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Connections Between Wind Energy, Poverty and Social Sustainability in Brazil's Semiarid

Maria Luiza de Medeiros Galvão [1,2,*], Marco Aurélio dos Santos [2], Neilton Fidelis da Silva [1,2,3] and Valdenildo Pedro da Silva [1]

[1] Federal Institute of Education, Science and Technology of Rio Grande do Norte (IFRN), Natal 59015-000, Brazil; neilton@ivig.coppe.ufrj.br (N.F.S.); valdenildo.silva@ifrn.edu.br (V.P.S.)
[2] Energy Planning Program of Alberto Luiz Coimbra Institute for Graduate Studies and Engineering Research, Federal University of Rio de Janeiro, Rio de Janeiro 21941-909, Brazil; aurelio@ppe.ufrj.br
[3] International Virtual Institute of Global Changes IVIG/COPPE/UFRJ—University City, Rio de Janeiro/RJ, CEP 21941-485, Brazil
* Correspondence: luiza.galvao@ifrn.edu.br; Tel.: +55-084-99915-9398

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Abstract: In Brazil, the technical-scientific and informational knowledge records abundance of winds of high commercial viability and its use has usually occurred in spaces socially characterized by poverty. In the state of Rio Grande do Norte, the Mato Grande territory concentrates 3758 MW of installed capacity in 114 wind farms. In opposition to this economic and technological development, 5191 families settled in 73 rural settlements live in poverty, living with restrictions on land use and exploitation caused by water stress and without enjoying the benefits of energy activity. Therefore, the aim of this study is to understand the connections between the implementation of wind farms as sustainability promoters and the permanence of poverty levels. To this end, a literature review, secondary data systematization and field visits to two wind farms and two rural settlements were conducted, where interviews were conducted with their representatives. The results show that wind energy does not positively impact the researched region that has a history of backwardness and poverty. They also indicate that the wind projects implemented in the study area have disregarded the yearning for the development of the surrounding communities, since after a decade, they did not promote inflections on the family welfare curve. The research innovates in addressing the relationship between poverty and energy, thus, surpassing the frontier of the discussion "Energy Poverty", since access to electricity is already universal in Brazil.

Keywords: sustainable development; wind energy; poverty; welfare; semiarid

1. Introduction

In recent years, renewable energy has become one of the essential requirements for human sustainability, given the limitations and problems arising from access and use of fossil fuels, due to: Exhaustion, unequal distribution in countries and degradation on multiple scales, affecting human health and environmental conditions [1]. The inclusion of renewable sources in the global energy matrix has been considered important for human development, especially for the rural environment [2], but without much evidence of the socio-spatial sustainability afforded to rural communities. One author points out that the generation of electricity from renewable sources has significant potential and can bring substantial savings compared to a fossil and nuclear-based scenario [3]. In this sense, it is known that the production and harnessing of the benefits of renewable energy for all individuals without distinction can contribute to human transformation, emancipation and prosperity, from the perspective of 2030 Agenda [4]. Specifically, wind energy production has been transforming and imposing new uses on the physical substrate of Brazil's semiarid region, highlighting here the Mato Grande space in the state of Rio Grande do Norte, which may not be directly contributing to

sustainability, emancipation and human prosperity. In this sense, it is theoretically in accordance with Santos's idea [5] that the territory is not a pure entity, not just nature, not just political, not just economic or cultural, nor is it homogeneous. Thus, the Mato Grande semiarid is considered as a synonym for used territory, since it is constituted by objects and actions [5]—new/old, internal/external, material/immaterial, fast/slow, integration/differentiation-and it presents itself as a relevant analytical instrument, because "the used territory, seen as a totality, is a privileged field for the analysis in that, on the one hand, it reveals the global structure of society, and on the other hand, the complexity and inequality of its use " [6].

In the report "Our Common Future", it was already stated that renewable energy sources were the basis for the 21st century global energy structure. However, the document warned that changes would occur in the patterns of energy generation and use in developing countries, achievable through energy efficiency policies for producers and consumers [7]. Oyedepo [8] argued, in one of his studies in Nigeria, that the use of renewable energy makes it possible to achieve sustainability in both the developing and industrialized energy sectors. The author points out that the widespread use of renewable energy will lead to poverty reduction, sustainability and development.

From this perspective, we highlight the discussion of diffusion and production of alternative energies as a guarantee of sustainability, according to the report of INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE-IPCC [9]. This report states that renewable sources of energy give rise to the use of multiple integrated sources, besides contributing to the reduction of greenhouse gas emissions and the mitigation of climate change. However, there are gaps in the discussion literature on the connection between renewable energy production and generation and their links with the most vulnerable and poor human environments and groups from the perspective of the 2030 Agenda. The 2030 Agenda document includes an action plan for people, to the living environment in every corner of the planet, and to prosperity, by recognizing that the eradication of extreme poverty in all its forms and dimensions is one of the greatest challenges for human sustainability [4].

It is known that safe and reliable energy supply for households and the productive sector has undoubtedly become a basic factor for the promotion of the human and economic development of the territory as the primary geographical expression of social power [10]. Access to energy is directly linked to the possibility of approximation to several other essential public rights, such as water, health, education and security. The eradication of poverty involves providing the fundamental services available to all through the stage of development achieved by society [11]. Poverty, in the view of some authors, is not just about lack of income, but involves poor health, poor education and a life deprived of dreams and freedoms [12,13].

However, it is recognized the importance that renewable energies have played in the energy matrix vis-à-vis fossil and nuclear energy sources in this current period. Nevertheless, the increase in the domestic supply of electric power of a national state has not warranted the promotion of capacities and welfare for all its population [14]. Electricity generation has focused, above all, on the center of economic activities, directly interfering and intending the circulation of goods, being vital to the system producing goods and services and not to human development with freedoms.

The expansion of the electricity sector follows the increase in energy consumption worldwide. The sector drives technological and economic development, but causes major social and environmental changes, with impacts on the territory, which is the physical support of energy generation activities [15]. Large projects generate significant impacts on geographical areas and local populations, and in many cases, with serious environmental consequences on livelihoods [16]. In developing countries, the expansion of the sector has intensified socioeconomic and environmental problems on the part of the population, which is still without access to the benefits of electricity and is often directly affected by projects.

In rural areas, the biggest arena of attraction of electric enterprises, this scenario is even more serious, and very often, they disregard and exclude this population, leaving almost always the transition from rural poverty to urban poverty. Extreme poverty exists in many developed countries and characterizes entire regions of the developing world, revealing that the effects of economic, social and technological progress have not been effective in combating, much less eradicating poverty. In

this context, with the goal of promoting a world free from extreme poverty, hunger, disease and poverty in which all life can thrive, the United Nations presents the new 2030 Agenda for Sustainable Development. In the presentation document Transforming our world: The 2030 Agenda for Sustainable Development, before defining the 17 goals, there is a Declaration composed of 59 items establishing the principles for the 2030 Agenda. These principles lead to the choice of the 17 Sustainable Development Goals—SDGs to be achieved until 2030. In the Declaration, under the label The new Agenda (principles 18–38), principle 24 states the purpose to "devote resources to rural development and sustainable agriculture (...) in developing countries, particularly in the least developed countries" [4].

Despite improved welfare and poverty reduction in recent decades, the world remains with numerous consequences of inequalities, and, especially in rural areas of developing countries, extreme poverty remains disproportionate and overwhelming. Food production outcomes and declining global hunger are positive, but food insecurity persists, notably in Africa and Latin America, where there is greater inequality in access to food [17].

Over time, semiarid natural conditions-high temperatures, low rainfall, high insolation, water deficiency, among others-have been considered as reasons for the backwardness and rural poverty in these areas. In this contemporary world, the abundant solar irradiation and the presence of constant and fast winds in the Brazilian semiarid became resources of great commercial value for conversion to electricity as can be seen in Figure 1, with Solar and Wind Energy Potential, and Figure 2, with wind farms and photovoltaic solar plants in the Brazilian semiarid. The Brazilian Semiarid Region (SAB) is a delimitation of the national territory, defined by Ordinance No. 89, 2005. The Semiarid is a set of municipalities meeting one of these criteria: Average annual rainfall; aridity and risk of drought or its prolongation [18].

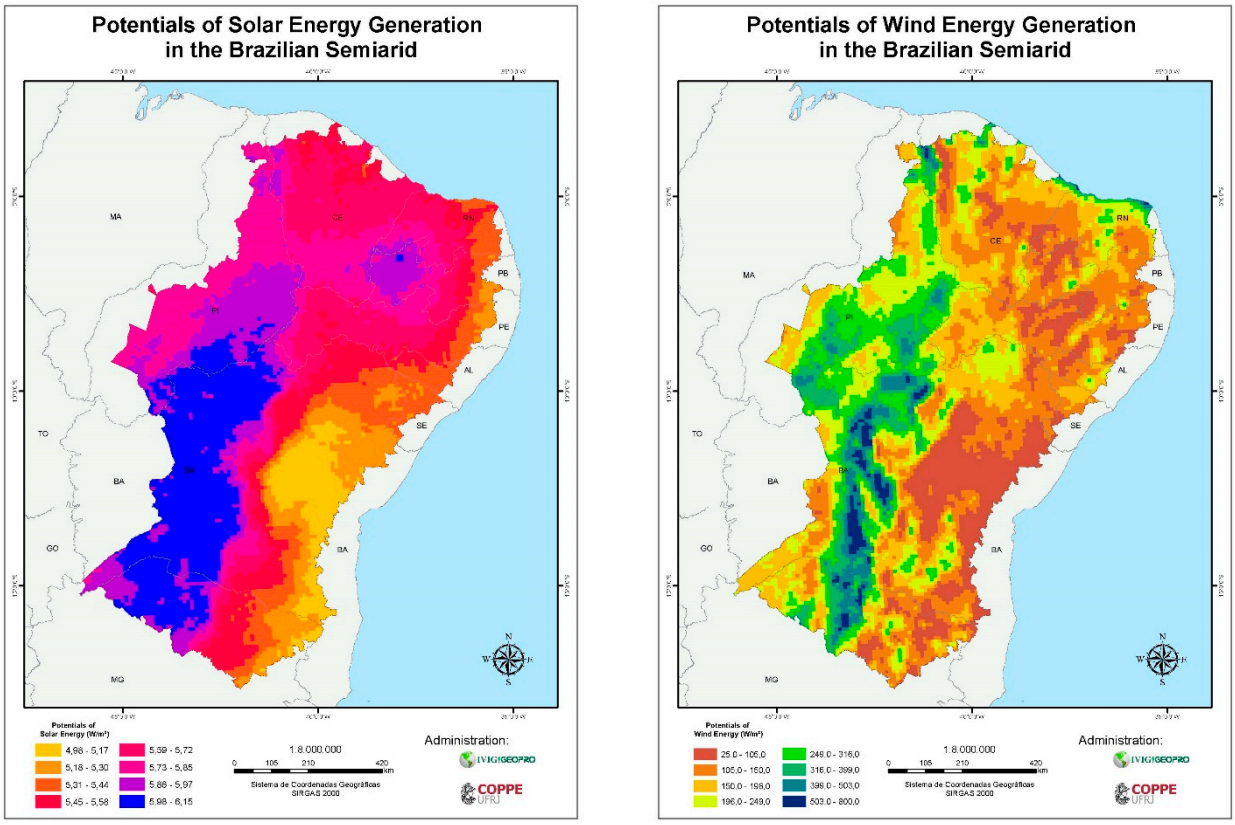

Figure 1. Solar and wind power generation potentials in the Brazilian semiarid. Source: Authors' elaboration from the Electric Energy Research Center, Brazilian Institute of Geography and Statistics—IBGE, National Institute for Space Research—INPE and the Ministry of Environment's data.

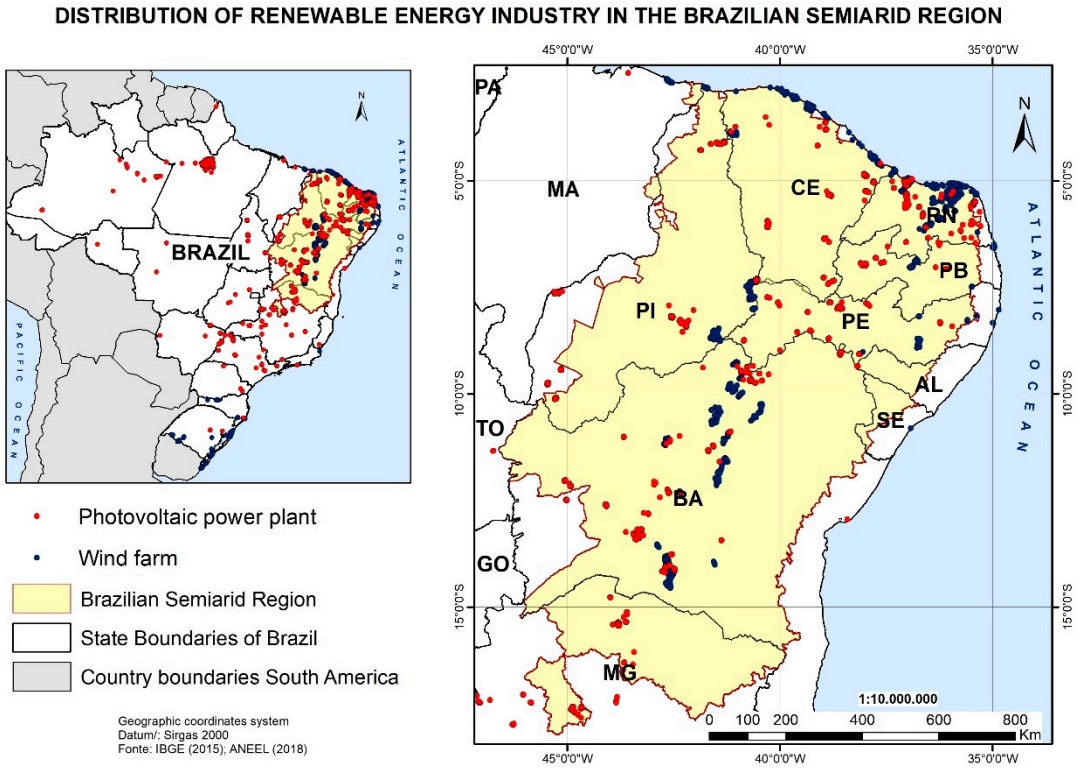

Figure 2. Distribution of wind farms and photovoltaic solar plants. Source: Authors' elaboration from application for web maps of the Company of Energy Research—WEBMAP EPE.

The expansion of wind energy in the Brazilian territory has been attributed to extraordinary winds, competitive generation costs and technical benefits of lower installation costs. These characteristics favored a strong reduction in wind energy prices from auctions, starting at US$ 76.43/MWh in the 2009 Reserve Energy Auction, and reaching US$ 21.47/MWh in the New Energy Auction A-4/2018 [19]. In the northeastern semiarid rural environment, the wind source is exploited with a view to increasing the supply of electricity to be offered by the National Interconnected System (SIN), and above all, in response to the expansion of markets of wind power companies [20]. This configures the commodification of resources and places, which are integrated by a technical system, granting it the specialization for new uses of the territory, through intentionality and localization of its production [5].

From this perspective, it is evident that the semiarid renewable resources have become attractive natural phenomena, especially for the wind sector. The advancement of wind power projects on this spatial profile is not motivated by the lack of access to electricity for the surrounding population, since the universalization of public electric power services was established by Law No. 10,438, of April 26, 2002, as amended by Law No. 10,762 of November 11, 2003, of the National Electric Energy Agency [21]. This has been a public policy in place that puts energy at the center of development to reduce social inequality and poverty.

Table 1 presents the relationship population, GDP, electricity consumption and distribution of universal access to electricity in the five regions of Brazil. The data show high coverage rates of electric services (95%), as well as clear and deep regional socioeconomic inequalities. The Southeast region of Brazil is home to 41.87% of the population and has a GDP of 53.2%; the South has 14.27% of the population and 17% of GDP, the Northeast has 27.57% of the population and participates with 14.3% of GDP. In terms of electricity consumption, the unequal GDP structure confirms the imbalance in national electricity consumption. The data express the discrepancy between the Southeast, which consumes 49.78% of all domestic electricity supply, and the Northeast with only 17.07%.

Table 1. Percentage of service coverage and electricity consumption by area, population and GDP of each region of Brazil. Source: Authors' elaboration from IBGE, EPE and The Brazilian Electricity Regulatory Agency—ANEEL.

Region	Area		Population		Electricity Consumption		GDP	Electric Service Coverage
	Km²	%	Inhabitants	%	MWh	%	%	%
Midwest	1,606,415.201	18.86	15,875,907	7.65	35,407,740	7.58	10.1	95.8
Northeast	1,554,291.744	18.25	57,254,159	27.57	79,731,255	17.07	14.3	87.7
North	3,853,669.768	45.26	17,936,201	8.64	34,510,271	7.38	5.4	81.6
Southeast	924,616.968	10.86	86,949,714	41.87	232,514,731	49.78	53.2	98.8
South	576,773.368	6.77	29,644,948	14.27	84,997,182	18.19	17.0	98.0
Brazil	8,515,767.049	100	207,660,929	100	467,161,179	...	100	94.5

However, with the expansion of wind companies, aimed at intensifying their investments in areas that present a higher capacity factor for their projects, the states of Bahia, Ceará and Rio Grande do Norte-RN in the Northeast Region became the center of this kind of interest. In RN, the Mato Grande region has become the most attractive area for wind investments, acquiring a new socioeconomic and spatial dynamic determined by the magnitude of the energy sector. In this region, a favorable environment has been created for the capital of electricity generation and trading companies, enhancing their economic results. The other side of the magnitude of this sector is its social set, with a high degree of poverty and inequality in relation to the sector's economic growth, which is insufficient to provide human well-being [3,22].

There is a process of expansion of wind power production driven by government plans and programs to avoid electricity supply crises, such as that recorded in 2001 [23]. In addition, Brazil has been in line with the global climate change containment agenda, not least by its voluntary commitments under the United Nations Framework Convention on Climate Change. In this context, wind energy has been considered a sustainable, non-polluting alternative energy and of significant contribution to global efforts to reduce greenhouse gas concentrations. Wind power has been continuously and steadily spreading worldwide [24], and in Brazil, electricity production reached 48,475 GWh in 2018, equivalent to a 14.4% increase over the previous year, when it reached 42,373. GWh [25]. This is in line with economic, social and environmental sustainability, as these dimensions need to be taken into account and harmonized [1].

In Brazil, the state of Rio Grande do Norte leads in installed capacity the production of wind power with 3980.1 MW [26]. According to government records, there are currently 151 wind farms in operation, and there are already contracts for the installation of 35 more to be built in the next five years. In the municipalities of Parazinho and João Câmara, the first and second places in the national ranking of municipalities that host wind farms (members of the Mato Grande region), there are more than 650 wind turbines in operation. In all, the state has more than 1,500 wind turbines, while the runner-up on the list, the state of Bahia, has around 900 [27].

To reach these numbers, companies already in 2015 incorporated 44,240.25 ha of land in the region of Mato Grande, which has the best wind conditions [21]. However, in this region, 5191 families are distributed in 73 rural settlements [28], facing restrictions on land use and exploitation caused by water stress from periodic droughts, typical of the northeastern semiarid. Scarcity and negligible drainage impose activities of the little economic impact on a mass of small farmers who have "occupied the land for years but are impoverished, living poorly, discouraged. Almost forgotten" [29].

In this sense, the objective of this study is to understand the connections between the implementation of wind farms as sustainability promoters and the permanence of poverty levels in the semiarid region, taking as a case study the region of Mato Grande of the state of Rio Grande do Norte, Brazil.

The research innovates with regard to reflection on energy and poverty, advancing the discussion on the development and appropriation of renewable energy resources, such as wind,

because, where companies spread, live populations with access to electricity, but with severe difficulties in overcoming poverty in all its socioeconomic and cultural forms and dimensions. In this sense, the study contributes to the theme of energy poverty, showing that only access to energy is not a guarantee of poverty suppression, as discussed in Reference [30].

In its conceptual basis, energy poverty is presented as resulting from the complete lack of access to modern sources of energy. Earlier this century, the United Nations Development Program broadened the concept beyond access to sources to include reliable, safe and acceptable use. In this concept, the supply and use of energy sources must happen in an environmentally safe manner, promoting economic and social development. In societies where access to electricity services is already guaranteed to the population, poverty as an expression related only to energy activity surpasses this frontier of discussion and assumes a new conception as a multidimensional phenomenon with a view to its analysis and combat [31–33]. The connection between the results of energy and poverty motivates discussions [34] .

2. Theoretical Contributions on Wind Energy, Development and Poverty

This study brings to light the contemporary reality of renewable energy production, especially wind energy produced in Mato Grande-RN, from the territory and its use, full of contradictions and inequalities. The concept of used territory by Santos [5], which is basic in this article, considers territorial configurations, infrastructures and the environment as inseparable from explaining the territorial dynamics performed by its agents: Firms, institutions and people. This concept allows one to glimpse the production of wind energy in Mato Grande, not differing from other more developed capitalist spaces. With the production of this new activity, the territory gains new content and new possibilities of use are established, even though it generates unequal access for its population. The confrontation between the new and the old transforms the territory in use by wind energy into an arena, an inseparable, solidary and contradictory set of systems of objects and actions that contribute to the generation of new dynamics, forming it into a "space of all people, all companies and all institutions, capable of being described as a system of objects animated by a system of actions", despite its unequal strength.

Energy is an essential input to socioeconomic development. With a view to well-being, its access can promote the integration of dimensions essential to human life, such as education, health, water supply, sanitation, productive and subsistence processes, among others [35]. Electricity is also one of the aspirations of populations living in poverty, which still depend on traditional energy sources, and can lead to the transition towards a more equitable and sustainable development [36]. For Sen [13], the formidable achievements of the capitalist system cannot be underestimated, for "in development, the trust of the parties involved can be an important ingredient for the success of the market." In this way, the success of the market will reflect on poverty, so that "we must also consider the lives and capacities of the citizens".

Despite the possibility of sustainable energy use in peripheral regions, the sector is fundamentally tied to monopolistic capital. In this sense, the development model remains questionable, as it motivates states and companies to continue to seek unbridled industrialization, based on the uncontrolled exploitation of natural resources. Such a predatory characteristic, under the pretext of providing a good life to humanity, actually, endangers the environment, since it cannot renew itself in the same proportion as it is exploited. The greatest consequences fall on populations that suffer from poverty and conditions that are averse to the environment in which they live [37]. When the adverse conditions are maintained, sustainability is contradicted in its environmental, social and economic dimensions, and under these conditions, the increasing incorporation of renewable energy sources does not positively influence the development [33,34].

The inclusion of renewable sources is conceptually of global interest for achieving sustainable development [38]. However, its path has become the current challenge and "one of the most generous ideals that emerged in the last century. Only comparable to the much older longing for social justice" [39,40]. Since the 1970s, climate change and anti-poverty issues have been discussed and negotiated in global forums, with a view to more sustainable economic development [41]. Ahlborg [42], when

analyzing renewable energy projects in Tanzania, identified the discrepancy between the discourse and the path to development. For this conclusion, the author emphasizes the studies [43–45] to explain the ambiguities of the development of the industry, that is, on the one hand, its reproduction, and on the other, the permanence of the present social orders unequal and intact.

Among the various renewable sources, the wind source is considered an important alternative to fossil fuels for electricity production and has a significant growth in the world's electricity matrix. It can be assessed as environmentally sustainable because its impacts are generally less problematic than those of other energy sources [22,46]. The studies have been focused on evaluations of wind potential, business models and technological improvements, aiming at optimizing energy generation itself and not for the unraveling of the links between the interaction of technology with the territory and the communities around it.

In these terms, the production of wind energy brings with it numerous social, economic and environmental challenges. Costa [47] points out that the positive aspects caused by the implementation of wind farms do not always meet the expectations of the populations living in the same territories, especially when they do not receive any kind of income from energy production. The consequence is the gap between development and poverty [48–50].

The option for renewable energy is due, among other things, to the harmful effects of climate change, of the need for energy security and of the primacy of development [51]. In this sense, the option for it is associated with the socioeconomic, environmental and developmental aspects, which, respectively, enable each country or region to use its resources; allow the analysis of the specific conditions of each place; consider economic efficiency; social justice; and ecological prudence [3]. In this respect, Dester, Andrade and Bajay [52] state that Brazil meets the conditions of exploitation of renewable resources and must seek ways to make exploration viable as a basis for sustainable socioeconomic development. Thus, renewable sources are viable options, given the diversity of sources in the country. The tendency to expand them is real and long-term energy policies must inhibit negative externalities and wasteful lifestyles [53,54]. Is there such a commitment? Is the increase in the supply of electricity on the market based on the development and eradication of poverty in the territory where it is being produced?

Considering the Brazilian reality as an object of research, Gorayeb, Brannstrom, Andrade, and Mendes [23] question: Is the development of wind energy in Brazil sustainable? In response, the authors state that the Brazilian wind energy program was a successful response of the public-private sector to the electricity supply crisis that occurred in 2001, but it brings with it major socioeconomic and environmental impacts-land conflicts, erosion of livelihoods and political responses that have contributed little to the eradication of poverty. For Costa, Schaeffer and Cohen [55], the production and use of energy can shape life and organize human societies. However, Riva, Ahlborg, Hartvigsson, Pachauri and Colombo [56] point out in their studies that in rural areas of developing countries, the relation between electricity and development prioritizes macroeconomics and does not insert the local dimension.

As affirmed by Reis and Fadigas [22], energy policy focuses on supply, as to disregard the issues essential to full social and economic development for specific groups of populations, regarding the sustainable use of wind energy. According to Ahlborg [42], this stems from a policy of renewable energy projects, dominated by economic and technical analysis, without due attention to the energy and social development link.

The improvement of the technical progress and of the wind power projects has led to an increase in the share of the wind power source in the Brazilian energy matrix. However, the progress made does not adhere to the real needs of the rural communities settled in the surroundings of these enterprises, since the privations have remained within the populations with little or no perspective of overcoming the poverty [6]. Extensive rural areas of northeastern Brazil are occupied with wind farms which have generated large gains in capital from the sale of electricity. Companies assume the status of monopolies and once installed, they have an "exorbitant power, which tends to increase by [the] accumulation" [57]. According to Chesnais [58], the incorporation of land is conditioned to the

rentier character of investors, who aim at appropriating part of the economic gain with the exploitation of resources.

Energy enterprises generate new dynamics and new centralities in areas of poverty and stagnation with populations subjected to precarious living conditions [59]. Under the pretext of providing good life to humanity, the State and companies continue to seek industrialization with an end to energy supply, but it is fundamental that the state and companies recognize poverty as morally condemnable, socially costly and territorially striking and address it with public policies with a view to its eradication [60].

In the rural areas of the Brazilian Northeast, adequate for wind expansion, an environment favorable to the capital of wind power generation and commercialization companies were created. They produce a re-signification of space, where rural spaces gain promising dimensions, driven by capitalism that produces a geographic landscape appropriate to its own dynamics of accumulation [61]. Economic results dissociate from the social set of the territory, since growth is a necessary condition, but insufficient to achieve well-being [3,22]. In this way, the abundance of the wind and poverty are opposed to the global development strategy, which is that of satisfying, simultaneously, the population and the market needs [62].

Thus, energy policy in vogue is in line with the dynamics of contemporary development, which values capital, dominant relations and knowledge appropriation [63]. However, it is essential to bring human dignity, security and social justice to the idea of development. In this way, the qualitative analysis of the population's well-being will become relevant [64]. It is important that, in Brazil, wind projects accompany the successful experiences registered worldwide, such as Quebec (Canada), where compatibilization of community interests and social acceptance are considered for the construction of wind farms [65]. India, interested in the development and concerned about the current pace of the demographic explosion, intends to achieve a technical-economic balance with an emphasis on environmental sustainability. To this end, it prioritizes the use of renewable energies, particularly solar and wind energy sources [66].

Thus, it is imperative to reflect on what degree of commitment wind generation and the sustainable use of energy is inserted in the scope of the policies of the electric sector in Brazil. If there is no compatibility between energy and poverty, there remains the barrier to reducing inequality, which has become a challenge in the 21st century: Achieving sustainability through a technological and economic development model that impacts the environment as little as possible and guarantees human well-being and social equity. How to reach them? Sachs [3] explains that to move in this direction, we must diversify and complexify productive structures and reduce the distances that separate the layers of the population. For Hobsbawm [67], "the rate of development should be reduced to the 'sustainable' in the medium term" and in the long run can strike a balance between humanity and renewable resources.

In the pursuit for the interrelation or not between the terms or concepts that have been giving support to the screen research, theoretical foundations on wind energy, development and poverty were searched. Through a dialogue of the ideas of the authors of this area of studies, it is possible to advance in the theoretical-empirical discussion about the concept of development and progress widely diffused in recent times in the territory of Mato Grande of Rio Grande do Norte. However, the discussion on progress and wind power development is expected to entail connections with multidimensional poverty levels [12,13], which still remain in the wind farms. Wind power has prioritized technical issues of wind efficiency and quality to the detriment of the living conditions and humanity of the urban territories, and above all, of the rural areas where wind turbines are installed [23]. It is known that companies have used and dominated the wind-generating territories [10,68] as a resource that can be appropriated to capitalist accumulation, competing for the areas of winds most suitable for the generation of energy, rather than toward a more prosperous and sustainably developed life [69].

3. Methodology

The study in question is characterized as an exploratory, descriptive and explanatory research, since it was carried out through survey and revision of national and international literature, secondary data collection and field research. This field research was highlighted as a priority because it observed the real environment of the empirical study directly [70,71]. For the survey of the literature, some steps of a systematic review of the literature were considered.

In the first step, digital libraries were visited where articles were searched by keywords or the set of them, namely: renewable energy, wind power, rural poverty and development, observing the written reports that divulge the results of research and the discoveries carried out [71]. The second step consisted of the selection of the studies, the reading of titles and abstracts and the identification of the most relevant publications for the research area. The third step, the writing of the review, was conducted through the inclusion of specialized studies on energy, poverty and development. In this way, the relationship between the conceptual apparatus and the studied problem was established [72,73].

Secondary data were collected from Internet databases, specialized magazines and government information contained in annual reports and official documents (ANEEL, WORLD BANK, EPE, MME, IBGE, IPCC GLOBAL WIND ENERGY COUNCIL, UNDP, IPEA and UN). The information is related to the process of installation and production of wind energy in municipalities in the Mato Grande territory of the State of Rio Grande do Norte in Brazil and articulated with the development scenario of the wind power source in the generation of electric energy. The survey was conducted in 2018, revised in 2019 and based on the relationship between energy and poverty in research and data analysis, as recommended by Laville [72] and Severino [73].

The field research, for which direct observation was chosen, as proposed by Gil [74], occurred in the second semester of 2017 and first of 2018, through technical visits to Asa Branca and União dos Ventos wind farms, located in the municipalities of João Câmara and Pedra Grande, respectively. In an exploratory manner, seeking to analyze the connections between wind energy, poverty and local sustainability, some contacts were maintained with leaders of these two wind farms, who presented a set of actions regarding the social responsibilities of organizations, and, in view of this, some questions were asked, seeking to understand how the following points have been occurring: (i) Relationship of wind farms with the surroundings; (ii) the benefits generated for the population; (iii) job creation; and (iv) environmental impacts, with the implementation of wind farms in these territories.

The rural settlements Modelo II and Maria da Paz, located, respectively, in the municipalities of Parazinho and João Câmara, were chosen as exploratory empirical objects of this research, given the geographical proximity to the wind farms and the acceptance of some household heads to answer some research questions. The questions sought to know the rural settlers' perceptions regarding: (i) Occupation and income; (ii) integration of wind farm versus community; (iii) financial return; and (iv) environmental impacts. The programming was carried out by a group of researchers, who adopted participant observation as a technique, aiming at the dialogue with the researched universe during the visits [71,72].

To elaborate the maps, the ArcGis 10.6 application was used for the processing of information in a GIS environment. The cartographic base consisted of vector files, in Shapefile (SHP), Datum Sigas 2000 formats, linked to the database of the Brazilian Institute of Geography and Statistics (IBGE), the National Institute of Colonization and Agrarian Reform (INCRA), the National Agency of Electric Energy (ANEEL) and the Energy Research Company (EPE). In the first institution, the vectors of the regional, federative and municipal units of Brazil were obtained. In the second, the rural settlements vectors were provided. In the last two institutions that offered applications, such as SINGEL and WEBMAP EPE, respectively, it was possible to download files with the location of Wind farms, Wind turbines and Solar power plants scattered throughout the Brazilian semiarid. The collected data were compiled in the software, using the tools "counting points in the polygon" and "select by location" in order to analyze the spatial distribution of wind turbines and their distance in relation to the coastline. The five, 10 and 25 km (onshore) coastline buffers were created, allowing the identification

of the positioning of the points (wind turbines), to spatially highlight the wind farms in relation to the rural settlements.

Thus, it can be said, to some extent, that the methodologies of the works that were listed in this text included the ideas of social cartography [75], which were direct and participatory observation with some local people, representatives of wind companies and community leaders. According to the authors, social cartography makes it possible to spatially characterize territories that arouse socioenvironmental, economic and cultural interests, as well as to improve understanding of the populations, particularly, the most vulnerable. For the interpretation of the spatial dimension, the cartographic representation favored the choice of the scale of analysis that expresses the ties of geographical proximity between wind farms and surrounding communities.

In order to show that the advance of energy projects is not motivated by the population's lack of access to electricity, Table 1 was constructed, showing the population, GDP and electricity demand relation, as well as the coverage of electric services in the country. As stated by Gil [74], the tables summarize and synthesize data and produce in the researcher and reader clarity of the subject studied. In this way, the methodological aspects considered allowed to present the regional disparities in Brazil and the panorama of the established social gap.

In order to compose the poverty and vulnerability frameworks of the Mato Grande territory, the Atlas of Human Development in Brazil provided the municipal information that was adequate to the problem studied and to the research objectives [74]. In addition, the information extracted from official sites and reports was indispensable in the analysis of the social condition of the rural families. In order to express it, we opted for the data on extreme poverty and vulnerability to poverty in the 15 municipalities of the Mato Grande Region. In order to compose the wind panorama, we decided on the number of plants already projected and in operation. The information gives the nature of the sources the quantitative content, incorporating to the text dialogues with the figures, making the statistical and spatial reading clear and easy to understand [71,73].

Other results of the study are systematized in Table 3, which presents data regarding the number of the resident population, per capita income and the Municipal Human Development Index (MHDI). The Brazilian HDI follows the three dimensions as the Global HDI-longevity, education and income, but goes further: It adapts the global methodology to the Brazilian context and the availability of national indicators [75]. The indicators considered in the MHDI are better suited to assess Brazilian municipalities [76,77]. To classify the MHDI, we consider the summarized measure of the long-term progress in three dimensions: Income, education, and health for human development. Their scales are distributed in: Very low, between 0.000 to 0.499; low, between 0.500 and 0.599; average between 0.600 to 0.699; high between 0.700 and 0.799 and very high, between 0.800 and 1.000 [77,78]. For this publication, we used data from the 1991, 2000 and 2010 demographic censuses, which happen every ten years, provided by the Brazilian Institute of Geography and Statistics (IBGE), and included topics, such as health, education, income, work, housing and vulnerability [78].

Bolsa Família Program is a conditional cash transfer program of the Federal Government of Brazil, which unified and extended previous existing cash transfer programs. To have access to *Bolsa Família* income, groups considered in poverty and extreme poverty are those with per capita income below R$ 85.00 (US$ 20.69) or between R$ 85.01 (US$ 20.69) to R$ 170.00 (US$ 41.38) at a dollar rate on 15, December 2019 [79]. The total beneficiary of the *Bolsa Família* Program in the Mato Grande region summarizes a socioeconomic scenario that characterizes the scarcity of economic and material resources of the population of the 15 municipalities of this region. The calculation of GDP per capita considers the economic dimension of development [80].

4. Results and Discussion

The results of this study show that wind power generation has been, in the current period, a renewable energy source that enjoys high technological development and high economic viability. In the Brazilian territory, it has spread, mainly, from governmental incentives. To this end, the Federal Government of Brazil has cleared import taxes and reduced transmission and technological development costs for large-scale power generation equipment [69,81]. In Brazil, the state of Rio

Grande do Norte became the largest wind power producer with an installed capacity of 3875.55 MW in January 2019, ahead of the states of Bahia with 3591.99 MW and Ceará with 1813.73 MW [82]. Among the incentives for wind generation are the auctions from 2009–2018, whose results favored investments with R$ 20,481,243,810 (US$ 5,307,407.11) [83].

The results of this study indicate that in the state of Rio Grande do Norte, the region of Mato Grande, embedded in the semiarid region, has been the area with the greatest dynamism of production and wind farms. There are 114 plants, totaling 3758 MW of installed capacity, as shown in Table 2. João Câmara and Parazinho are leaders in installed capacity in the state on a municipal scale, surpassed, in Brazil, by the municipalities of Sento Sé (746 MW) and Caetité (730 MW), both located in the state of Bahia.

Table 2. Wind Farms and Power (MW) in the municipalities of the Region of Mato Grande-RN. Source: Authors' elaboration based on Reference [82].

Municipalities	Number of Wind Farms	Installed Capacity (MW)
Bento Fernandes	07	588
Jandaíra	07	281
João Câmara	29	742
Parazinho	22	629
Pedra Grande	13	241
Rio do Fogo	01	493
São Bento do Norte	14	322
São Miguel do Gostoso	10	238
Touros	11	224
Total	114	3758

The results of the research also indicate that the wind farms are onshore producers and are located in the rural area of nine of the municipalities of the region, as shown in Table 2 and represented in Figure 3. These are places linked to technological innovations, through energy companies, which have the wind for conversion into electricity. However, the form that takes the territory is counteracted by the presence of impoverished segments of the population, since the wind power generation has not contributed to change the socioeconomic conditions of the majority of the population, especially low-income families residing in rural settlements. Thus, in the same territory, there is the electricity industry with highly innovative technical progress, renewable energy, and on the other, groups of rural people with serious financial, social and material difficulties, which are typical of poverty. Thus, in this space is a set of contradictions remaining with little or no perspective of overcoming deprivations [6].

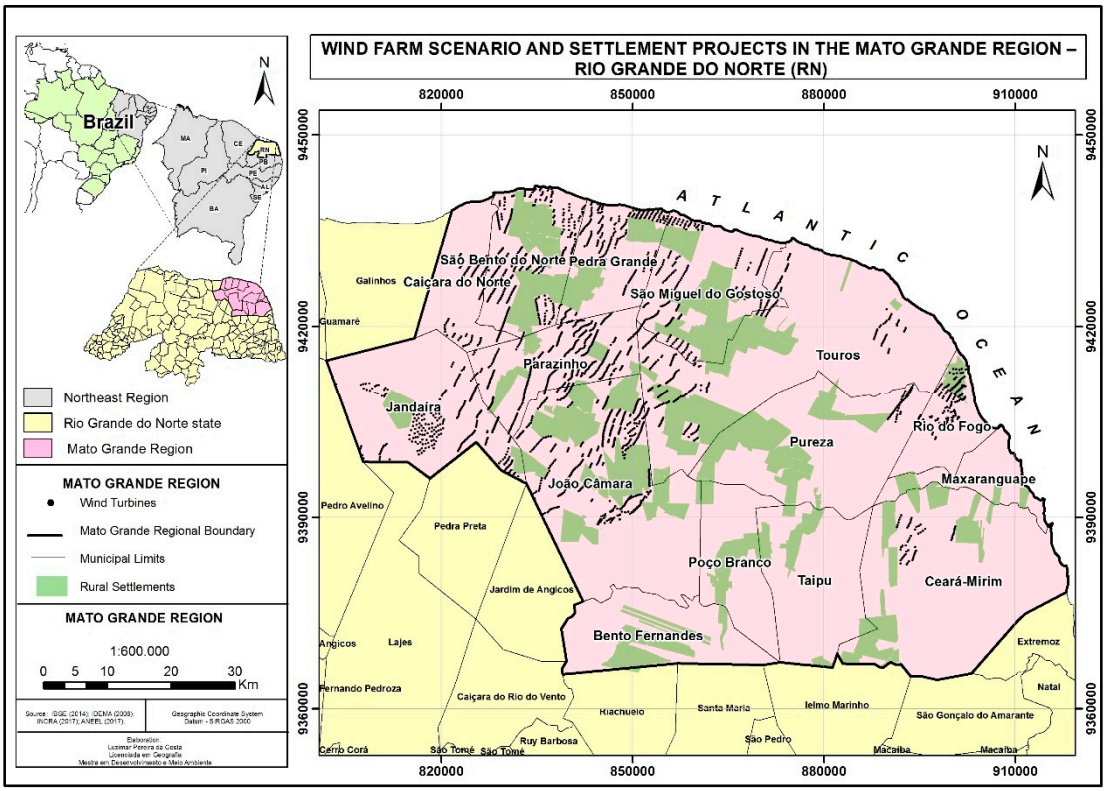

Figure 3. Spatial distribution of wind farms and rural settlements in the Mato Grande RN region. Source: Elaboration of authors from ANEEL databases.

The present study verified the existence and permanence of a kind of unequal and combined spatial division, being, on the one hand, the wind industry with competitive advantages and dynamism typical of its kind, and on the other, urban and rural environments with families in state of chronic poverty and in abandonment [84]. It is clear that development and poverty are intertwined in an antagonistic, extremely unequal condition in which accumulation and misery coexist [85]. This social reality runs counter to what is sought as benefits of access to electricity and the use of local energy resources as a generator of employment and income, since the need to expand electricity supply is part of the drive for energy inclusion, poverty decrease and social inclusion [86].

The Economic Development Strategic Plan of Rio Grande do Norte proposes a long-term strategy deployed in actions for priority sectors; map investment and business opportunities for the private sector; an agenda of public initiatives to positively impact the competitiveness of the state; and the sharing of an investment estimate to achieve strategic goals [87]. According to this Strategic Plan, the state will increase the installed capacity of solar and wind energy, the production and refining of oil, natural gas and thermal energy, being wind power the top of the list of priorities and investments for the intersection 2016–2035. The state projects to reach 13.9 GW of installed capacity for electricity generation, from renewable sources, betting on the high solar incidence and strong winds. In these terms, the wind industry will continue to strengthen in this new market, because it has in hand the dominance of the domestic market and the conditions for generating jobs and income.

Regarding the energy industry, accounted for in the manufacturing industry, in ten years, it has contributed 2368 jobs out of a total of 14,635 jobs from 2006 to 2016 in the municipalities with wind farms, as shown in Figure 4. This occupation record corresponded to the production phase of the engineering infrastructure of the wind farms, offering direct jobs, because it is in this activity that there is great potential for the insertion of local labor from the communities where the wind farm is to be installed [88]. At this stage, there is almost no technical requirement to fill the vacancies provided by the sector, but when this stage is completed, local jobs are reduced considerably. This

piece of data was also verified during the field visits, through the narratives of the community representatives.

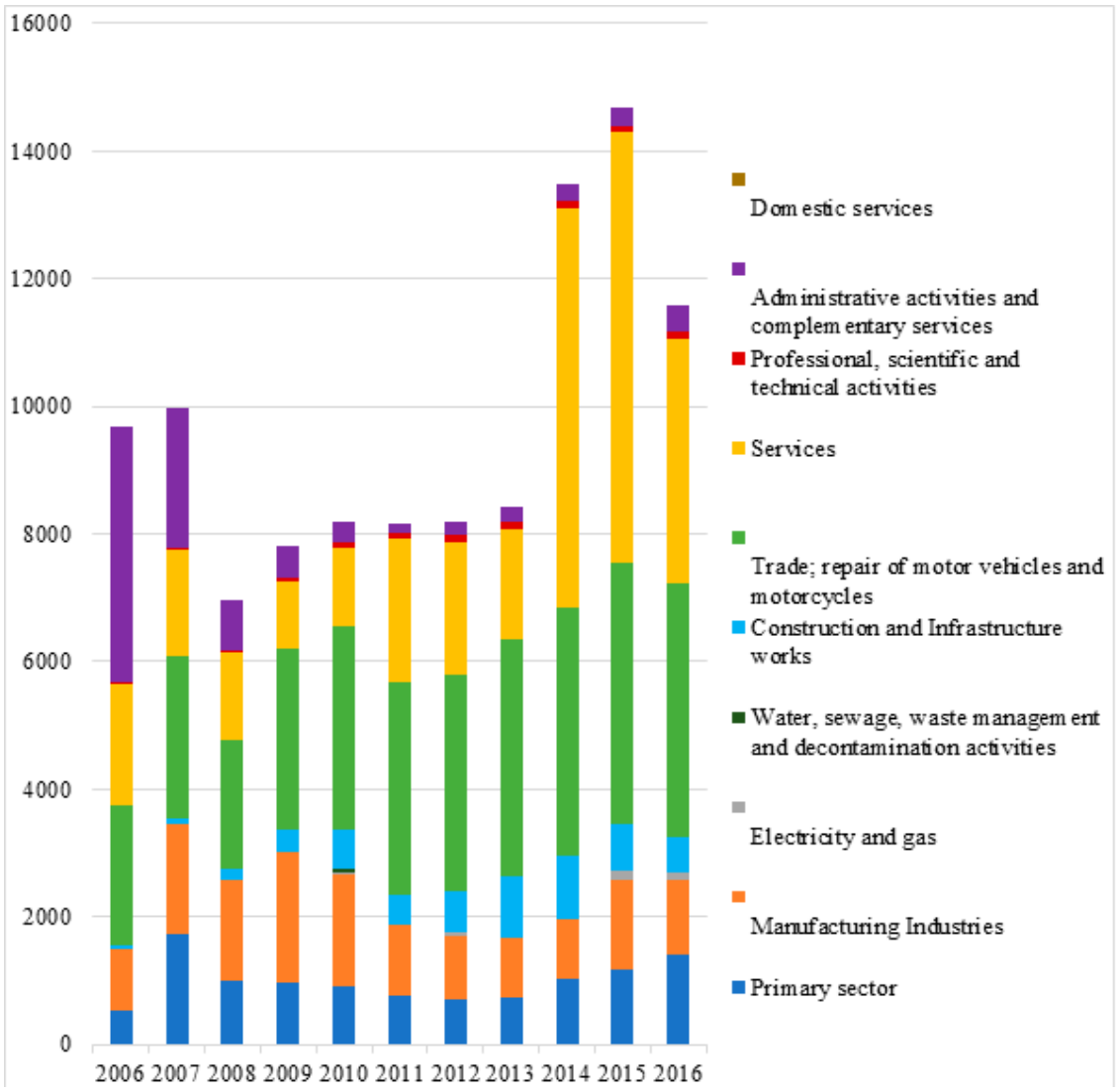

Figure 4. Personnel employed in the region of Mato Grande RN. Source: Authors' elaboration from data taken from IBGE Automatic Recovery System—IBGE/SIDRA.

The conciliation of economic, social and environmental results must be part of the companies' strategy so that, on a local scale, energy facilitates economic development, improves productivity and enables income generation [8]. SDG 7 is related to the energy transition from non-renewable sources to clean renewable sources. However, there is still no clear achievement of 2030 Agenda Goal 8, which has the primary purpose of promoting sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all, towards adequate work and economic growth [4]. Even present for over a decade in the study area, wind energy production has provided little in this direction, as shown in Figure 4., but, above all, in the statements of the interviewees.

The results of the surveys carried out with some wind farm managers, located in Mato Grande-RN, show that the relationship between wind farms and the community and its territory have been limited to mere dialogues with the community people, being restricted to guidelines and special measures to be observed during the stages of production, transmission, distribution and energy consumption. They consider the periodic meetings with the population, to clarify and disclose the schedule of the stages of construction works and make them aware of possible accidents, as benefits generated with the advent of wind farms to the population.

As for the generation of jobs, they emphasize it to be a job-generating activity that impacts on household income, when hiring labor to clean the territorial areas where the wind farms are built (through deforestation, road openings, mainly). It is worth mentioning that job creation, involving the residents of local rural communities, are temporary and low-paid jobs, performed by unskilled people in the production of wind energy. Regarding the environmental impacts generated by the implementation of wind farms, the interviewed representatives assume that they exist, are unavoidable, but are mitigated with actions to combat deforestation and the construction of wildlife escape corridors, provided for in the environmental licensing.

Moreover, the managers mentioned that when there is a manifestation of the guardianship institutions of the settled families about social risk or intervention in the areas of geographical influence of the settlements, they promptly follow the recommendations. However, even questioned, they did not reveal which are the most frequent themes.

Regarding occupation and income, the collection pointed as failsafe monthly household income, rural pensions and income transfer programs, highlighting *Bolsa Família* grant. The collection noted that any additions are acquired with temporary city work, performed by the younger in the family. Cashew nut processing, although precarious, has been an alternative source of income and survival for rural communities in Mato Grande. Following the countryside tradition in the wetter periods, subsistence farming generates surpluses, and thus, small incomes from sales of seasonal produce.

The interviewees stated that although being in the same territory of geographical influence of the companies, there is still no formal bond favorable to the effective coexistence, nor measures aimed at improving the lives of the families surrounding the enterprises, which remain true to the expectations of job and income generation. The survey found that wind farms have not impacted positively yet on health, education and sustainable development of rural communities. Concerning financial return, the interviewees claim it not to exist and also complain about the loss of jobs with the end of the installation works of the enterprises. Furthermore, regarding finances, there is speculation about the future payment of wind power royalties, but there is no official determination about it.

Regarding environmental impacts, most respondents elect as the center of concerns, the suppression of the *Caatinga* vegetation, because animals feed on it, ensuring their survival in periods of drought or prolonged drought. Concerns about the birdlife have been expressed, due to reports of birds colliding with wind turbines or even a decrease in common species in the environment. In the Modelo II Settlement, the presence of bats in the orchard is attributed by the rural farmers to a route deviation of the species caused by the Asa Branca Park wind turbines. Despite the reported, it is valid to say that when establishing Environmental Impact Assessment, environmental issues are considered for the development of onshore wind projects. The CONAMA Resolution 462 of July 24, 2014 [89] updates the need for environmental licensing of power generation projects from the terrestrial surface wind source, with the purpose of risk mapping. However, it has been treated as a very simplified process in the implementation of electric power transmission systems in most of the Northeast coastal and rural wind farms.

However, the counterparts to contain the expected impacts (noise, visual and wildlife impacts) ignore the most severe ones in order to favor new uses of the countryside by energy companies. Moreover, it contradicts the discourse of support for renewable energies worldwide, based on the one that advocates the pursuit of sustainable development. The establishment of wind farms and settlements in the same space configures an intrinsic and complex relationship between nature and society. Availability, intensity and capacity for electricity becomes strategic for companies and conditions for wind farm installation. This space also brings together the largest number of families with access to land from agrarian reform but living in poverty and without inputs for productive activities.

Renewable sources of energy, in particular, wind farms, decisively impact the capital of companies responsible for the generation and distribution of energy in the market. For this, Mato Grande has been incorporated into the global economic system, following the logic of making profits and the new forms of use and appropriation of the territory. However, this dynamism becomes

antagonistic as it does not change the picture of poverty or align with the commitments of the 2030 Agenda, which are the dissemination of an action plan for people, territory and prosperity. It was found in the main testimonies collected from the residents of the two settlements surveyed that the installation of wind farms has not contributed significantly so far to improve the quality of life of the residents nor to the development of these rural communities. The improvements we see from the wind farms, one of the locals said, "are visible only to the owners of the wind farms," the true hegemonic actors of this expropriating and unequal economic activity.

The characteristics of wind energy are conducive to a sustainable trajectory in job creation, and there is even some consensus that renewable energy generates more jobs than fossil energy [88]. The very definition of sustainable development in "Our Common Future" includes employment as the "most basic need". It must meet the aspirations and needs of the population, especially in developing countries [7].

Starting, operating and maintaining renewable energy projects requires a skilled workforce, as the energy sector requires human resources with diverse skills. This need is not met by the workforce in the region studied, but it could be an asset for companies because there is a real need to train more people with basic and specialized technical skills who can contribute to the maintenance of the new infrastructure [90].

As for the primary activities that traditionally account for the occupation of labor in agriculture and livestock, their inexpressiveness in the set of formal jobs of people residing in the municipalities of the Mato Grande territory is observed. In addition, there was a decrease in the number of employed persons between 2008 and 2013, which influenced food production, with inevitable consequences for the survival of the farmer, his family and the community. In this sense, the words of Malvezzi [91] are fundamental, because he states that this situation adds to the progressive scarcity of water and the daily struggle of the hinterland communities to remain in the semiarid territory.

The data analyzed above allow us to infer that there is a prevalence of low MHDI on the scale between 0.500 and 0.599 among the 15 municipalities, as well as some discrepancy in GDP *per capita*, especially among the three largest wind energy producers: João Câmara, Parazinho and Pedra Grande. The number of dependents on the *Bolsa Família* allowance broadens the understanding of the absence of income obtained from work, and consequently, of the presence of the State to guarantee the minimum income, and consequently, the alleviation of socioeconomic deprivation. Thus, reading the data makes it possible to infer that poverty becomes wider and more complete in the municipalities surveyed, and therefore, far from reaching favorable positions in the human development ranking. Therefore, they are also far from 2030 Agenda Goal 3 (SDG), which proposes a safe, healthy life and well-being for all at all ages [4].

To analyze the economic situation of income, we considered per capita household income figures for 2017 for Brazil (US$ 308.64), and Rio Grande do Norte (US$ 205.68). These values allow the observation of a significant inequality and unevenness of the State, as the average production of national income. The state has an unimpressive economic performance and demands more investments, even with the greater capital flow from the wind source.

Regarding the per capita GDP of the municipalities in the region under study, there is a discrepancy between their total values, US$ 1797.97 (Bento Fernandes) and US$ 17,225.00 (Parazinho). However, it is prudent to observe that the highest values are generated in wind power producing municipalities, as shown in Table 3. The analysis allows us to infer that the situation represented by the indicator does not reflect the social reality of the territories, nor even reveals the existence of poverty. In this sense, the income produced by wind activity is not circulating in local economies.

Table 3. Mato Grande Region: Population, per capita income.

Municipalites in *Mato Grande* Region	**Estimate Population 2018**	**GDP Per Capita (US$) 2017**	**MHDI (2010)**	***Bolsa Família* (FEB 2019)**	***Bolsa Família* Benefits Total (US$)**

Bento Fernandes	5469	1797.97	0.582	898	56,501.00
Caiçara do Norte	6537	2265.46	0.574	911	56,832.00
Ceará-Mirim	73,099	2608.85	0.616	7867	310,739.00
Jandaíra	6863	2249.92	0.569	1174	45,148.00
Joao Câmara	34,747	6614.21	0.595	5750	309,320.00
Maxaranguape	12,194	2091.46	0.608	1166	54,272.00
Parazinho	5258	17,225.00	0.549	902	51,819.00
Pedra Grande	3275	15,139.00	0.559	638	42,383.00
Poco Branco	15,294	15,139.00	0.587	1906	98,587.00
Pureza	9516	2550.20	0.567	1566	96,200.00
Rio do Fogo	10,789	2663.44	0.569	1973	117,256.00
São Bento do Norte	2778	13,956.00	0.555	541	23,221.00
São Miguel do Gostoso	9531	8812.02	0.591	1258	64,199.00
Taipu	12,261	2093.07	0.569	1902	81,896.00
Touros	33,734	3912.89	0.572	5002	228,477.00
Total					
Rio Grande do Norte	3,479,010	205.68 household	0.684	354,455	16,085,613.00
Brazil	208,494,900	308.64 household	0.699	13,914,330	635,239,680.00

MHDI, Bolsa Família-HDI Scale: 0.800 to 1.000 (Very High); 0.700 to 0.799 (High); 0.600 to 0.699 (Medium); 0.500 to 0.599 (Low); 0.000 to 0.499 (Very Low). Source: Authors' elaboration from IBGE and the Brazilian MHDI's data.

In addition to the data mentioned above, Figure 5 shows the percentage of vulnerable populations in the 15 municipalities in the Mato Grande region, confirming a scenario of poverty and social deprivation and of situations of exposure to risk or to environmental degradation [92]. It was found that in this region more than half of the population is conditioned by the shortcomings of the low social conditions in relation to obtaining income, schooling, purchasing power, consumption, among others, which remain tolerated by society, despite the profound incompatibility with the current economic order [85].

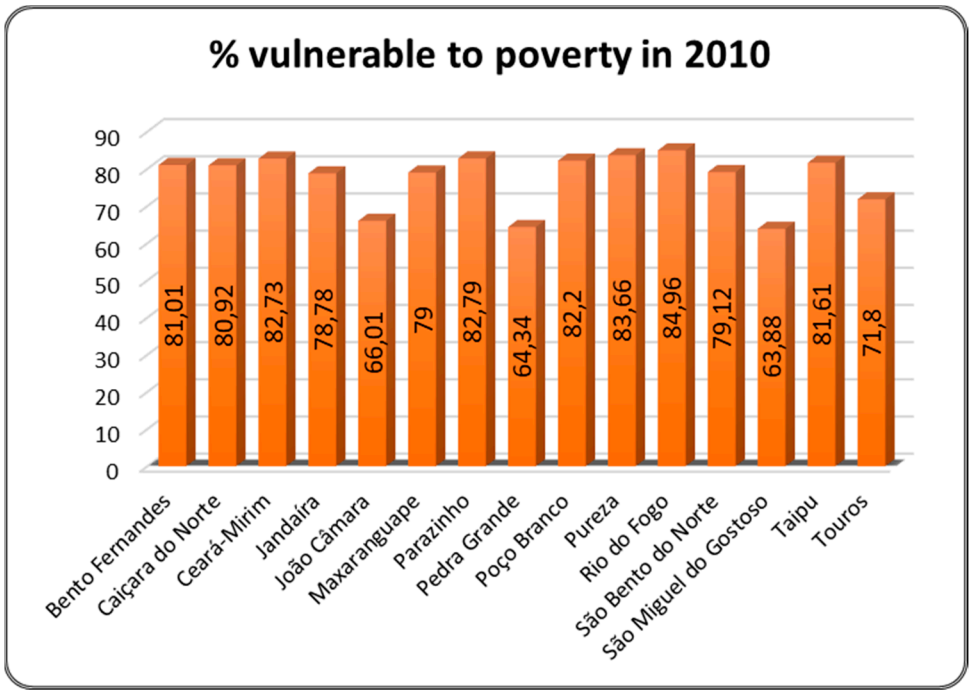

Figure 5. Social vulnerability in the Mato Grande region. Source: Authors' elaboration from the Brazilian Municipal Human Development Index.

In order to analyze the social vulnerability, the multidimensional approach was adopted, considering poverty situations and uncertainties, since politics is no longer a positive reference for the collective ideal [93]. To characterize social vulnerability, it was considered, above all, the problem of poverty beyond income level, even if this be considered as an essential element, along with other complementary means of survival [85]. The analysis also indicates that in the municipalities studied, socio-spatial vulnerability is a geographical expression of the probability of loss of human well-being [94]. It is known that, in Brazil, the panorama of vulnerability and poverty is multidimensional, also providing interpretations on social development, and in these terms, the interpretations of reality become more complex, since it seeks welfare and quality of life beyond insufficiency of income. Hence, there comes the interpretation of poverty through a multiple and varied set of needs of vulnerable groups living in poverty and extreme poverty conditions [95].

All percentages presented in Figure 5 are above 60%, indicating a predominance of people vulnerable to poverty in all municipalities. The results enable the interpretation of the unacceptable panorama of the living conditions of the poorer social groups [92]. These groups end up facing the challenges posed by the vulnerability in which they live, which are expressed in the quality of the housing fabric, the costs of energy and supply, the instability of family income and social and health relations [94]. These are situations of deprivation related to employment, income, rights, demotion or confinement in social or economic spaces, where there is a break in social ties [96].

In relation to the percentages of the populations living in extreme poverty, Figure 6 presents the current situation of the 15 municipalities in the Mato Grande Region. The results show a situation of high deprivation, which deepens with the permanent decrease in the expectations of generating income and employment opportunities [95,97]. The aggravation of social problems makes social justice difficult, since extreme poverty has the potential to be highly destabilizing [98]. Particularly in rural contexts, families living in extreme poverty need to start from their own work, increase food production and income in order to overcome the conditions imposed on them [76]. Otherwise, they will remain "subordinated in society and deprived of the means of providing for their own subsistence" [85].

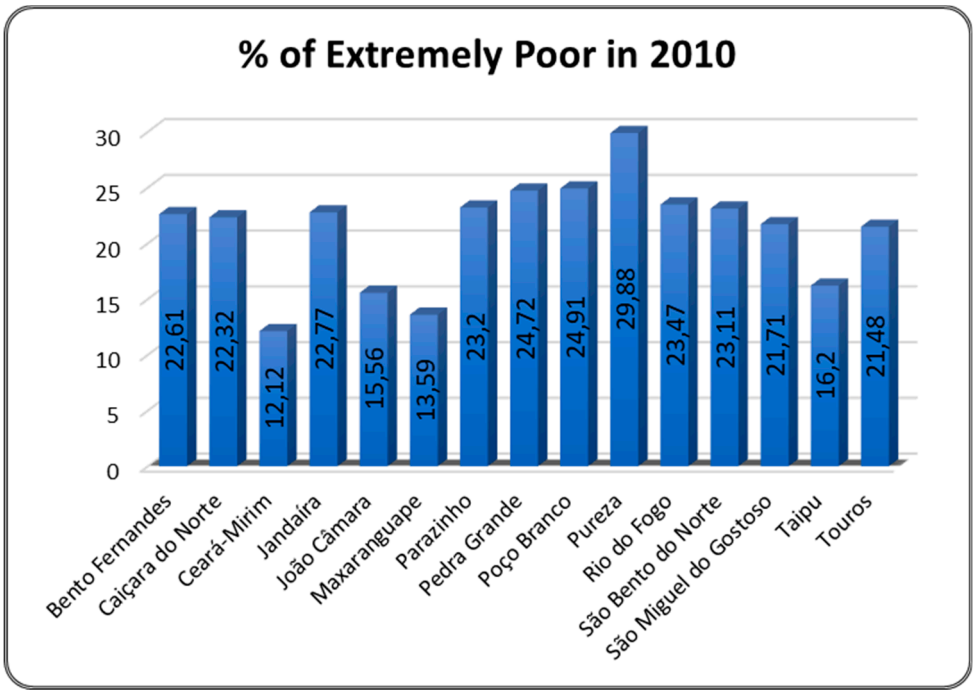

Figure 6. Extreme poverty in the Mato Grande region. Source: Authors' elaboration from the Brazilian Municipal Human Development Index.

The populations of the municipalities that have wind farms in Mato Grande often live with water scarcity, resulting from irregular rainfall and low rainfall, which makes the situation of income and work vulnerability more acute. IPCC [99] points to the land, including its water bodies, as the foundation that fundamentally underpins the supply of food, bioenergy and freshwater. The report warns that water scarcity in drylands contributes to increasing risks of economic loss, declining livelihoods and negative health effects [99]. Even so, families settled around wind farms practice low-impact agriculture and added to their income from work the benefits of pensions, confirming a picture of poverty. Meanwhile, geographic space becomes the appropriation of wind power companies for electricity generation.

It was found that the benefits of wind energy have not led to poverty reduction in its multiple dimensions. This finding runs counter to 2030 Agenda Sustainable Development Goals 1 and 7, which are: Goal 1-End poverty in all its forms everywhere and Goal 7-Ensure access to affordable, reliable, sustainable and modern energy for all [4]. The data show that in the region of Mato Grande, which holds large wind investments, the energy industry has been expanding with technological innovation and prospects for improvements in the world, since renewable energy, from its current conceptualization, is also an area of global interest for achieving sustainable development [38]. However, the populations living in the municipalities of this geographical region live with poverty mishaps and without access to the benefits of wind activity. However, the speeches of public managers and private initiative have been given by the bias of job and income generation and local development [100] which are not materialized in the study region.

The benefits of adopting renewable sources, in line with the determinants of sustainability, are pointed out as incoherent by Harjanne and Korhonen [101]. The authors consider that from the perspective of promoting sustainability to the distributed nature of wind power, local communities can take advantage of wind resources in their own benefits, such as generators or local energy suppliers. However, social reality has shown that technological complexity, market interests and necessary investments prevent the communities from accessing the benefits of renewable energy.

It was exemplified by Hager and Stefes [102] and Harjanne and Korhonen [101] that even in rich Germany, the economic benefits from wind power expansion were appropriated by the portion of the population with the highest income, with the lowest purchasing power groups remaining

unrelated to the process. In this context, renewable energy, like the wind power source, has limitations, to the point where the authors propose abandoning this concept.

It was also verified through this research that, to date, few connections have occurred between the progress of energy production in the territory of Mato Grande of Rio Grande do Norte and the longings for prosperous and lasting well-being to all who live in this space cutout. The unfavorable picture of poverty exposes limitations to the subspace studied here, which continues to claim for welfare, especially in the municipalities producing wind power (Table 3), with low MHDI (0.500 to 0.599), which are the territories with the greatest geographical influence of the wind farms.

It has been demonstrated in the secondary data that the production of electricity from the wind power source has the potential to contribute to increasing wealth and promoting development. That is why "it is so important to recognize the crucial role of wealth in determining our conditions and quality of life" [13]. In many developing countries, such as Brazil, which is part of the BRICS (Brazil, Russia, India, China, and South Africa's emerging national economies), increasing wealth has not resulted in poverty reduction because the benefits generated by this wealth are not properly distributed. In this way, it is inferred that the type of policy practiced-with emphasis on the supply of electricity, ignores the essential issues of full development, such as employment and income, and consequently, what comes from it [22]. The recognition of poverty and inequality must be the objective of public policies and must be directly related to the availability of energy [103].

The information resulting from field visits deals with knowledge of reality in real time, as recommended by Yin [104]. The pieces of information concern the perception of the families, regarding the wind sector. Families recognize the importance of wind activity and how high the financial return for companies should be. The families also have clarity about the short period of jobs generated with the installation of wind turbines and how the impact on the income obtained from temporary work is brief. They recognize how the companies have the means to implement socioeconomic and environmental benefits, but there are no concrete actions yet. Thus, we reflect that without a network of solidarity among the local productive sectors, local sustainable development is not generated [100].

In the analysis, another important point concerns the recognition of a greater impoverishment of the families who cannot continue with the practice of traditional agriculture, due to lack of water, marked by the drought. Family farming, especially in semiarid regions, represents the social, economic and productive model of survival and income generation for Brazilian society [105]. Traditionally, family farming represents the key to the rebirth of people's well-being in rural areas, but their permanence depends on a technical project and on a strategy that really changes the social reality of the region [91]. Without the practice of agriculture, the final income of rural families is reduced to rural pensions, *Bolsa Família* allowance and the action *Garantia-Safra* (Harvest-Guarantee Social benefit that guarantees to the family farmer a pecuniary aid, for a period, if the family loses its harvest, due to the phenomenon of the drought or of the excess water). These facts are a clear sign of the material and financial deprivation of the populations of the surveyed municipalities.

According to the narratives of community representatives, there is an expectation that soon companies will pay royalties for the electricity generated in wind farms. The population knows the legal impediments, since they occupy collective lands, but they keep the dream of the substantial improvement that can happen through remuneration paid by the wind sector for the use of the land in the territory of Mato Grande. In the federal parliament, the Constitution and Justice Commission estimates payment of royalties in wind energy exploitation, claiming that wind farms demand large territorial areas, limiting the performance of other economic activities in the same geographic spaces [106]. However, the proposal only deals with admissibility, requiring time for its implementation, if it occurs, and keeping the experienced uncertainties.

While visiting wind farms, there were identifications through the narratives of their representatives that the relationship or contact between the sector and the surrounding communities are formal, and they consider the inclusion of communities in social and environmental projects. The relationship is foreseen in the technical constraints and in the legal obligations, which are strictly respected. They emphasize that the operation of the wind farms is authorized by the environmental

agency, under rigorous Environmental Impact Study. In addition, they believe that the promotion of social investments is oriented to the local reality, but they admit that the actions are punctual.

However, it was verified that the contact between representatives of the companies and of the communities in their surroundings is superficial and of indifference. There is silence from the representatives regarding the conditions of poverty and vulnerability of most of the local society. There were no allusions or even mentions about proposals for long-term and consistent actions for coexistence in the semiarid region that, for climatic reasons, punish the poor, but for the same reasons, favor the formation of a region with abundant winds favorable for electric generation. Therefore, there are no projects that foster a cycle of sustainability, which can generate employment and income, or even act in the availability of water supply for family agriculture in order to reduce the more severe impacts of poverty. The absence of these initiatives prevents effective changes in welfare and conditions the permanence of disengagement between the wind industry and its neighbors. Despite all that, the field research data were obtained through eighteen participant families of two rural settlements and through teams of representatives of two wind farms, all of them agree that wind energy generation may be a possibility of creating community welfare and development in the semiarid.

Brazil´s Demographic Census is a statistical study concerning the life of the Brazilian population in several aspects and carried out every ten years by IBGE. The last one was held in 2010. The publications with the results of poverty and vulnerability refer to data from Brazil's last Demographic Census. They are indicative of the life of deprivations to which the poorest local populations are subjected. In the 15 municipalities surveyed, the resources accessed by the *Bolsa Família* Program represent the guaranteed income-in many cases, the only-of the registered families. In addition, the permanence of poverty in a context of the development of energy activities, in a territory where access to electricity services is already guaranteed to the population, requires new development strategies.

5. Conclusion

It is concluded that the production and the development of wind energy, aimed at the distribution or transmission of energy by the SIN to all Brazilians, have grown at an exponential rate. This development has occurred, above all, in the rural territories characterized by information technology innovations where extreme poverty is more visible in current time. In Rio Grande do Norte, and particularly, in the Mato Grande territory, the projects of a generation and use of wind energy contemplated the private interests, regarding the prominence of the capital of the wind companies in detriment of a development project with sustainability in the social, economic and environmental dimensions.

From the installation of hundreds of wind energy enterprises to the end of this piece of research, it has been observed that there were no effective benefits to the well-being of the families, mainly of those living in their surroundings. It was also verified that the wind sector in Rio Grande do Norte occupies, in a greater number of units, agrarian territories of a region with a very complex semiarid environment, where a high degree of distance from public policies persists, and there is much poverty what, in its turn, demands investments and intervention projects in order to change the reality of its population. In this environment, there is a big opportunity to change the face of poverty and renewable energy offers tax conditions to be used in favor of the population of the municipalities and communities where the enterprises are located.

In Brazil, the concept that social responsibility is the obligation of governments to honor corporate taxes is still alive. Despite this, there is already a scenario of change through examples of corporate social responsibility, albeit incipient. Brookfield Renewable Energy, adopts lines of action, aiming at inclusive and sustainable production, the use of solid waste and the management and safety of water resources; Voltalia, with a wind farm in the Serra do Mel-RN municipality, also manages investments oriented to water and income. To realize their projects, these companies understand that in addition to generating profit, they must consider the well-being of employees, the quality of life of communities, the ethical relationship with suppliers and governments. Thus, it is hoped with these examples, and especially, with the results of studies, such as this, may contribute to social and environmental

development programs in the research space, leading to positive consequences, such as the generation of jobs, income and for the well-being families in the community.

By analyzing the used territory of Mato Grande, through objects and actions, the research highlighted the antagonistic relationship between wind energy and poverty and concluded that renewable energies favor new job opportunities. However, given the greater flow of capital in the current technical information period, it is expected that entrepreneurs will define a program capable of improving the environment and the local development. Thus, significant advances are expected to change the rural socioeconomic situation of this space inhabited substantially by low-income families.

In order to change this scenario, it is fundamental to promote broader and more effective participation of the populations that inhabit the environment of wind projects in order to allow a more equitable distribution of economic gains. The change will happen when a new correlation is created between the actors involved and the local communities. For this, the socioenvironmental projects should recognize the work potential and income-generating capacity of families living in a context of poverty and social vulnerability. The lessons learned in this study allow us to affirm that the decision to progressively develop renewable energies, and particularly, wind energy is a political fact. Therefore, the problems that suffocate the communities surrounding the wind farms deserve to be included in their projects.

For the time being, the energy policy model does not conciliate the economic results with the deprivation situation of the populations and its continuity will maintain the social fabric that involves energy and poverty in a perverse relationship that the world seems to abominate. Its discontinuity may be in the shift from the theoretical conception of renewable energy, seen as the driving force behind clean development, to be the key to the economic and technological development with social inclusion.

Thus, considering the research data to express the possibilities and the limitations for the development of the Mato Grande territory with rich, energetic potential, it was verified the pertinence of the subject and its relevance for the public policies that need to re-signify the space of the wind farms. Wind energy and poverty data are conflictive, and the variables explain the coexistent antagonistic condition between the wind power industry and the rural population settled in the main electric energy generation region in Rio Grande do Norte.

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