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# Territorial Normatization , wind Energy and Unequal Spatialization of the Impacts of Wind Energy Around the World: A Systematic Review

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## Abstract

In this study, we start from the hypothesis of the unequal spatialisation of the impacts generated by the territorialisation of wind farms, arguing that the expansion of wind energy, despite its sustainability discourse, reproduces socio-economic and environmental inequalities. To examine this issue, a systematic literature review was conducted using the PRISMA method, comparing the impacts of wind energy between developed and developing countries. The results indicate that the negative impacts, particularly socio-economic ones, are concentrated in the Global South, in countries such as Mexico, Brazil, India, and Colombia, where weak environmental regulations and asymmetric power relations favour the interests of large energy conglomerates. While in developed countries wind energy contributes to boosting local economies, in developing nations it predominantly results in processes of dispossession, abusive contracts, environmental degradation, and the exclusion of communities from decision-making processes. Finally, we interpret this process as a form of green colonialism, aimed at maintaining capital accumulation and reproduction through the exploitation of wind resources. As with previous forms of colonialism, green colonialism imposes an external model of exploitation, disregarding local territorialities. It is concluded that a just energy transition requires democratic participation and regulatory frameworks that ensure the equitable distribution of benefits, preventing wind energy from becoming yet another mechanism of accumulation by dispossession.


**Keywords:** Wind energy, territorialisation, systematic review, green colonialism, energy transition, energy justice.

# 1. Introduction

The demand for energy has been growing all over the planet in recent years. Between the 1980s and 2010s, the world economy grew by 3.3% while demand for energy increased by 3.6% (Saidur et al., 2011). In view of this scenario of pressure on natural resources, especially fossil fuels which represent more than 80% of the world's energy mix, the promotion of an energy transition for renewable energy sources has become essential in today's global scenario, especially due to climate change and global warming. In this context, wind farms have emerged as a promising alternative, as they produce energy from a renewable source. However, the territorialization of these parks comes with a variety of social and environmental impacts, both positive and negative, which I seek to investigate in this article. To do this, I carried out a systematic analysis of the literature based on the PRISMA method on the impacts of wind farms around the world. The time frame of this research is between 2010 and 2022. The year 2010 represents the beginning of the boom in wind energy production, stimulated by the effects of the 2008 economic crisis and the spatial reorganization of capital around the world.

I'm starting from the idea that the advance of renewable energy production is one more way of standardizing territories in order to accumulate capital. In this article, I work from the perspective of the territorialization of wind farms. The territory, understood as a fraction of space delimited by and based on power relations, resulting from the spatial transformations and adjustments of capitalism (Raffestin, 1993; Harvey, 2006; Fernandes, 2008; Saquet, 2011), is the most appropriate category of spatial analysis for this research. The territorialization of wind farms is taking place on the basis of a correlation of forces that is being presented as unequal, supported by the standardization of territories by public and private agents. Territorialization is understood here as a process, a movement that takes place over time and space, the result of disputes that culminate in the formation of territories. For example, our analysis identified the majority of impacts in the United States (33) and Brazil (20). In the United States, 42.4% of these impacts were categorized as socio-economic synergies, whereas in Brazil, only 25% of the identified impacts fell within this category. Conversely, 40% of the impacts in Brazil were associated with socio-economic trade-offs, compared to only 9% in the United States. Regarding environmental impacts, the indicators between the two countries were relatively similar. In the United States, 3% of the impacts were classified as environmental synergies, while 45.4% were associated with environmental trade-offs. In Brazil, no environmental synergies were identified in relation to the territorialization of wind farms, and approximately 35% of the impacts were linked to environmental trade-offs.

## 1.1 Materials and Methods

The aim of this part of the work is to identify, through a systematic literature review based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) method (Moher et al., 2009; Kapsar et al., 2019), the impacts produced by the territorialization of wind farms around the world. The PRISMA method is a tool adopted in systematic literature review procedures through the adoption of a checklist and flowchart (figure 1) that assists researchers in the appropriate inclusion of relevant studies and in the clear presentation of the search, selection, eligibility and inclusion processes of the articles analyzed. As it is a systematic and reproducible review, this tool enables peer review of the results and guarantees methodological transparency.

The PRISMA checklist provides a structured approach to conducting systematic reviews. Its components ensure that all stages of the research process are considered, from the initial identification of studies to the synthesis of results. In this study, the checklist played a crucial role in maintaining a transparent and replicable methodology. By clearly defining eligibility criteria, search strategies and data extraction methods, the review minimizes bias and ensures that all relevant studies are included.

As a data source, I used articles indexed in the Web of Science (WOS) database, covering the period from 2010 to 2022. This database was chosen because of its extensive coverage of peer-reviewed journals and its relevance to the environmental and social sciences. Initially, 169 articles were retrieved using three specific keyword combinations: 'Impact of wind energy', 'Impact of wind farms' and 'Impact of wind energy'. These keywords were applied to all of the repository's research domains to ensure comprehensive coverage. The search was carried out until January of 2023 and the resulting dataset was subjected to an exhaustive selection process.

The initial search produced a diverse set of studies, covering different geographical regions, methodologies and domains of incidence. This diversity underlines the global nature of the impacts of wind farms and highlights the importance of carrying out a systematic analysis to synthesize these findings into coherent patterns. The decision to use WOS as the main database ensured a high level of academic rigor, while providing access to a wide range of disciplines relevant to the topic.

The screening process was guided by the eligibility criteria outlined in the PRISMA checklist. Publications were included if they met the following conditions:

1. Published in English.
2. Peer-reviewed and indexed in the Web of Science.
3. Published between January 1, 2010, and December 31, 2022.

This rigorous screening ensured that only high-quality studies relevant to the research objectives were included. After the initial triage, six duplicate articles were identified and removed, leaving 163 unique studies. In the next stage, the abstracts of these studies were reviewed to assess their relevance to the research focus. Seven articles were excluded because they were not open access, further reducing the dataset to 156 articles.

The exclusion of these articles was based on their inability to meet the core objectives of the review, such as analyzing the social and environmental impacts of wind farm territorialization. Of the remaining 156 articles, 87 were further excluded as they focused on unrelated technical issues or theoretical frameworks. This left a total of 69 studies that directly addressed the research question.

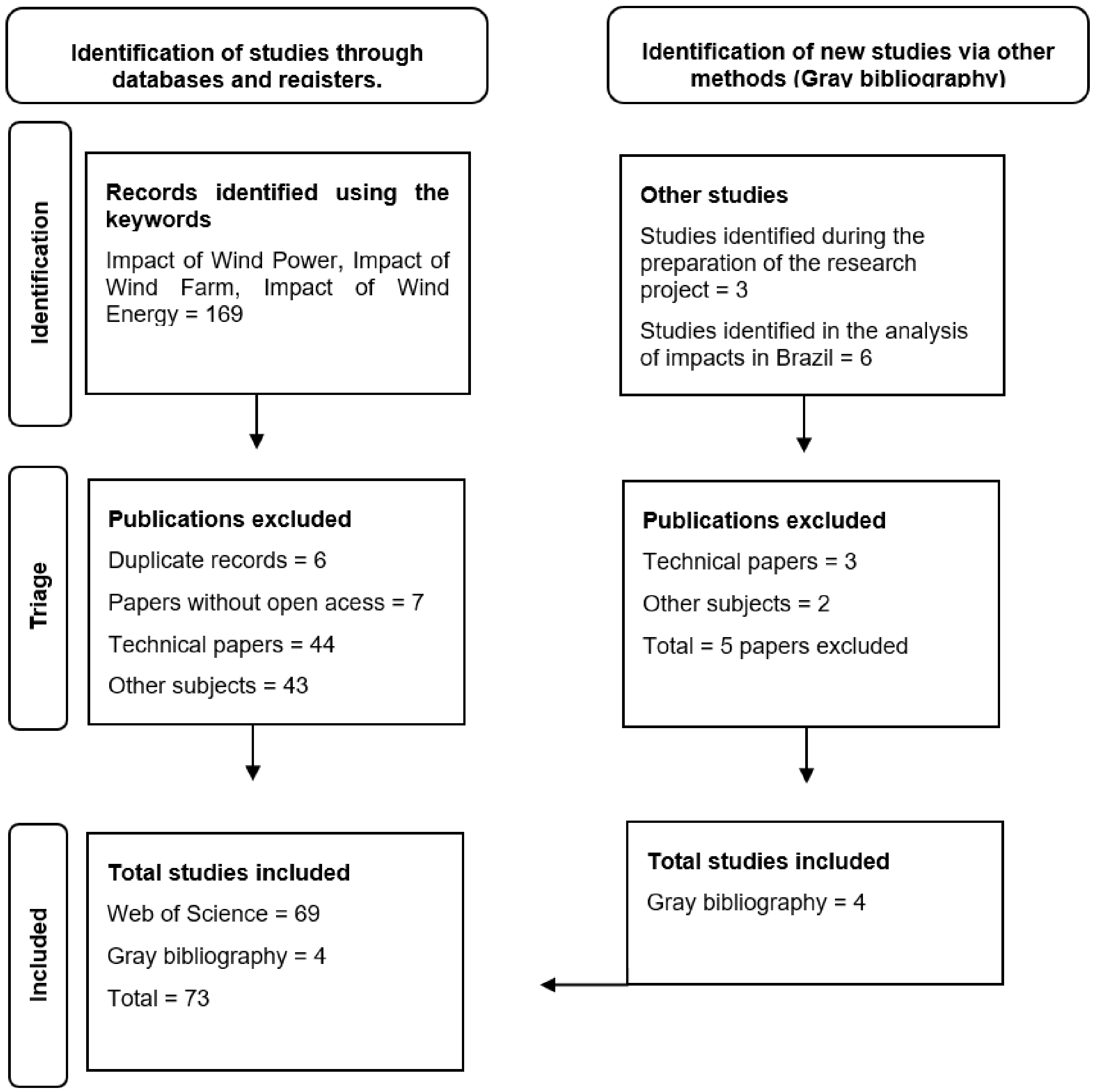


*Figure 1: World - Systematic review of the impacts of the territorialization of wind farms - 2010 - 2022.*
*Source: Organized by the author based on Web of Science, 2023.*

The data collection process involved organising the selected articles in an Excel spreadsheet to facilitate the meta-analysis. The main information extracted from each study included the year of publication, the focus of the study, the spatial scale of the analysis, the types of impacts identified and their frequency of occurrence. This structured approach allowed for a comprehensive synthesis of findings, highlighting patterns and disparities in the impacts of the territorialisation of wind farms in different regions.

A particularly noteworthy aspect of the data collection was the identification of trends over time. For example, the number of studies focusing on the impacts of wind farms has kept pace with the expansion of installed wind energy capacity around the world, especially following the global commitments made in the 2030 Agenda, the Paris Agreement and the quest for energy transition from fossil fuels to a renewable matrix. This time trend provides valuable information on how the academic community has responded to political and technological developments in the field of renewable energy.

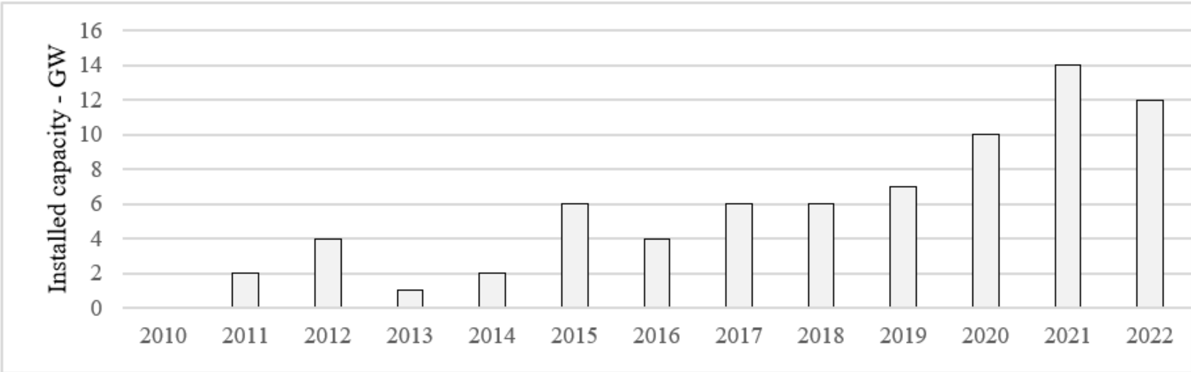


*Figure 2 - Installed wind energy capacity worldwide (GW) - 2010 – 2022*
*Source: Organized by the author based on Statista, 2023.*

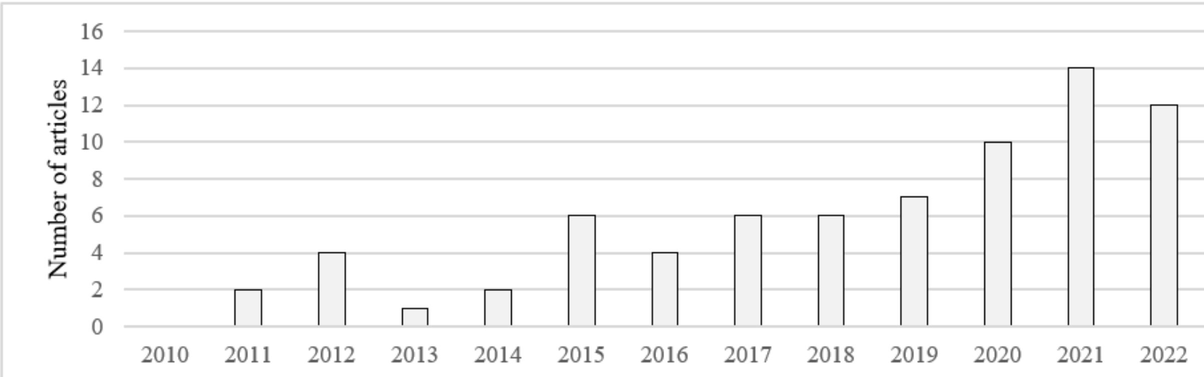


*Figure 3 - Articles Published on the Impacts of Wind Farm Territorialization Worldwide – 2010-2022*
*Source: Organized by the author based on Web Of Science, 2023.*

The rationale for this study is rooted in the scarcity of research addressing the unequal spatialization of wind farm impacts. Existing literature often focuses on specific aspects of wind energy development, neglecting the broader socio-environmental implications. This review aims to bridge this gap by validating the hypothesis that the impacts of wind farm territorialization vary significantly between developed and developing countries. The objectives include producing data visualizations, such as tables, graphs, and maps, to illustrate these disparities.

The systematic review identified distinct patterns in the impacts of wind farms. In developed countries, research has predominantly focused on environmental impacts, such as disruptions to bird and bat populations and changes to local microclimates. These studies have generally adopted a narrow scope, analysing specific issues without considering their wider socio-environmental context. On the other hand, studies from developing countries have adopted a more holistic perspective, addressing a wide range of impacts, including land conflicts, deforestation and displacement of local communities.

Social and environmental impacts.

Positive impacts:

- Job creation and economic growth at a regional level.

- Contributions to renewable energy targets and reduction of carbon emissions.

Negative impacts:

- Environmental: loss of habitat, disturbance of wildlife populations and changes in the microclimate.

- Social: Land use conflicts, displacement of communities and reduced access to natural resources.

The uneven distribution of these impacts highlights the need for context-specific policies to deal with the challenges associated with the territorialisation of wind farms. Furthermore, the analysis revealed that the positive impacts are generally concentrated in developed countries, while the negative impacts disproportionately affect developing nations, especially the positive socio-economic impacts which have greater synergies in countries that are central to the economic mode of production than in peripheral countries.

The review acknowledges several limitations, including the reliance on English-language studies and the exclusive use of the Web of Science database. While these criteria ensured the quality and relevance of the included studies, they may have excluded valuable research published in other languages or indexed in local repositories. Additionally, the focus on peer-reviewed articles may have overlooked insights from non-academic sources, such as government reports and community case studies.

Another potential source of bias is the variability in research focus between developed and developing countries. In developed countries, the emphasis on technical and environmental issues may reflect the priorities of funding agencies and research institutions. In contrast, the broader scope of studies in developing countries may be driven by the complex socio-environmental challenges associated with wind farm development in these regions.

Finally, I carried out an analysis of the synergies and trade-offs, based on the relationship between positive and negative impacts, between SDG 7 of the UN's 2030 Agenda and other SDGs on this agenda. In other words, the level to which the impact of the territorialization of parks produces synergies or trade-offs with the goals necessary to achieve the other SDGs. The organization of this data has a quantitative aspect, since I measured the frequency of the impacts that were investigated in the studies I analyzed in this review, but also a qualitative aspect, since it was up to the researcher to designate the synergies or trade-offs based on the impacts verified in the articles listed in Table 1.

*Table 1 - World - Synergies and trade-offs between SDG 7 and other SDGs*

| | **References** | |
|---|---|---|
| **SDGS** | **Synergies** | **Trade-offs** |
| 1 | Brow et al., 2012; Huesca-Pérez et al., 2016; Castleberry e Greene, 2017; Copena et al., 2019; Frate et al., 2019; Jenniches et al., 2019; Faturay et al., 2020; Costa e Veiga, 2021; Pavlowsky e Travis, 2021 ; Oliveira et al., 2022; Shoeib et al., 2022; Vasconcellos e Couto, 2022. | Delicado et al., 2013; Huesca-Pérez et al., 2016; Gawande e Chaudhry 2019; Mueller e Brooks 2020; Costa e Veiga, 2021; Urziceanu et al., 2021; Oliveira et al., 2022; Vasconcellos e Couto, 2022. |
| 2 | Siedersleben et al., 2018; Pavlowsky e Travis, 2021; Shoeib et al., 2022. | Gawande e Chaudhry 2019; Mueller et al., 2020; Urziceanu et al., 2021; Oliveira et al., 2022. |
| 3 | Qiu et al., 2022; | Botterill e Cockfield, 2016; Josimovic et al., 2021; Nguyen e Thanh, 2022. |
| 6 | Não identificado. | Gawande e Chaudhry 2019; Luo et al., 2021; Wang et al., 2022. |
| 8 | Brown et al, 2012; Jenniches et al., 2019; Costa e Veiga, 2021; Vasconcellos e Couto, 2021; Oliveira et al., 2022; Shoeib et al., 2022; | Costa e Veiga, 2021; Vasconcellos e Couto, 2021; Oliveira et al., 2022. Sobrinho Júnior et al., 2021 |
| 10 | Brown et al, 2012; Huesca-Pérez et al., 2016; Okkonen e Lehtonen, 2016; Castleberry e Scott, 2017; Copena et al., | Mueller et al., 2020; Costa e Veiga, 2021; Saethorsdottir et al., 2021; Oliveira et al., 2022; Sobrinho Junior et al., 2022; Santos et al., 2022; |

| | References | |
|---|---|---|
| SDGS | Synergies | Trade-offs |
| | 2019; Frate et al., 2019; Jenniches et al., 2019; Faturay et al., 2020; Costa e Veiga, 2021; Shoeib et al, 2021; Vasconcellos e Couto, 2021; Oliveira et al., 2022; Shoeib et al., 2022; | |
| 11 | Brown et al, 2012; Agha et al., 2015; Castleberry e Scott, 2017; Siedersleben et al., 2018; Gao et al., 2019; Jenniches et al., 2019; Costa e Veiga, 2021; Li et al., 2021; Stergiannis et al., 2021; Vasconcellos e Couto, 2021; Qiu et al., 2022; Ruan et al., 2022; Shoeib et al., 2022; Wang et al., 2022; | Delicado et al., 2013; Diffendorfer e Compton, 2014; Huesca-Pérez et al., 2016; Scherhaufer et al., 2017; Miller e Keith, 2018; Wang et al., 2019; Mooney et al., 2020; Mueller et al., 2020; Bahramian et al., 2021; Costa e Veiga, 2021; Li et al., 2021; Shoeib et al, 2021; Urziceanu et al., 2021; Sobrinho Junior et al., 2022; Qin et al., 2022; |
| 14 | Scheidat et al., 2011; | Scheidat et al., 2011; Pearce-Higgins et al., 2012; Siedersleben et al., 2018; Mooney et al., 2020; |
| 15 | Pearce-Higgins et al., 2012; Agha et al., 2015; Copena et al., 2019; Luo et al., 2021; Ferrer et al., 2022; Good et al., 2022; | Perrow et al., 2011; Lucas et al., 2012 (a); Lucas et al., 2012 (b); Pearce-Higgins et al., 2012; Diffendorfer e Compton, 2014; Lebeau et al., 2015; Hernandez-Pliego et al., 2015; Millon et al., 2015; Valença e Bernard, 2015; Bastos et al., 2015; Farfan et al., 2017; Lopucki et al., 2017; Scherhaufer et al., 2017; Smith et al., 2017; Tang et al., 2017; Davis et al., 2018; Sebastian-Gonzalez et al., 2018; Millon et al., 2018; Fernandez-Bellon et al., 2018; Gawande e Chaudhry 2019; Wang et al., 2019; Chipps et al., 2020; Lemaitre e Lamarre, 2020; May et al., 2020; Marques et al., 2020; Smith et al., 2020; Zhao et al., 2020; Li et al., 2021; Luo et al., 2021; Turkovska et al., 2021; Proett et al., 2022; Qin et al., 2022; Santos et al., 2022; Wang et al., 2022; |

*Source: Organized by the author based on Web of Science, 2023.*

## 2. Results

From the systematic review of the literature on the impacts of the territorialization of wind farms around the world, I found that the large majority of the 73 studies were dedicated to analyzing a specific impact. Other studies had a more holistic perspective and looked at more than one type of impact (Roy e Traiteur, 2010; Scheidat et al., 2011; Lucas et al., 2012a; Pearce-Higgins et al., 2012; Meireles, 2011; Hernandez-Pliego et al., 2015; Zhao et al., 2015; Botterill e Cockfield, 2016; Tang et al., 2017; Farfan et al., 2017; Sebastián-González et al., 2018; Nunes et al., 2019; Gao et al., 2019; Gawande e Chaudhry, 2019; Luo et al., 2021; Vasconcellos e Couto, 2021; e Shoeib et al., 2022). These impacts were organized and classified as shown in Table 2:

*Table 2 - World - Classification of the impacts analyzed.*

| Group | Principal impacts checked | |
|---|---|---|
| | **Positive impacts** | **Negative impacts** |
| Impacts on bird population dynamics. | Reduction in the number of natural predators. Reduced mortality of some species. | Increased mortality of several bird species due to collisions with wind turbines. Impacts on the migratory flow of some species. Reduction in species diversity in areas close to wind farms. |
| Impacts on bat population dynamics. | Reducing bat mortality by adopting mitigating measures such as switching off turbines during periods of low wind intensity and acoustic dissuasion to keep some species away from areas with wind farms. | Increased bat mortality from collisions with wind turbines. Reduction in species diversity near wind farms. Forced migration of some species to other areas. |
| Impacts on the population dynamics of other fauna species. | An increase in the population of some species in areas close to offshore wind farms because of the reef effect around the towers, which generates more food for some species. | Increased mortality of some species. Forced migration of some species due to reduced food supply and/or an increase in the population of natural predators. |
| Impacts on land use and cover. | Creation of protection areas in vulnerable environments near wind farms. | Suppression of native vegetation and forested areas during the process of construction the parks. Impacts on the growth of some vegetation species, especially native ones. Impact on the population of endangered species. |
| Impacts on the microclimate. | Night-time surface heating can be a protective factor against frost in agricultural areas. Improved air quality in areas with a high concentration of wind farms that have advanced in the energy transition process. | Increase in land evapotranspiration. Impacts on local atmospheric dynamics with changes in wind direction and intensity. |
| Socio-economic impacts. | Increased per capita income in areas where parks have been installed. Increased tax collection and local economic dynamics during the construction period. Temporary increase in jobs during the construction period. Maintenance of other economic activities, especially in rural areas, due to the income extracted from leasing the land. | Creation of low-skilled and temporary jobs for impacted communities. Procedural injustice and lack of transparency on the part of the companies. Impacts on tourist activity in some locations. Increased conflict between areas that receive land leases and areas that receive no value. Contracts with abusive clauses and power concentrated in the hands of the companies. Invasion and land grabbing, especially of rural and traditional communities. |
| Impacts on human health. | Not checked. | Increase in psychological disorders, nausea, dizziness due to the noise of the parks and increase in the occurrence and/or aggravation of respiratory problems during the construction of the parks. |

*Source: Organized by the author based on Web of Science, 2023.*

In relation to the impacts on bird population dynamics, the negative effects are mainly related to increased mortality due to collisions with wind tower blades (Lucas et al., 2012b; Bastos et al., 2015; Sebastián-González et al, 2018; and Schippers et al., 2020), the forced migration of species to areas far from wind farms (Fernandez-Bellon et al., 2018; Zhao et al., 2020; and

May et al., 2020) and the loss of biodiversity of some species (Farfan et al., 2017; and Gawande and Chaudhry, 2019).

Social and economic impacts were analyzed in 26 articles. In these studies, the increase in individual income, related to the leasing of land for the installation of parks, and the increase in job creation, especially during the construction period (Roy and Traiteur, 2010; Brow et al., 2012; Nunes et al, 2019; Vasconcellos and Couto, 2021; Costa and Veiga, 2021; and Shoeib et al., 2022), were the positive impacts with the greatest occurrence in the research, followed by analyses of the increase in local tax collection (Castleberry and Greene, 2017; Jenniches et al., 2019). The negative social and economic impacts are related to economic losses in agriculture due to the enclosure of areas, the expulsion of traditional peoples and communities from their territories and the lack of skilled jobs for the affected communities (Roy, 2011; Gawande and Chaudhry, 2019).

The changes in the local microclimate have attracted the attention of some researchers. These impacts, for the most part, are associated with night-time heating of areas near wind farms (Slawsky et al., 2015; Miller and Keith, 2018; Qin et al., 2022), with negative effects on vegetation growth, directly impacting agricultural areas (Roy and Traiteur, 2010; Roy, 2011; Tang et al., 2017; and Wang et al., 2022). Some positive impacts have been checked, such as the relationship between night-time heating and increased crop protection in periods of frost (Roy and Traiteur, 2010). Impacts on human health have also been observed, with the occurrence of physical problems such as nausea, vomiting, headaches and sleep disorders, as well as psychological problems related to the noise and shading caused by the operation of wind turbines (Botterrill and Cockfield, 2016; Nunes et al., 2019; Gawande and Chaudhry, 2019; and Josimovic et al., 2021).

Other impacts occurred to a lesser extent in the studies, such as impacts on bat population dynamics, linked to increased mortality and forced migration of species (Peste et al., 2015; Millon et al., 2015; et al., 2015; Millon et al., 2018; Sebastián-Gonzalez et al., 2018; and Gawande and Chaud, 2019), 2018; and Gawande and Chaudhry, 2019), impacts on the population dynamics of other fauna species (Scheidat et al., 2011; Perrow et al., 2011; Lopucki et al., 2017; Gawande and Chaudhry, 2019; and Sobrinho Júnior et al., 2021), as well as changes in land use and cover, with the suppression of native forests and impacts on the natural landscape (Tang et al., 2017; and Sobrinho Júnior et al., 2021). Impacts have also been identified, from changes in coral reef areas to offshore wind farms (Scheidat et al., 2011) and records of improved air quality in some locations with a high concentration of wind farms situated in highly urbanized areas (Ruan et al., 2022). Figure 4 shows the distribution of this data:

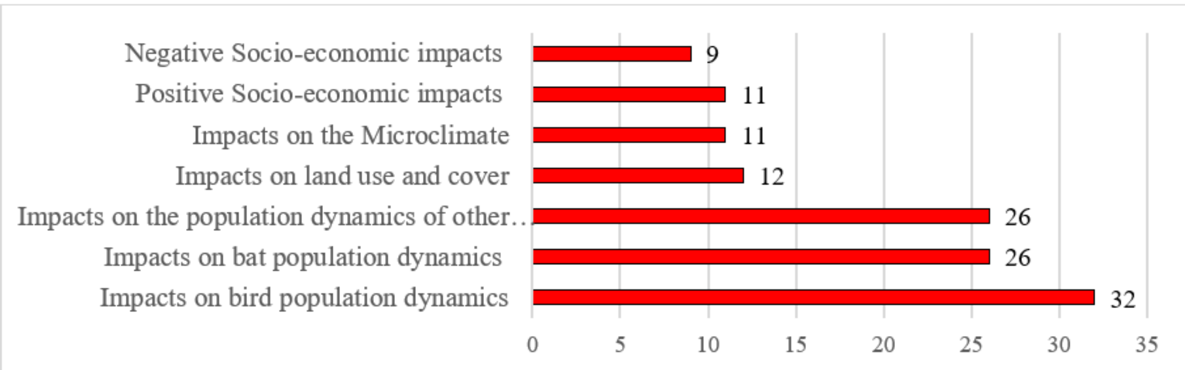


*Figure 4 - World - Occurrence of impacts in the articles analysed.*
*Source: Organized by the author based on WOS, 2022.*

In terms of spatial scale, 26 countries were studied in the papers analyzed. The countries that stand out in terms of the territorialization of the impacts of wind farms are the United States, China, Brazil and Spain, which are also among the 7 largest producers of this energy source. It was in this group of countries that the publications were concentrated. In the other countries, in general, few publications analyzed one or two impacts, with the exception of India, where only one paper analyzed 5 different impacts, and Austria, where one paper investigated 4 different impacts. In Figure 5, I highlight this spatialization.

In the United States, of the 32 impacts investigated, 17 were associated with the social and economic consequences—both positive and negative—of wind farms (Brow et al., 2012; Castleberry and Greene, 2017; Mueller and Brooks, 2020; Faturay et al., 2020; Pavlowsky and Gliedt, 2021; Shoeib et al., 2021, Shoeib et al., 2022). For example, in Oklahoma, the establishment of wind farms contributed to increased tax revenues in districts hosting these facilities, making them less vulnerable to fluctuations in state and federal funding for public education. In Oklahoma, a portion of public school funding is derived from property taxes, similar to the property tax levied in Brazil. Districts with wind farms experienced increased funding for public schools (Castleberry and Greene, 2017). Faturay et al. (2020) identified that the installation of wind farms may result in spill-over effects, whereby nearby regions experience positive socioeconomic benefits due to their proximity to the wind farms.

Additionally, seven impacts were identified concerning the population dynamics of birds, bats, and other local wildlife (Lebeau et al., 2015; Agha et al., 2015; Arnett and May, 2016; Smith et al., 2017; Mooney et al., 2020; Chipps et al., 2020; Smith et al., 2020; Proett et al., 2022; Good et al., 2022), four impacts related to microclimate changes (Roy and Traiteur, 2010; Slawsky et al., 2015; Miller and Keith, 2018; Qin et al., 2022), and four impacts on land use and land cover (Diffendorfer and Compton, 2014; Davis et al., 2018). Bird population dynamics were particularly affected by the construction of wind farms along migratory routes, leading to increased mortality rates. Microclimate impacts were associated with changes in land use and vegetation removal, which led to deforestation and increases in nighttime temperatures (Qin et al., 2022).

In Brazil, of the 20 impacts investigated, 13 were related to both positive and negative socioeconomic consequences (Frate et al., 2019; Vasconcellos and Couto, 2021; Oliveira et al., 2022; Santos et al., 2022; Sobrinho Júnior et al., 2021). For instance, in Rio Grande do Norte, various impacts were observed, including an increase in air pollution associated with intensified vehicle traffic required for the construction and operation of wind farms. Furthermore, five impacts were related to the population dynamics of birds, bats, and other wildlife (Valença and Bernard, 2015; Sobrinho Júnior et al., 2021), alongside two impacts on land use and land cover, tied to deforestation in sensitive environments such as the Caatinga, as well as the burial of lagoons and soil compaction and impermeabilisation (Turkovska et al., 2021; Sobrinho Júnior et al., 2021).

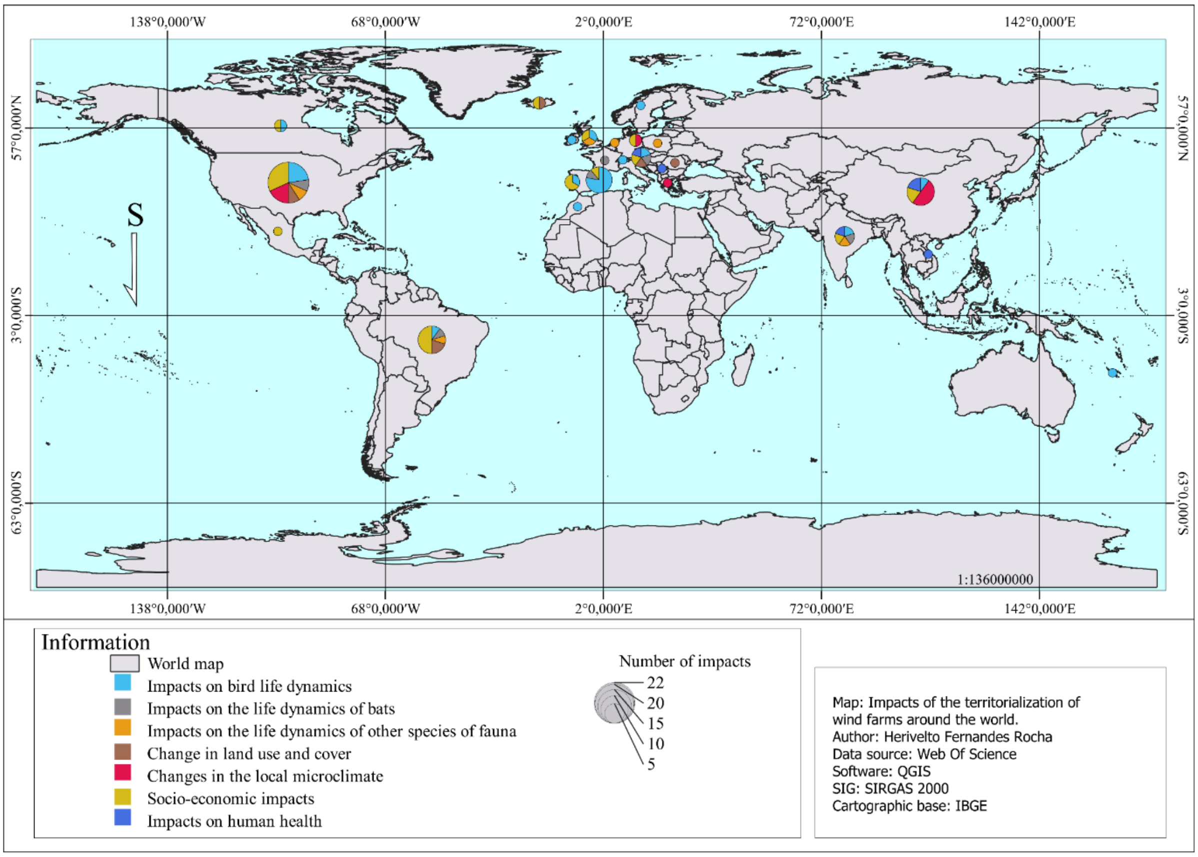


*Figure 5- World - Impacts of the territorialization of wind farms - 2022*

Although studies focusing on bird population dynamics in Brazil are limited, the construction and operation of a wind farm in Canudos, located in the Caatinga biome of Bahia, have faced resistance from local communities and public authorities due to the risk posed to the Lear's macaw (*Anodorhynchus leari*), an endemic and critically endangered species. The wind farm is situated along the migration route of this species, and the Federal Public Prosecutor's Office has initiated a civil lawsuit against the French company Voltalia and the Bahia State Institute for the Environment and Water Resources (INEMA). The lawsuit seeks to revoke the preliminary, installation, and operating licences of the wind farm until an Environmental Impact Study (EIA) and Environmental Impact Report (RIMA) are conducted.

Environmental licensing by state environmental agencies in Brazil reflects the ambivalence surrounding the notion of sustainable development. To expedite the implementation of wind farms, several agencies classify such projects as low-impact activities, potentially due to their association with renewable energy—widely regarded as "clean" and essential for mitigating climate change through the energy transition. Consequently, large wind complexes are often constructed without EIAs, RIMAs, or adherence to other legal requirements, such as prior consultation with traditional communities. Although existing regulations could mitigate the adverse effects of wind farm territorialisation, they are frequently overlooked.

For instance, the 3rd Civil and Criminal Court of Feira de Santana ruled that INEMA disregarded Resolution 462/2014 of the National Environmental Council, which stipulates that wind farms located in areas of endangered species, restricted endemism, or migratory bird routes cannot be classified as low-impact activities subject only to a simplified environmental report (RAS). INEMA's classification of Voltalia's project as low-impact demonstrates a clear bias towards the intensification of wind farm territorialisation in the state. Some companies exploit this system by fragmenting wind farms within a single complex to achieve low-impact classification. For example, in Campo Formoso (BA), the Morrinhos wind complex, comprising over 90 turbines, has been divided into smaller farms within the same territory. In 2024, INEMA approved the construction of the Manacá complex, which integrates wind, solar, and green hydrogen energy production under Quinto Energy. This project, involving an investment of R$ 10 billion, aims to install over 400 turbines and 476,000 solar panels in a conservation-priority area designated by the Ministry of the Environment. However, it was approved without the requisite environmental studies.

In China, six impacts on microclimate alterations were analysed (Tang et al., 2017; Sun et al., 2018; Wang et al., 2019; Li et al., 2021; Luo et al., 2021). In addition to temperature changes observed in the United States, studies in China also identified shifts in spatial temperature patterns, including surface soil temperature, land surface temperature, evapotranspiration, and vegetation indices (Luo et al., 2021). These localised climatic impacts may have more severe consequences in arid or semi-arid regions, such as the Caatinga, particularly regarding increased evapotranspiration in areas with scarce water resources.

Furthermore, two impacts on land use and land cover were identified (Tang et al., 2017; Luo et al., 2021), as well as two impacts on bird population dynamics (Zhao et al., 2020). Land use impacts were related to vegetation development; wind farms had a significant inhibitory effect on vegetation growth, driven by changes in soil temperature and moisture. These farms reduced soil moisture and increased water stress in the analysed areas (Tang et al., 2017).

In Spain, 11 impacts were observed, nine of which pertained to the population dynamics of birds and bats (Lucas et al., 2012a; Lucas et al., 2012b; Hernandez-Pliego et al., 2015; Farfan et al., 2017; Sebastián-González et al., 2018; Marques et al., 2020; Ferrer et al., 2022). This trend was also recorded across other European countries, where most studies focused on such impacts (Scheidat et al., 2011; Perrow et al., 2011; Pearce-Higgins et al., 2012; Millon et al., 2015; Bastos et al., 2015; Lopucki et al., 2017; Millon et al., 2018; Fernandez-Bellon et al., 2018; Schippers et al., 2020). Ferrer et al. (2022) assessed the effects of implementing turbine shutdown protocols on the mortality of large birds and bats. Following the adoption of these protocols, overall mortality decreased by 67%, with a 92.8% reduction for a specific species, *Gyps fulvus* (a vulture characteristic of Europe). This outcome was achieved with minimal energy production loss, which declined by less than 0.51%. While the protocol significantly reduced mortality among vultures and other large bird species, it was less effective for bats. These findings underscore the potential for such strategies to balance wind farm operations with avifauna conservation.

The expansion of wind energy production capacity is a fundamental component of mitigating the effects of climate change and global warming. However, the pursuit of this objective, which is part of Sustainable Development Goal (SDG) 7 of the 2030 Agenda, affects other SDGs that are essential for achieving the broader agenda. The 2030 Agenda, adopted by the United Nations in 2015, establishes 17 SDGs aimed at addressing and providing solutions to global challenges, such as poverty eradication, gender equality, and climate change mitigation. This agenda is the outcome of previous initiatives that failed to achieve the expected results, such as the Millennium Development Goals (MDGs), defined in 2000, which primarily focused on reducing extreme poverty and tackling other global challenges by 2015 (Sachs, 2015).

Global conferences, such as the Conferences of the Parties (COP) under the United Nations Framework Convention on Climate Change (UNFCCC), as well as reports from the Intergovernmental Panel on Climate Change (IPCC), have contributed to raising awareness of the climate crisis. However, the effectiveness of these initiatives depends on concrete and binding actions from signatory countries. In this regard, there has been significant regression, particularly due to the growing influence of neoliberal ideology on the agencies and institutions responsible for discussing and proposing solutions to global issues. Until the mid-2000s, climate policies involved binding commitments, such as mandatory reductions in greenhouse gas emissions. However, this has shifted towards a voluntary framework, in which emitting countries define their own targets.

The most recent and significant example of this regression is the Paris Agreement, signed in June 2017 by 153 countries, of which 147 presented voluntary commitments to reduce emissions. Victor et al. (2017) emphasise that the voluntary pledges under the Paris Agreement lack robust monitoring and governance mechanisms, allowing countries to establish emission reduction targets that they ultimately fail to meet. The absence of effective governance and enforcement mechanisms prevents climate commitments from progressing at the necessary pace, highlighting the challenge of aligning capitalist economic interests with socio-environmental imperatives, particularly those related to climate change.

An analysis of the relationship between the impacts of wind farm territorialisation worldwide and the SDGs reveals that synergies—primarily socio-economic—between these objectives are more prevalent in developed countries. This observation reinforces our argument concerning the unequal spatial distribution of the impacts caused by wind farm territorialisation. For instance, in our analysis of the impacts of wind farm territorialisation in Brazil, socio-environmental trade-offs are predominant. This trend is also observed in other Global South countries, such as Mexico and India (cite relevant studies). Figure 6 presents the data from this review, organised according to the incidence of specific impacts and their potential contributions—whether positive or negative—to the achievement of other SDG targets.

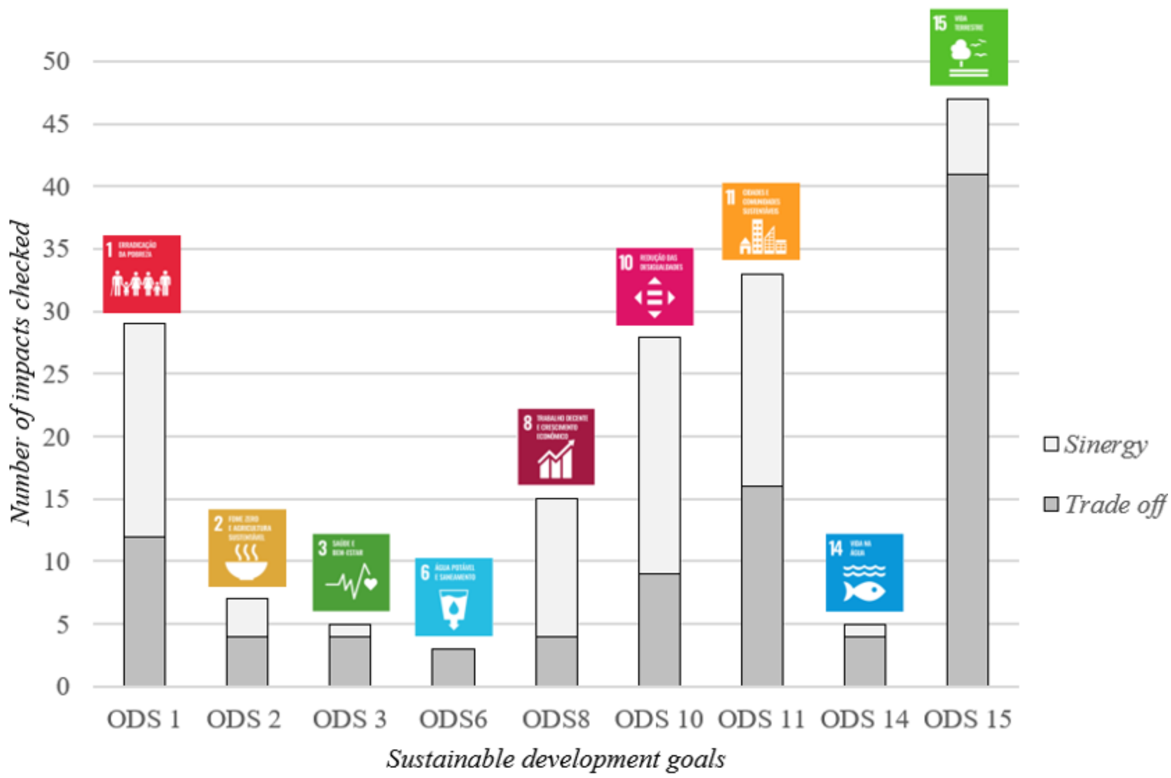


*Figure 6- World - Synergies and trade-offs between SDG 7 and the other SDGs.*

*Source: Organized by the author based on WOS, 2022.*

In general, the relationship between SDG 7 and SDG 1 is synergistic, particularly in terms of job creation and increased household income for affected communities (Brown et al., 2012; Huesca-Pérez et al., 2016; Castleberry and Greene, 2017; Copena et al., 2019; Frate et al., 2019; Jenniches et al., 2019; Faturay et al., 2020; Costa and Veiga, 2021; Pavlowsky and Gliedt, 2021; Vasconcellos and Couto, 2021; Oliveira et al., 2022; Shoeib et al., 2022).

In the United States, for example, the establishment of wind farms has allowed farmers and ranchers who lease part of their land to maintain their agricultural and livestock activities. Many landowners report that royalties paid by wind energy companies have enabled them to retain their land and businesses, preventing indebtedness or the forced sale of their properties. This can directly contribute to poverty reduction in rural areas (Pavlowsky and Gliedt, 2021).

In this context, increased income plays a crucial role in sustaining local territorialities. However, in other countries, such as Mexico, the arrival of wind farms has been accompanied by a range of challenges for communities in the Isthmus of Tehuantepec, located in southern Mexico between the Gulf of Mexico and the Pacific Ocean. Whereas in rural communities in the United States, land leasing serves as a means of economic resilience and continuity, in Mexico, the relatively low lease payments—compared to other parts of the world—are accompanied by a series of processes that fragment communities. These communities operate under a communal land-use and occupancy system inherited from the Mexican Revolution of 1917. Wind energy projects have exacerbated tensions between landowners, *ejido* members, and communities that do not have access to economic benefits (Huesca-Pérez et al., 2016).

The trade-offs observed are related to the creation of low-skilled or unskilled jobs, which are generally allocated to local populations affected by wind farm developments (Delicado et al., 2013; Huesca-Pérez et al., 2016; Gawande and Chaudhry, 2019; Mueller and Brooks, 2020; Costa and Veiga, 2021; Urziceanu et al., 2021; Vasconcellos and Couto, 2021; Oliveira et al., 2022).

Job creation in wind farms depends on several factors, including location, the availability of skilled local labour and supplies, and the site's integration into the supply chains necessary for the project's implementation (Huesca-Pérez et al., 2016). In locations where these factors align, the impacts on employment and income generation tend to be more significant. However, in areas where only resource extraction takes place, the impacts tend to be smaller.

Jobs, particularly those related to the operation of wind farms after the construction phase, are often used as a form of "bargaining currency" by companies responsible for executing and managing wind farms. In areas with low levels of formal employment and low average incomes, a formal job position can play a crucial role in persuading local communities of the benefits of wind energy production.

In Portugal, Costa and Veiga (2021) found that the main impacts on employment and income generation occurred during the construction phase of wind farms, with a reduction in unemployment of between 0.17 and 0.23 percentage points per 100 MW installed, benefiting primarily low-skilled male workers. An increase in municipal revenues was also observed through taxes and fees related to the movement of goods and wind energy production, which strengthened local finances. However, these benefits were predominantly short-term, with minimal impact on job creation during the operation and maintenance phases.

Regarding SDG 2, which addresses the eradication of hunger, food security, nutrition, and sustainable agriculture, synergies are linked to the potential for increased investment in agricultural activities due to higher land revenues generated by leasing agreements (Siedersleben et al., 2018; Pavlowsky and Gliedt, 2021; Shoeib et al., 2022). Conversely, trade-offs are associated with a reduction in cultivated land area, the unequal distribution of benefits derived from wind energy exploitation, and disagreements over lease payments (Gawande and Chaudhry, 2019; Mueller and Brooks, 2020; Urziceanu et al., 2021; Oliveira et al., 2022).

In countries—particularly those considered developed—that are experiencing rural depopulation and an ageing population, the arrival of wind farms has the potential to revitalise rural economies, as seen in Spain (Copena et al., 2019) and the United States (Pavlowsky and Gliedt, 2021). However, in developing countries where rural populations remain significant, the expansion of wind farms exacerbates long-standing structural issues, such as land conflicts. In Mexico, in the Isthmus of Tehuantepec, the territorialisation of wind farms has contributed to the fragmentation and transformation of traditional communities whose livelihoods and cultural identity are deeply connected to their land (Huesca-Pérez et al., 2016). This process contradicts the dominant global market-oriented logic.

Land lease agreements, which primarily serve corporate interests, and the absence of prior consultation—required under Convention 169 of the International Labour Organization (ILO), to which Mexico is a signatory—have intensified conflicts in the region. A similar situation occurs in Brazil, particularly in the *Fundo de Pasto* communities in the interior of Bahia. These traditional communities generally do not have their right to prior consultation respected and are subjected to highly disadvantageous lease agreements. The similarities between Mexico and Brazil, where comparable trade-offs occur, or between the United States and Spain, where synergies are more prevalent, are not coincidental. Rather, they reflect the modus operandi of major energy corporations responsible for wind farm development, which adopt different strategies depending on the location being exploited.

Regarding SDG 3, which addresses health and well-being, a key synergy relates to improvements in air quality following the implementation of large wind power complexes near densely populated urban areas. This synergy is relevant both globally, as wind energy production contributes to the energy transition, and locally, where the replacement of fossil fuel-based power plants with wind farms can improve air quality. This is particularly significant with respect to pollutants emitted by fossil fuels that have a direct impact on human health, such as sulphur nitrates, nitrogen oxides, and particulate matter produced by the combustion of fossil fuels in thermal power plants (Qiu et al., 2022).

Conversely, the main trade-offs are associated with health problems caused by noise pollution and the shadow flicker effect produced by wind turbines (Botterill and Cockfield, 2016; Josimovic et al., 2021;). Josimovic et al. (2021) analysed the implementation of a wind farm in Serbia and proposed relocating certain wind turbines to mitigate negative health impacts on local populations and wildlife. Using noise emission modelling, they found that three turbines could exceed the decibel limits set by local regulations. In response, the company responsible for the project chose to relocate the turbines, thereby eliminating the problem.

In Brazil, for example, there is no specific legislation regulating the minimum distance between wind farms and residential areas. The only relevant regulation is a resolution from the National Environmental Council (CONAMA), which requires companies to assess noise levels in compliance with Brazilian Association of Technical Standards (ABNT) regulations. Furthermore, for wind turbines located within 400 metres of a residence, this assessment must also include an evaluation of the stroboscopic effect produced by the turbines (CONAMA, 2014).

The resolution applies to wind farms located less than 400 metres from residential areas, disregarding those situated at greater distances. It also stipulates that this assessment must be included in the Environmental Impact Study (EIA). However, the same resolution states that "the environmental licensing of wind energy developments considered to have a low environmental impact will be conducted through a simplified procedure" (CONAMA, 2024). This provision facilitates a common strategy employed by wind energy companies, which fragment large wind complexes into smaller parks to qualify for a Simplified Environmental Report (RAS) instead of undergoing a full EIA process with state environmental agencies.

In the RAS, many potential impacts do not need to be assessed, as the aim is to streamline the licensing process for wind farm construction. However, this does not mean these impacts do not exist—quite the contrary. A study conducted in communities affected by wind farms in the Brazilian state of Pernambuco by Wanessa da Silva Gomes from the Federal University of Pernambuco (UFPE) and André Monteiro from the public health agency Fundação Oswaldo Cruz (FIOCRUZ) identified health issues related to wind turbine noise, such as Wind Turbine Syndrome (WTS) and Vibroacoustic Disease (VAD), as well as allergies caused by water contamination resulting from turbine operation. In these rural communities, affected by the territorialisation of wind farms, a significant portion of the population relies on medication to mitigate the effects of turbine noise and shadow flicker.

Regarding SDG 6, which concerns water availability and resource management, no synergies were identified, while three trade-offs were observed. These include increased evapotranspiration, which can reduce water availability, particularly in arid and semi-arid regions, as well as the silting of rivers, lakes, and lagoons in water-scarce areas (Gawande and Chaudhry, 2019; Luo et al., 2021). In Maharashtra, India, within the Western Ghats—a region rich in biodiversity—the territorialisation of wind farms has led to severe soil erosion and sedimentation in water bodies, compromising local water supplies. Additionally, the construction of large roads required for transporting wind farm infrastructure has significantly altered the natural flow of streams and creeks, fragmenting hydrological ecosystems and reducing water availability for both local communities and wildlife.

These changes in land use and land cover have also intensified surface runoff, increasing the risk of flooding in areas surrounding wind farms. The removal of native vegetation has reduced water infiltration into the soil, negatively affecting groundwater recharge and disrupting the region’s hydrological cycle (Gawande and Chaudhry, 2019).

In China, an analysis of the territorialisation of wind farms in Shangyi, Hebei province, conducted by Luo et al. (2021), identified an increase in soil evapotranspiration in areas affected by wind farm development. Evapotranspiration, a crucial component of the hydrological cycle, rose significantly within the wind farm area, increasing from 34 mm/year before turbine installation to 95 mm/year after operations began. This increase was more pronounced within the wind farm than in the surrounding buffer zone of approximately 10 km, suggesting that changes in local wind flow and thermal dynamics caused by the turbines intensified water consumption in the environment. While this process may benefit certain crops and ecosystems, increased evapotranspiration can also reduce water availability in semi-arid regions or areas with already limited water resources.

In Brazil, for instance, within the Caatinga biome, the impacts on the water balance may exacerbate the region’s chronic water scarcity, which is historically linked to droughts in the most densely populated arid region on the planet.

Regarding SDG 8, which aims to promote inclusive and sustainable economic growth, full employment, and decent work, synergies were more significant than trade-offs. The synergies are associated with increased job opportunities and higher per capita income at the local level (Brow et al., 2012; Jenniches et al., 2019; Costa and Veiga, 2021; Vasconcellos and Couto, 2021; Oliveira et al., 2022; Shoeib et al., 2022). Conversely, the trade-offs relate to the low lease payments for land and the prevalence of low-wage job opportunities for residents of affected communities (Costa and Veiga, 2021; Vasconcellos and Couto, 2021; Sobrinho Júnior et al., 2021; Oliveira et al., 2022). The positive and negative impacts on this SDG are similar to those already analysed in relation to SDGs 1 and 2.

With regard to SDG 10, which focuses on reducing inequalities within and between countries, synergies were also more significant than trade-offs. These synergies include increased employment opportunities, higher per capita income at the local level, greater tax revenue, improvements in public services, and the expansion of certain agricultural activities (Brow et al., 2012; Huesca-Pérez et al., 2016; Castleberry and Greene, 2017; Copena et al., 2019; Frate et al., 2019; Jenniches et al., 2019; Faturay et al., 2020; Costa and Veiga, 2021; Pavlowsky and Gliedt, 2021; Vasconcellos and Couto, 2021; Shoeib et al., 2021; Oliveira et al., 2022; Shoeib et al., 2022).

However, trade-offs in this context are associated with a lack of transparency from companies, particularly regarding energy generation and financial transactions related to production. Additionally, the absence of dialogue between companies and affected communities—especially during the installation phase of wind turbines—has contributed to tensions. Further concerns include issues related to land lease agreements and negative impacts on the tourism industry in certain locations (Mueller and Brooks, 2020; Costa and Veiga, 2021; Saethorsdottir et al., 2021; Sobrinho Júnior et al., 2021; Oliveira et al., 2022; Santos et al., 2022).

Regarding SDG 11, which aims to promote more sustainable cities and communities, the balance between synergies and trade-offs is relatively even. The synergies are related to the capacity, efficiency, and sustainability of wind energy compared to other energy sources and improvements in economic indicators (Brow et al., 2012; Agha et al., 2015; Castleberry and Greene, 2017; Siedersleben et al., 2018; Gao et al., 2019; Jenniches et al., 2019; Li et al., 2021; Stergiannis et al., 2021; Vasconcellos and Couto, 2021; Qiu et al., 2022; Ruan et al., 2022; Shoeib et al., 2022; Wang et al., 2022). The trade-offs, on the other hand, are associated with impacts on fishery resources in offshore wind farms, non-compliance with international regulations such as Convention 169 of the International Labour Organization (ILO), and changes in land use and land cover (Delicado et al., 2013; Diffendorfer and Compton, 2014; Huesca-Pérez et al., 2016; Scherhaufer et al., 2017; Miller and Keith, 2018; Qin et al., 2022; Wang et al., 2019; Mooney et al., 2020; Mueller and Brooks, 2020; Bahramian et al., 2021; Costa and Veiga, 2021; Urziceanu et al., 2021; Sobrinho Júnior et al., 2021).

The issue of impacts on fishery resources related to the territorialisation of offshore wind farms has drawn significant attention in some states of northeastern Brazil. In a study, Gorayebe et al. (2024) analysed the attempted implementation of a wind farm along the coast of Ceará. Notably, some of the strategies used in the territorialisation of onshore wind farms are also replicated in offshore wind farms, such as fostering internal conflicts within communities that may be affected by the project, making promises of improvements that do not solely depend on the companies' willingness, and holding public hearings that fail to ensure energy justice (Sovacool and Dworkin, 2015).

The licence for the wind farm in Ceará was denied by the Brazilian Institute of Environment and Renewable Natural Resources (IBAMA), which deemed the Environmental Impact Assessment (EIA) inadequate in several fundamental aspects related to the potential socio-environmental impacts of the project. This point is particularly relevant because, while onshore wind farms have advanced with the support of state environmental agencies—such as INEMA in Bahia, where most projects require only a Simplified Environmental Report (RAS)—at the federal level, IBAMA's oversight and the requirement for more comprehensive and complex EIAs may hinder the territorialisation of projects with the potential to negatively impact communities and the environment at the local level. However, according to Gorayebe et al. (2024), the involvement of a federal agency does not prevent local elites, who often act as intermediaries for wind energy companies, from attempting to control decision-making processes.

Regarding the relationship between SDG 7 and SDG 14, which focuses on the conservation and sustainable use of marine and ocean resources, one synergy was identified: the reef effect generated by offshore wind farms, which led to an increase in food availability for some marine species (Scheidat et al., 2011). However, trade-offs were also observed, mainly concerning the impact on the life cycle of certain species, due primarily to the noise emitted by wind turbines and the decline of some populations during the installation phase of the wind farms (Scheidat et al., 2011; Pearce-Higgins et al., 2012; Siedersleben et al., 2018; Mooney et al., 2020).

Finally, in relation to SDG 15, which concerns the protection and sustainable use of terrestrial ecosystems, this analysis identified six synergies and 40 trade-offs. The synergies are associated with an increase in the population of certain bird species, a reduction in bat mortality following the adoption of mitigation measures, and investments in environmental compensation initiatives in affected areas (Pearce-Higgins et al., 2012; Agha et al., 2015; Copena et al., 2019; Luo et al., 2021; Ferrer et al., 2022; Good et al., 2022). The trade-offs, on the other hand, are linked to changes in land use and land cover, increased mortality, and changes in the life dynamics of various bird and bat species (Perrow et al., 2011; Lucas et al., 2012a; Lucas et al., 2012b; Diffendorfer and Compton, 2014; Lebeau et al., 2015; Hernandez-Pliego et al., 2015; Millon et al., 2015; Peste et al., 2015; Valença and Bernard, 2015; Bastos et al., 2015; Farfan et al., 2017; Lopucki et al., 2017; Scherhaufer et al., 2017; Smith et al., 2017; Tang et al., 2017; Davis et al., 2018; Millon et al., 2018; Sebastián-Gonzalez et al., 2018; Fernandez-Bellon et al., 2018; Chipps et al., 2020; Gawande and Chaudhry, 2019; Lemaitre and Lamarre, 2020; Marques et al., 2020; May et al., 2020; Smith et al., 2020; Zhao et al., 2020; Luo et al., 2021; May et al., 2021; Turkovska et al., 2021; Proett et al., 2022; Qin et al., 2022; Santos et al., 2022; Wang et al., 2022).

The analysis of interactions between SDG 7 and other Sustainable Development Goals reveals a complex network of synergies and trade-offs. Significant synergies exist, such as the positive impact on job creation and income growth, but there are also trade-offs, including challenges related to job qualifications and remuneration, as well as impacts on terrestrial and marine life. The synergies, particularly the positive effects on employment and income generation in certain locations, highlight the transformative potential of renewable energy in addressing economic and social challenges, even though the main economic activities associated with these benefits are concentrated during the construction phase of wind farms. However, the associated trade-offs reveal the complexity and costs of this process, underscoring the need for more inclusive and integrated policies to minimise negative impacts.

Examples such as the United States demonstrate that leasing land for wind farms can strengthen the rural economy and secure the livelihoods of families in agricultural areas. However, in Global South countries such as Mexico, Brazil, India, and Colombia, economic benefits are primarily concentrated in the construction phase of wind farms and are often accompanied by long-term or permanent socio-environmental impacts. These include disadvantageous land lease agreements and community fragmentation, which exacerbate preexisting inequalities, emphasising the need for strategies that balance economic interests with the rights of affected communities.

While there is potential to stimulate local economies and strengthen supply chains, particularly in Global South countries—through technology transfer between nations or professional training for members of affected communities—the reality in many areas is characterised by the prevalence of low-skilled jobs and inadequate remuneration from land leases. Advances in tax revenue collection and improvements in public services in certain locations contrast with the lack of effective governance mechanisms, while the absence or inadequacy of prior consultation with affected communities perpetuates power asymmetries and socio-economic inequalities.

## 3. Discussion

The unequal territorialisation of the impacts generated by the expansion of wind farms worldwide can be explained by the hypothesis that the underlying logic of wind energy generation, even when anchored in a discourse of sustainability and supported by the SDGs of the 2030 Agenda or the Paris Agreement, follows the same logic as other activities that are harmful to society and the environment. These activities are characteristic of the capitalist mode of production, in which externalities are, for the most part, directed towards "others" (Brand and Wissen, 2021). Based on a systematic analysis of the literature, it is possible to infer that this hypothesis is corroborated by reality, particularly when considering how wind farms are territorialised in countries with different levels of development. Most of the negative socio-economic impacts are concentrated in countries such as Mexico, Brazil, and India, alongside significant impacts on land use and land cover, particularly in forested areas and sensitive biomes in developing countries.

The territorialisation of wind farms is based on the normalisation of territories (Santos, 2009), which is necessary to ensure the expansion of capital across the globe. In the case of wind farms, beyond the technical elements implemented in space—such as wind turbines and fences, which introduce a set of regulations into an area where they previously did not exist—there are also technical, political, economic, social, legal, and informal norms that may either accelerate or slow down the process of territorialisation (Ribeiro et al., 2018; Ribeiro and Oliveira, 2021). In Brazil, for example, wind farms are generally perceived by official institutions as an economic activity with low environmental and social impact, a perspective that facilitates the implementation of these structures, as in such cases, only the Simplified Environmental Report (RAS) is required (Traldi, 2021).

In Colombia, when analysing the territorialisation of renewable energy investments in indigenous communities, Ramírez et al. (2023) argue that the responses to climate issues—centred on the pursuit of energy transition—may perpetuate power imbalances, marginalising traditional peoples and communities through a new form of colonialism, known as *green colonialism*. According to the authors, the logic of green colonialism imposes the idea that only through a rapid and hasty energy transition can climate change be effectively addressed, disregarding the ontology of traditional peoples and communities, who inhabit their respective territories in a relationship of balance with nature.

The logic behind this new form of colonialism results from a historical process aimed at preserving colonial structures (Cesaire, 2020; Galeano, 2018), which have persisted since the 15th century. The maintenance of this logic is not exclusive to renewable energy production processes. Bombardi (2023), in an analysis of the use and distribution of agrochemicals worldwide, highlights, for instance, that many pesticides produced in Global North countries are widely used on agricultural crops in underdeveloped or developing countries, even when such products are banned in their countries of origin. The author classifies this process as *chemical colonialism*.

Thus, modern forms of colonialism persist to safeguard the mode of production and way of life that have long been hegemonic in the world. The way companies operate—whether in the renewable or non-renewable energy sector, agrochemicals, or food production, among others, often under the same financial conglomerates—varies from country to country, resulting in specific impacts depending on the location being exploited. For example, in this review and in other readings conducted during my doctoral research, I have found few analyses concerning the role of intermediaries, the restriction or prohibition of people's movement, reports of abusive contracts, or low remuneration for land leases in developed countries—situations that are common in developing or underdeveloped nations (Fairhead et al, 2012; Hofstaetter, 2016; Huesca-Pérez et al., 2016; Traldi, 2019).

## 4. Conclusions

The expansion of wind energy, although supported by sustainability discourses and global climate agreements, operates under the same logic of capitalist accumulation that has historically shaped the unequal distribution of wealth, environmental degradation, and social inequalities. The production of space for wind energy generation is not a neutral or merely technical process; rather, it is deeply embedded in power relations that prioritise corporate interests over local communities, particularly in the Global South.

The contradictions inherent in this process reveal the dual nature of wind energy development: on the one hand, it represents an alternative to fossil fuel dependence, contributing to the energy transition; on the other, it reproduces historical patterns of expropriation, marginalisation, and environmental degradation. Evidence from Mexico, Brazil, India, and Colombia demonstrates that the purported benefits of wind energy are not equitably distributed. Instead, economic gains are concentrated in the hands of large corporations and financial conglomerates, while socio-environmental costs are externalised onto marginalised communities.

The concept of *green colonialism* encapsulates how renewable energy projects, despite their apparent environmental benefits, function as new mechanisms for capital expansion into peripheral territories. Much like historical forms of colonialism, these projects impose an external logic of land use, disregarding traditional knowledge and the socio-spatial practices of local communities. The promotion of a rapid and large-scale energy transition, with minimal consideration for energy justice, spatially produces unequal impacts that are detrimental to both people and nature.

An energy transition that incorporates energy justice must address the historical and structural contradictions of capitalist expansion over territories. A truly just energy transition requires the democratic participation of local communities and stricter regulatory frameworks that protect territories and territorialities. Without such structural transformations, wind energy risks becoming merely another instrument of accumulation, perpetuating the very inequalities and environmental crises that the concepts of sustainable development and sustainability aim to combat.

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