning, 2400 ha were barred in order to expand a saline plant [48]. This was the largest environmental crime ever registered in the state, which decimated the entire fauna and flora in the area, compromising the community's way of life, as part of their livelihood originated from the mangrove.

4.3.2. Investor Perceptions

By breaking a modus operandi already in course, the residents' movement caused strangeness to the investors. Seen as positive, the arrival of wind power brought the hope that its economic dynamism would reflect locally. However, knowledge of the community's reaction led to different reactions from actors related to investors. Table 1 illustrates some positions publicly assumed by the investors and their representatives.

Table 1. Investor perceptions regarding Galinhos population reactions.

Entity	Sectorial Perception
CERN—Center for Strategies in Natural Resources and Energy	"[. . .] the community of Galinhos must attempt to weigh losses and gains provided by the installation of the wind farm in the municipality. If the loss is only defacing the area, then it's worth it. [. . .] it is not permissible for a community that does not take care of its own garbage to yell against wind power ventures. [. . .] Creating job openings, even for a predetermined time interval is not a bad thing. [. . .]." [49].
ABEEOLICA—Brazilian Wind Power Association	"this is the first time that a Brazilian municipality population is opposed to installing a wind farm. I'm surprised. I honestly have not understood this movement yet. Regarding all wind farms in operation or under construction in the country, the community is attracted by the job offers and local development. [. . .] the movement that is under way in Galinhos is against what has been happening in the entire country today." [49].
FIERN—Rio Grande do Norte Industries Federation	"[. . .] Basically it's a bunch of buggers who I've never heard of and don't even know the size. What community is this? Are they two, half a dozen? I admit that the information I have is that they are a very small group of buggers. A group of fishers who are imagining a problem. [. . .] The way it's being put by them, they are stating that wind farms will scare the fish. They are stating that it will disrupt turtle spawning. On what basis? On what scientific basis? None. [. . .] So it was a speculation of a small group that, in my opinion, does not represent the entire Galinhos community. [. . .] The dune, which is the specific case, when it has no vegetation cover, this dune is mobile . . . you cannot destroy the existing vegetation cover in the dune. But when that dune does not have vegetation cover, you install a wind turbine there, you are fixing the dune because you are giving it a treatment." [22].
Brasventos Consortium	"the consortium met all the requirements set by the state environmental agency to license the turbines. There is no reason to reallocate the wind turbines, since everything has been done within the environmental law, and the environmental impact is small. We have already reallocated five of them position, which were closer to the Galos village" [50].

Thus, it is possible to consider these actors' perceptions from public statements regarding Galinhos community's reactions, which can be synthesized as follows:

(i) Disqualifying the "Wind Power yes, not in our dunes!!" movement as representative of the community's demands;
(ii) The discontent originated from isolated leaderships, without any legitimacy;
(iii) The movement would be a manifestation of opportunistic local interests;
(iv) Absence of scientifically funded arguments to demonstrate potential environmental damages arising from wind farm installation.

It was feared that the diffusion and expansion of the movement would contaminate new ventures, leading potential investors to back down from new wind power projects in the region.

Thus, the social and environmental fragilities present at the Galinhos dunes, which were brought to light by the opposition movement, provoked investor reactions. Through these reactions we observed: (i) minimization of possible environmental damage to the region's natural heritage; (ii) changes in such an ecosystem, which could compromise ecosystem-dependent economic activities, were ignored; (iii) a community was treated as irrelevant, regardless of its legitimate concerns with the future and the self-management problems faced by its residents.

4.3.3. Governmental Actions

Since the first required studies, IDEMA acted to remove or overcome any impediments to the project. At that time, a strong demand for wind power expansion in the country was observed, and a highly articulated business group, inevitably with strategic support from the Government, put pressure on the environmental licensing agencies in order to expedite the release of legal constraints. Questioned about the reaction of Galinhos residents, the then IDEMA Director General stated:

> "It's the federal government's main project to comply with the Kyoto Protocol, which will be presented at Rio + 20 in June. It would look bad if we did not grant the license for this project, or the Union went to the conference and said that we did not reach the Protocol's goals because Rio Grande do Norte did not license our main project. IDEMA will not assume this responsibility and I imagine the Attorney General's Office will not either.". [51]

It is important to point out that the IDEMA Director General's statement reflects the lack of preparation present in the environmental body's high management to address the issue, since it confuses concepts and guidelines, and it is necessary to clarify such inaccuracies: (i) Rio +20 was not a conference to discuss the Kyoto Protocol; (ii) Brazil, as a non-Annex I country, does not have mandatory reduction targets under the Kyoto Protocol; (iii) there is no relationship between wind farm implementation and commitment to reduce GHG emissions under the Kyoto Protocol, nor is any role played by the state of Rio Grande do Norte, IDEMA and the Attorney General's Office in this context.

In light of the controversy, Federal Justice asked IBAMA, at the request of the Attorney General's Office, to carry out a technical analysis on the environmental licensing of Galinhos wind farm, and was asked to answer the following questions: (i) whether there was in fact a non-compliance concerning the installation license; (ii) whether any other illegal degradation of environmental quality is occurring; and (iii) what measures had been taken to mitigate possible damages.

Technical Note No. 008/2012, prepared by IBAMA analysts, identifies significant legal and operational inconsistencies throughout the licensing process; the licenses were considered illegal, were granted in disagreement with legal norms and stood against collective interests. Twelve recommendations were drafted, in order to adjust the entire licensing process to the legal constraints, aiming to eliminate the observed socio-environmental damages. It is noteworthy that the first of the recommendations was explicit in requesting the annulment of the Rei dos Ventos I environmental license [52].

A lack of harmony between environmental agencies is noted, as well as a clear lack of preparation on their managers to independently deal with complex issues such as local and international repercussions. With a nationwide scope, IBAMA was activated in a consultant capacity and pointed out socio-environmental problems to be better investigated, related to the licensing carried out by

IDEMA. At the state level, responsible for providing environmental licensing, IDEMA was pressured to expedite the licensing, disregarding indications of socio-environmental violations that required, at the very least, the elaboration of scientific studies to support the installation of wind turbines in the dunes.

4.3.4. Judiciary Actions

The pressure exerted by the Galinhos' population against the installation of wind turbines at Dunas do Capim resulted in several actions, including:

(i) Wide dissemination of the reaction in the state press;
(ii) Delivery of a signed list, with 577 signatures, to the governor, explaining the community's motives, and requesting the non-installation of the wind turbines;
(iii) Articulation with CONETUR, which issued a note advising against the installation of wind farms in the dunes;
(iv) Manifestation from the Attorney General's Office to IDEMA, advising them not to grant the Installation License to Brasventos' wind farms.

Despite several oppositional movements, IDEMA issued the license on 4 May 2012 authorizing the beginning of the construction. The Attorney General's Office filed a Public Civil Action, requesting an injunction to suspend the construction works, canceling the licenses already granted to the consortium and demanding repair of already inflicted environmental damages. Two reasons were announced: (i) the consortium did not present a locational alternative for the projects, a mandatory item in previous studies; (ii) the traditional communities settled in the area were not consulted. The request for an injunction was upheld by a first instance court, suspending the works and establishing a fine in case of non-compliance. Both IDEMA and the consortium appealed the decision, and the cases were judged on 14 June 2012 by the RN State Court of Justice, which considered the projects to have low environmental impact and be fully reversible, with a license based on a Simplified Environmental Report—RAS—rather than an EIA/RIMA, a more extensive and detailed environmental report. The pressure from the community movement led IDEMA to request the EIA/RIMA to the consortium [51].

Since the wind farm is located in a costal Permanent Preservation Area, it was characterized as a Navy property, under the responsibility of the Union. Due to this condition, the Federal Justice assumed the action, where the Attorney General's Office manifested for the nullity of the decisions upheld by the State Court. The federal judge ruled for the continuity of the works, considering the RAS licensing regulation, which did not demonstrate any irregularity in the licensing by the state agency, whose license was considered to be "wholesome, regular and legal." When discussing the indispensability of the EIA/RIMA, a point raised by the Attorney General's Office, he understood that the situation conformed to the RAS, since:

> "It is a clean energy generation structure with minimal impact on environment. [. . .] since the environmental impact is minimal, without any area degradation or inconvenience to the local population, as evidenced by the reports given by the residents themselves, including their mayor and president of the City Council". [53]

As for the proposition of a locational alternative, which does not exist in the RAS and is superficially present in the EIA/RIMA report, when alerted by the Attorney General's Office, the judge understood that:

> "The parties involved in the licensing, initially in a simplified form and later through a more detailed study, took into account alternatives of location for the undertaking, being convinced that the chosen area would be the most adequate and efficient for the implementation of the project.". [53]

Regarding the possibility of a locational alternative to the coastal strip and the convenience of seeking other areas, he pointed out that:

> "It is necessary to recognize that entrepreneur's interest in the construction of wind farm is diminished in lands with lesser wind potential, which can make the business unfeasible, whose fruits, in the present case, were noticed not only by the owners of the business, but by the population in general.". [53]

and summarized:

> "it should be noted that the environmental impact produced by the wind farm has been shown to be minimal, with the tremendous actual benefits for the general population.". [53]

The trial was adjourned on 19 December 2013. The regularity and legality of the licensing process and the continuity of the works were the final decision. A market logic prevailed, while a discussion over the actual socio-environmental impacts became invisible. A market logic prevailed, while the lack of any detailed discussion over the actual socio-environmental impacts essentially rendered those impacts invisible.

4.4. Wind Power and Its Potential Impacts: What do Studies Say

The experience from conflicts in the implementation of wind farms in CE guided Galinhos residents. In Ceará, strong environmental impacts from wind farms in the coastal zone, dominated by dune fields, had already been identified. Thus, wind farms:

> are promoting profound negative environmental impacts along the northeastern coast. Those operating and under construction in the dune fields revealed that the area occupied by the wind turbines is severely degraded—terraced, fixed, fragmented, deforested, compacted, with altered morphology, topography and physiognomy. It is necessary to maintain a network of access routes for each wind turbine and to protect these structures bases from wind erosion. This led to a widespread and random process of artificial sand movement, damage to archaeological sites and privatization of these environmental systems, with relevant socio-environmental interest [19].

Therefore, concerns regarding the dune fields are existent, as anthropic changes, such as vegetation removal, dune cutting or planing, and interdunal lagoon burial lead to "anew dynamics, normally governed by the predominance of erosion" [19], and these actions are requirements for the installation of wind farms. Chen et al. [54] discuss the relationship between maintaining dune shape and their water content, which contributes to the maintenance of groundwater levels. Other studies, such as carried out by Albuquerque et al. [55] and Hadlich and Ucha [56], describe the ecological importance of apicuns flat areas, presenting high salinity or acidity, located in the supramarine region and with shallow or no vegetation, present in intertropical regions and associated with mangroves. These are natural protections for the coastal areas and act against erosion, besides being areas used in recycling nutrients and energy [57]. Studies by Martínez at al. [58], Pinto [59] and Schlacher et al. [60] report concerns regarding the management of coastal strips, their occupation by economic activities and impacts resulting from climate change.

In a study on Galinhos geomorphology, Lima [61] demonstrated that:

> the area is characterized by the complexity of its geomorphological features, represented by beaches, reefs, estuaries, mangrove swamps, lagoons, sand dunes and spits. These features are the result of the joint action of waves, coastal currents and winds, related to sea level variations during the Quaternary period. [...] The Galinhos spit constitutes a fragile ecosystem, capable of rapid natural and anthropic modifications.

Costa Neto [62] analyzed environmental changes in the Galinhos-Guamaré estuarine lagoon complex, assessing to natural phenomena (tides, currents, rains, winds and waves) and anthropogenic (excavation and channel bush construction of slopes in inter- and supramarine areas, discharge of saline

effluents and shrimp farming into the aquatic environment, and mangroves destruction). The main identified impacts were: fauna and flora mortality; formation of sandy banks near the system's influx; increased salinity and water density; and increased nutrient concentrations, contributing to eutrophication. The study proposes the implementation of an Environmental Conservation Unit at the Guamaré-Galinhos region.

Regarding avifauna, some studies have been performed in the Galinhos estuarine region, including the saline area. Nearctic migratory shorebird species and resident birds were mapped. Eighteen bird species from the *Charadriidae*, *Scolopacidae* and *Sternidae* families were identified [63–65]. The Nearctic species *Calidris pusilla*—the semipalmated sandpiper—was identified as the most abundant in the region, despite concerns about population reductions [66]. Birds use both natural regions, such as dunes and mangroves, and anthropic formations, such as salt farm areas, to seek refuge and food.

Several studies discuss the impacts of wind farms on birds. Langston and Pullan [67] identified the following potential hazards for birds: (i) disturbance, leading to displacement or exclusion, including movement barriers; (ii) collision mortality; (iii) loss or damage to habitat, resulting from wind turbines or associated infrastructure. Powlesland [68], corroborating the aforementioned impacts, identified characteristics that may contribute to bird impacts, such as: (i) the size of the wind farms; (ii) their configuration, construction and operation; (iii) the turbine blade size, its lights and speed; (iv) associated structures, such as the power grid; and (v) environmental characteristics. However, for Pearce-Higgins at al. [69] there is little evidence of overall bird population decline in the post-construction phase, although they believe that the construction can cause great damage. Percival [70], on the other hand understands that birds and wind farms can coexist, as long as areas: (i) with high bird of prey density; (ii) with high vulnerable species density; (iii) where disturbances may affect feeding or nesting, are avoided. Drewitt and Langston [71] point out that collision mortality can severely affect bird populations, and that significant effort is required to better estimate such effects, at the local, regional and national levels, in order to assess wind farms impacts on bird populations.

As for chelonians, spawning sites have been registered along the Brazilian coast. Specifically at the Potiguar Basin, *Chelonia mydas* was the most frequently found species, from 2010 to 2012. The presence of sea turtles was identified at the Galinhos-Caiçara coastal stretch, although in lesser amounts than in other stretches, such as Macau-Guamaré, Areia Branca-Porto do Mangue and Grossos-Icapuí [72]. As these species are threatened with extinction, concerns from governmental agencies and other entities have been noted, who monitor and establish strategies for their conservation [73].

Galinhos originated from a community of artisanal fishers, still present in the city's daily life, despite the growing touristic activities. These are defined as:

> those who, in catching and disembarking all kinds of aquatic species, work alone and/or use family or self-employed labor, exploring ecological environments located near the coast, since the vessel and apparatus used for such have little autonomy. Artisanal fishery is performed using reduced relative yield techniques, and the products are totally or partially destined to the local market [74].

In a study carried out with artisanal fishers at RDSEPT in Macau, near Galinhos, Oliveira et al. [75] indicate that flying fish, Atlantic thread herring and mullet are the main source of food and income for the communities. Fishers report improvements from the creation of RDSEPT, but fear certain environmental degradation factors such as predatory fishing, wind and oil enterprises, and lack of law and regulation enforcements.

Another study carried out in the traditional community of Xavier in CE, with a wind farm installed 200 m from inhabitant homes, noted that after a judicial demand, inhabitants were granted community improvements, such as: access to quality housing and electric powering and improvements in school transportation and access routes. However, overlapping negative factors were also observed, such as: privatization of common areas; reduction of surface water supply; suppression of freshwater ponds used for fishing; uncomfortable noise from the turbines; constant fear of accidents; and internal conflicts between residents, after the implementation of the compensatory measures [76].

An ethnographic study, carried out with the inhabitants of Galinhos, analyzed aspects related to local affectivity and identity, regarding resident relationship with the wind farm conflict. The affective memory regarding the past event of an environmental crime, due to saline plant expansions in the area, was taken into consideration, which led to a fisher protest, due to the potential destruction of the mangrove which provides food and economic sustenance. The study concluded that the conflicts took place not only as an authoritarian relationship between large economic groups and a small community with its economic sustainability threatened, i.e., a capital-location contradiction, but also through a process of affective attachment to the land and between people from this place, ties that were reinforced by a history of confrontations. Through these paths, this study identifies aspects that differentiate what took place in Galinhos regarding the wind farm and the non-occurrence of opposition to wind energy in other municipalities in the state [23].

5. Ex-Post Analysis: Community Perception after the Consolidation of the Wind Farm

5.1. Field Research

After six years of operation, an outward population movement regarding the wind farms is established, and, from a collective point of view it can be perceived that the ventures contributed little to the city's development. Therefore, some guidelines determined by the community prior to the implementation of the wind farms must be compared to the current reality, such as concerns on negative tourism and fishing interferences, and environmental developments.

Field research, aiming at capturing the community's perceptions, maps the expectations and concerns of Galinhos' population, materialized or not, after the implementation of the wind farms. The aspects that emerged in this process—ex-ante—raised from the appreciation of a documentary base. The analysis of these documents supports the synthesis of community perception, as presented in Table 2.

Table 2. Ex-ante expectations and community concerns, according to the economic, socio-cultural and environmental dimensions. Source: Based on [21,44–48,50–52].

Dimension	Expectations	Concerns
Economic	Job creation increases, commerce, and new business emergences	• Impairment of tourist activities: • Reduction in transportation activity: maritime and land; • Reduction in the commercial activity: inns, bars, restaurants and others. • Reduction in fishing activity.
Social	Benefits to the city's infrastructure	• Invisibilization of community demands: lack of dialogue with investors and government; • De-characterization of the traditional "islet" way of life; • Impossibility of access to the Dunas do Capim; • Emergence of car traffic in the city; • Risks of possible accidents arising from the operations.
Environmental	Contribution to sustainable development	• De-characterization of the natural landscape and visual pollution; • Governmental negligence to potential environmental damages; • Loss of biodiversity; • Damage to avifauna, ichthyofauna and chelonians; • Noise pollution.

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The ex-post analysis, carried out using questionnaires, aimed to unveil the perception regarding the operation of the wind farms.

5.2. Results and Discussion

5.2.1. Technological Dimension—Community Knowledge on the Concept of Renewable Energy

The study found that 66% of the interviews were unaware or cannot conceptualize renewable energy. Out of the 34% who claimed to be able to conceptualize renewable energy, only 63% presented a satisfactory response, leading us to infer that less than 22% of the population dominates this concept. The understanding of wind power also reaches less than 22% of the population. Figure 5 illustrates these results.

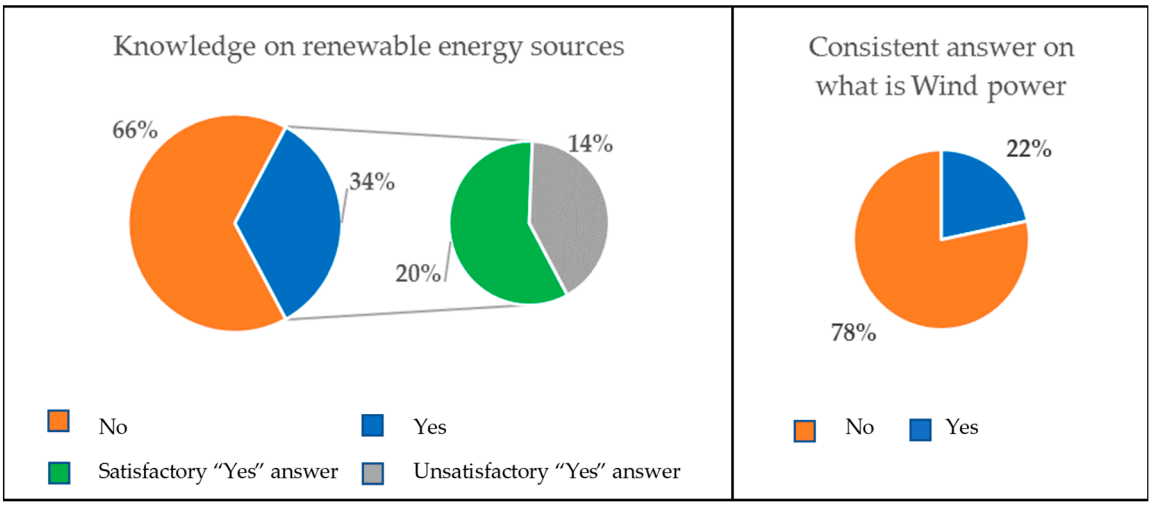

Figure 5. Knowledge on the concept of renewable energy. Source: field research data.

This ignorance of the population reflects their instruction level, given that the Galinhos Education HDI indicates a significant inertia of the population above 18 years old in terms of increasing schooling years, with one of the state's lowest HDI [42]. The responsibility of investors and government in shaping this framework cannot be ruled out, since the implementation of a project based on promoting sustainable development must, by means of a conceptual obligation, develop relations with its surroundings in order to appropriate the population with fundamental concepts of sustainability. This includes disseminating the conceptual bases of the applied technology, its socio-environmental benefits and potential damages. For collaborative decision-making, Jami recommends the presence of a knowledge-broker, which represents a third party with knowledge, enabling it to facilitate conversation on issues of dialogue between the parties involved in the conflict, supported by socio-scientific knowledge [77].

5.2.2. Environmental Dimension—The Wind Farm and the Environment

The region attracted fishers, due to its high productivity potential, who founded villages and created settlements. In this context, the traditional fishing of lookdown fish is relevant in building the city's identity and, therefore, preserving this species is important for the community. For 60% of the interviewees, the lookdown fish population has been reduced. However, only 6% of these believe that such a phenomenon is linked to the wind farms.

Turtle spawning on the coast was confirmed by 65% of the interviewees. This indicates that it is necessary to monitor these events, including development of research concerning the influence of the wind farms, since this has not been monitored so far.

The municipality of Galinhos stands out as an important migratory site for nearctic species such as *Calidris pusilla*, *Tringa flavipes* and *Tringa melanoleuca* [63,64]. It is important to emphasize that the maintenance of mangroves, beaches, estuaries and interdunarian lagoons are of the utmost importance for these migratory species [65,78–80].

In this regard, questionnaires revealed that 16% of respondents reported having knowledge of bird accidents. However, they cannot, in their entirety, link such accidents to the wind farm operations. Due to the importance of the region to bird migratory routes, it is necessary to structure monitoring regarding wind farm effects and/or damages to the bird fauna.

The reported concerns on potential damages to ichthyofauna, avifauna and chelonians arising from the noise pollution generated by the rotational movements of wind turbine blades, as well as effects from nocturnal signaling lights in parks are also noteworthy.

When asked if the park harms the environment, 44% of the interviewees said yes, arguing:

(i) The wind farm moved dunes and removed areas covered with vegetation;
(ii) Piçarra roads flattened dunes and dust covered and killed green areas;
(iii) Sand displaced from the dunes is carried to the river, contributing to its silting;
(iv) The construction violated archaeological sites.

Concerning the landscape, only 15% of the interviewees felt disturbed by the presence of the wind farms, claiming a visual intrusion that has the potential to harm tourism and commerce. Figure 6 illustrates these results.

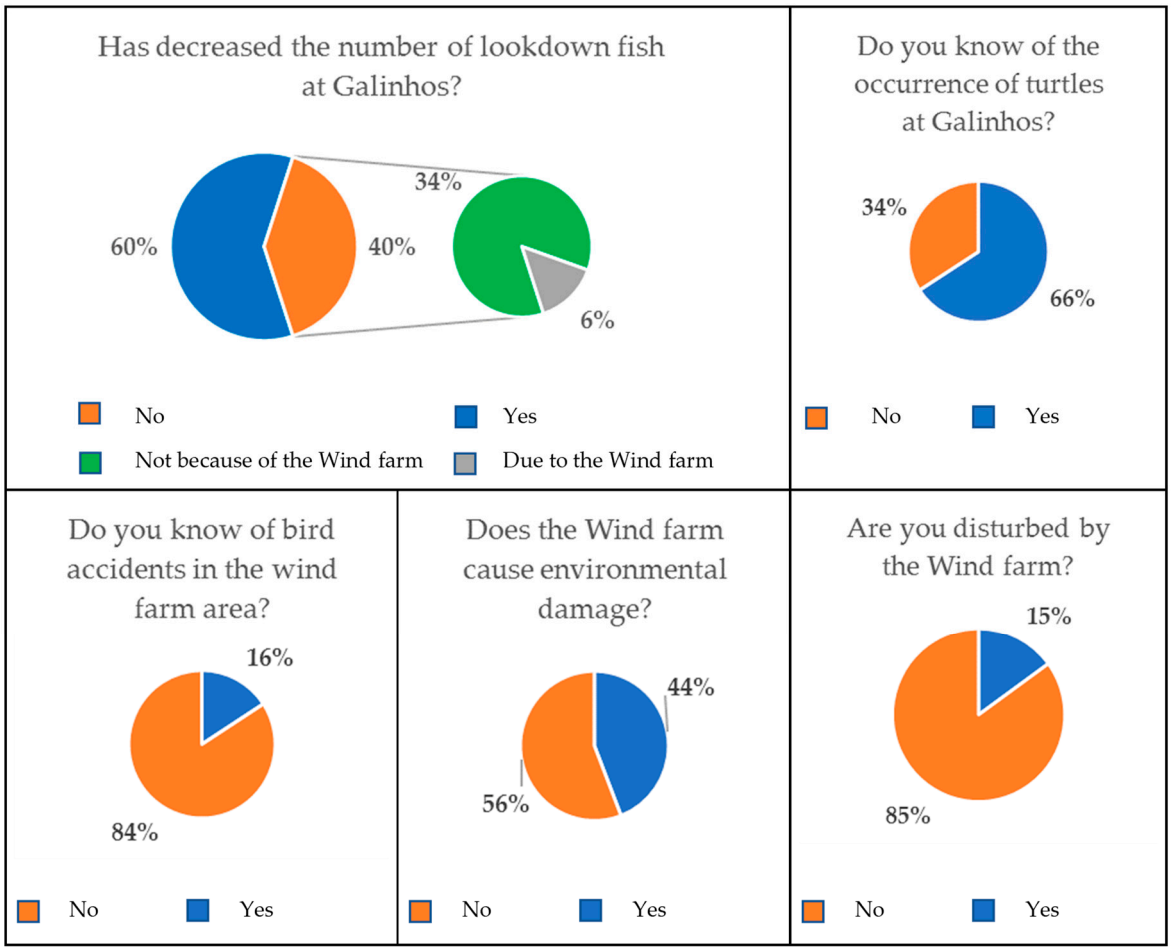

Figure 6. The wind farm and the environment. Source: Field research data.

5.2.3. Socioeconomic and Cultural Dimension—The Wind Farm and Its Consequences

Socioeconomic evaluation of an enterprise with the size of the wind farms under study requires the knowledge and processing of data and indicators that surpass the declared objectives of the research.

The interviews, therefore, aimed at revealing ex-ante and ex-post expectations and concerns by the community and showed that 57% of the respondents have the feeling that the number of jobs in the municipality increased. However, this possible increase was most likely linked to the period of construction of the wind farms, which temporarily requires a large number of workers. Traldi [39] points out that there is no guarantee of the employability of the local labor force since it demanded more intensely labor of workers with specific skills and competencies for the civil construction, which are not always available in the region. Once the construction finishes and the wind power generators are in motion, the number of jobs greatly reduces, and those required for the operation of the wind farms require professionals with greater expertise. In the case of the Galinhos wind farms, the survey registered the occupation of only five inhabitants of the municipality in functions of monitoring and maintenance of the internal roads.

Regarding trade, 69% of respondents indicated that no trade dynamics were altered. They credit this to the fact that the wind farm is alien to the city, since it does not employ the local population, does not boost commercial transactions, or lead to the emergence of new economic activities, hence being considered an enclave.

As for tourism, 67% said that this activity did not change, since tourism developed as an autonomous activity. Its natural attractions, driven by the unique form of "island way of life", were kept safe from potential interference. Therefore, the freedom to access and circulate in the wind farms, obtained through the political mobilization, was fundamental to maintain touristic attractiveness.

Galinhos access, which is isolated by natural barriers, is carried out mostly by boats. Opening roads, for 75% of the interviewees, led to a greater influx of cars to the city. On this matter, the data indicate that the population is divided as to the benefits or damages of this modification to the local way of life. A total of 46% consider an increase in traffic positive, because it can boost local commerce and tourism. For 15%, the presence of cars does not alter daily life, while 37% understand that it facilitates and significantly potentiates social problems, such as drug trafficking, mugging, etc.

It is important to note that 80% of the respondents had already used the road built with the wind farm to move in or out of Galinhos, demonstrating that a greater use of the land access is already a reality. Figure 7 illustrates these results.

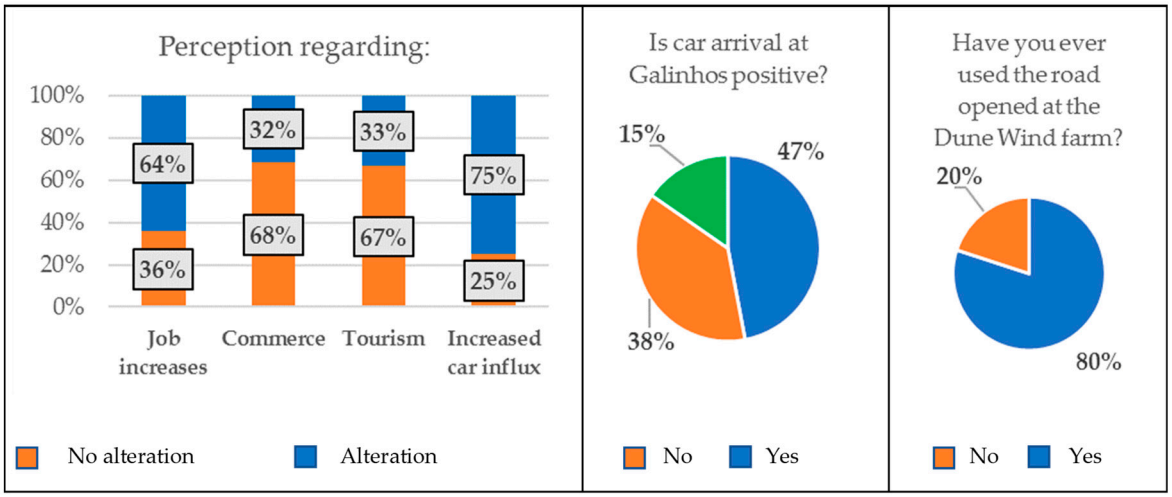

Figure 7. Wind farm and its consequences. Source: Field research data.

The perceptions and concerns pointed out by the documental analyses, as well as the diagnosis of the reality observed during field research are synthesized in Table 3.

Table 3. Synthesis of the perceptions and concerns before the installation and diagnosis of the reality observed by the field research. Source: elaborated by the authors.

*	**	Ex-Ante Concern	Ex-Post Diagnosis
E	1	Job Creation	• Full-time employment rates did not change significantly.
E	1	Commerce Increase	• No change in trade was noted.
E	1	New business	• New businesses arising from the wind farms were not recorded.
E	2	Benefits to the city's infrastructure	• Water desalination equipment is insufficient to meet the demand, and is unstable; • Open roads are used in the construction and maintenance of the wind farms, with possible uses by a community outside Galinhos—family, friends, and visitors.
E	3	Wind energy as a form of environmentally benign power generation	• Vegetation was removed and suffocated by dust from the construction. • Complaints about violation of archaeological sites;
C	1	Losses in touristic activity	• Tourism activity did not change due to the wind farms.
C	1	Losses in fishing activity	• There was no reduction in fishing activity.
C	2	Community Invisibilization	• There was no dialogue between the consortium management and the community
C	2	Islet way of life	• There is concern that increased car traffic will bring on violence and disrupt the city's tranquility;
C	2	Access to the wind farm area	• Due to the pressure from the residents, access for walks in the dunes preserved bugger activity and leisure activities.
C	2	Risks of accidents with the towers	• The population still fears occurrences such as fires or turbine blades falling.
C	3	De-characterization of the natural landscape	• There is no consensus among residents regarding negative influence on the landscape.
C	3	Governmental negligence in monitoring possible environmental damage	• Environmental agencies do not monitor compliance with environmental constraints or talk to residents.
C	3	Loss of biodiversity and damage to avifauna, ichthyofauna and chelonians	• There is register of accidents with birds and presence of turtles, but there is no known action taken by environmental agencies to monitor possible damages to these or other living species.

Label: (*) Aspect E—Expectations, C—Concerns; (**) Dimension: 1—Economic; 2—Socio-cultural; 3—Environmental.

6. Conclusions

The narrative that supports the expansion of wind farms grounds, in large part, on the argument that they promote sustainable development. However, such convergent ideas become fragile by the register of reactions originating in the receiving communities of these enterprises. These movements fear that the installation of wind farms could lead to situations of environmental, cultural, and socio-economic damages, in this case in poor and traditional communities.

The ex-ante analysis of the various actors in the community reaction to the wind farms in Galinhos allows for the conclusion, concerning investor behavior, a reaction directed to disqualify the community social movement from a logic that minimizes indications of social and environmental damages. As for the government, the study found the dissent among different environmental agencies, managers unprepared to face relevant environmental issues, and susceptibility to pressure from economic interests. Regarding for the Judiciary, the strong attachment to formal aspects of the law gave the impression that another interpretation would be possible, if some evidence of socio-environmental damages in the area had been considered. About the socio-environmental studies presented herein, it is clear that knowledge regarding the region already exists, which can contribute to better decisions made by governmental agents.

From the ex-post analysis, it is possible to conclude, from the perceptions expressed by the community, that: (i) the assessed wind farms did not promote local long term job creation and higher income in the communities in its surroundings; (ii) the dynamics of local tourism and trade had no significant interferences; (iii) regarding impacts on avifauna, ichthyofauna and chelonians, there is no evidence to indicate that the wind farms influenced the dynamics of these animal populations, making it imperative that studies to diagnose and monitor the situation are carried out, either by governmental agents or investors, due to the fact that the region shelters protected animal species; (iv) there is no record of complaints regarding noise pollution and other damages to human health by wind turbines, but no studies have been found that would allow us to extend such an affirmation towards animals health and comfort; (v) there is no significant contribution to the city's infrastructure; (vi) it was evident that the community manifests the lack of interlocution with investors, remaining invisible, even after implementation; (vii) the de-characterization of the traditional "islander" way of life remains a concern, especially for the older population; (viii) there is an increase in car traffic, due to the new access and maintenance roads created by the consortium.

The study demonstrates that it cannot be argued that the implementation of wind power production plants contributed to local sustainable development, since there is still a robust set of questions regarding the benefits and potential social and environmental damages, related to the construction and operation of the plant, aside from the de-characterization of the natural landscape. It also identified the need for a more inclusive energy production planning, in which renewable energy sources can also promote local jobs and higher income, aiding to redeem the social debt in a country marked by so many contradictions.

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