

Processes of vulnerabilization of wind enterprises in a peasant community in the Southern Agrest of Pernambuco

Processos de vulnerabilização de empreendimentos eólicos em comunidade camponesa no Agreste Meridional de Pernambuco

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ABSTRACT Amid sustainable agendas, renewable energy sources play a strong role, especially wind energy. However, the implementation of wind farms produces transformations in communities, causing impacts in different areas and vulnerability processes. The study aims to problematize the reports of the peasant population regarding the processes of vulnerability in the area of influence of the implementation of wind farms in a municipality in Pernambuco. This is an observational, descriptive research with a qualitative approach, carried out in a peasant community, located in the municipality of Caetés, Pernambuco, Brazil. Data collection was carried out through semi-structured interviews. Data analysis was based on the content analysis technique in the thematic modality. It was observed that the arrival and operation of the wind turbines coincided with the emergence of signs and symptoms, such as hearing and skin problems, anxiety, dizziness and headache. This situation allows us to consider a probable connection between the impacts caused by wind towers, already described in the literature, and those present in the participants' reports. Prudence is necessary when planning and building wind farms, since such health problems can be temporary or permanent, leading the local community to constant suffering.

KEYWORDS Wind energy. Health vulnerability. Health of the rural population. Health disease process.

RESUMO Em meio a pautas sustentáveis, as fontes de energia renováveis apresentam um forte papel, em especial, a energia eólica. No entanto, a implantação dos empreendimentos eólicos produz transformações nas comunidades, causando impactos em diferentes áreas e processos de vulnerabilização. O estudo objetiva problematizar os relatos da população camponesa referentes aos processos de vulnerabilização em área de influência da implantação dos empreendimentos eólicos em um município pernambucano. Trata-se de uma pesquisa observacional, descritiva de abordagem qualitativa, realizada em uma comunidade camponesa localizada no município de Caetés, Pernambuco, Brasil. A coleta de dados foi realizada mediante entrevista semiestruturada. A análise de dados partiu da técnica de análise de conteúdo na modalidade temática. Observou-se que a chegada e o funcionamento dos aerogeradores coincidiram com o surgimento de sinais e sintomas, como os problemas auditivos e de pele, ansiedade, tontura e cefaleia. Tal situação permite considerar uma provável ligação entre os impactos causados pelas torres eólicas, já descritos na literatura, com aqueles presentes nos relatos dos participantes. É necessário prudência no momento de planejamento e construção de complexos eólicos, uma vez que tais agravos à saúde podem se comportar como temporários ou permanentes, levando a comunidade local a um sofrimento constante.

PALAVRAS-CHAVE Energia eólica. Vulnerabilidade em saúde. Saúde da população rural. Processo saúde-doença.

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Introduction

Amid sustainable agendas and responses to the water consequences of energy crises, renewable energy sources play a strong role. Among the types of renewable energy available, wind energy stands out, being defined as the kinetic energy present in the movement of air masses (wind)¹.

The energy generated from the wind, since the beginning of civilization, has been used by man to move various devices, being used, for example, in the processing of grains and in pumping water, directly favoring the advancement of agriculture and countless other activities².

The implementation and operation of large projects, such as those related to wind energy, generally occur in traditional communities, such as peasant communities, and invariably generate tensions³. Even though there are benefits and great public acceptance of wind energy, systems to be put into operation are likely to generate undesirable changes, causing opposition from the community or local groups to the implementation and operation of wind projects⁴.

The implementation of wind farms produces transformations in communities, such as deforestation, audible noise from engines and from the wind hitting the turbine blades, interference with fauna and migratory bird routes, visual impacts and electromagnetic interference⁵. Generators produce various noises, which can cause discomfort and changes in people's quality of life, affecting concentration, communication and sleep, as well as damaging the functions of the auditory system and harming the physical, physiological and mental activity of the exposed individual⁶⁻⁸.

Among the states that make up the Northeast region, Pernambuco has potential for generating wind energy, which has attracted large investments to the state for the installation of companies in the wind sector. Currently, 60% of the wind energy distributed across the Northeast comes from wind farms located in Pernambuco¹.

The state has 18 municipalities with potential for exploiting wind energy, with 35 wind complexes installed on its soil by 2022⁹. In 2023, large companies in the wind sector were present in the Sertão and Agreste of Pernambuco. The municipality of Caetés, specifically, has seven wind farms, representing 1.3% of the wind energy generation capacity that the entire state has. Together with the cities of Pedra and Paratama, Caetés makes up the Ventos de Santa Brígida complex^{2,9}.

Initially, wind farms brought great expectations to the residents of Caetés who trusted in the announced benefits, involving employment and income, contributing to the development of the municipality. After implementation began, the first adverse effects of the project in the region were observed, especially on the health of peasants. Thus, the study aims to problematize the reports of the peasant population regarding the processes of vulnerability in the area of influence of the implementation of wind farms in the municipality of Caetés.

Material and methods

This is an observational, descriptive study with a qualitative approach, which refers to a tool for capturing subjective data related to the universe of meanings, relationships, representations, motives, aspirations, beliefs, perceptions, values and attitudes¹⁰.

The research was carried out in a peasant community, called Sítio Sobradinho, located in the municipality of Caetés, in the Agreste of Pernambuco, Brazil. This community was chosen because it is affected daily by the impacts of wind towers installed in the region.

The study population was made up of community and association leaders, representatives of social movements and the Rural Workers Union (STR) and peasant residents of the study site, over 18 years of age and who had lived there for more than a year. The participants were chosen intentionally and by saturation. In the end, seven people took part in the study.

The research was developed respecting all the parameters described in Resolution No. 510/16 of the National Research Ethics Commission (CONEP), which defines ethical issues in research in the area of human and social sciences. The research was evaluated by the Research Ethics Committee (CEP) of the University of Pernambuco, Multicampi Garanhuns, prepared by the Certificate of Presentation of Ethical Appreciation – CAAE n° 63459522.6.0000.0128 and approved by the CEP based on opinion n° 5.912.044. The study did not have any kind of financial support, being entirely financed by the authors.

When conducting the interviews, the main researcher presented the objectives of the research, explained the risks and benefits of the interviewee's participation in the study and guaranteed anonymity, only after authorization was requested to record the interview on an audio device. After acceptance to participate in the study, before the start of the interview, the signing of the Free and Informed Consent Form (TCLE) was requested, with a copy being given to the interviewee.

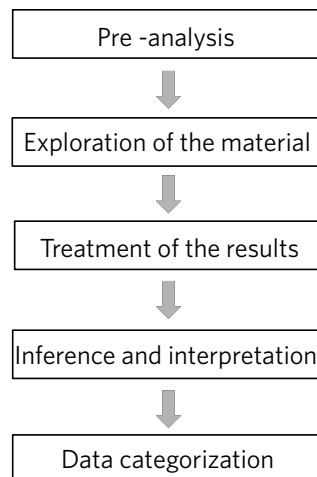
For data collection, interviews were carried out using a previously established script, with

open and closed questions. The instrument was organized into two parts, the first being composed of sociodemographic and economic data, and the second consisting of guiding questions: 'Did you notice changes in your sleep, difficulty concentrating, nausea or other sign or symptom after the arrival of the wind towers?'; 'Any health problems diagnosed after the period of implementation of the wind towers?'; 'Do the noises arising from the operation of wind towers cause any sensations in your body?'; 'Does the movement of the tower blades cause you any discomfort?'

The interviews were previously scheduled with the participants, carried out cautiously to avoid interference. These were recorded on an audio device and later transcribed in full into a Microsoft Word® file.

Data analysis occurred using the content analysis technique in the thematic modality, which aims to analyze what was said during an investigation, forming and presenting conceptions around an object of study. This technique is structured in three phases: pre-analysis, exploration of the material and treatment of results and interpretation¹¹.

Figure 1. Phases of Bardin's thematic content analysis



Source: Own elaboration.

In the pre-analysis, the material was read, the documents to be analyzed were chosen and the hypotheses were formulated. During the exploration of the material, classification and categorization phase, the information was organized systematically: ordering of events, starting from the participant's arrival in their territory; first actions by companies

and installation of wind towers; perceptions about changes in the territory and the vulnerability processes resulting from the arrival and operation of wind towers. In the end, two thematic units were established, the first being 'Vulnerability processes and impacts on human health', and the second, 'Wind turbines and the repercussions on quality of life'.

Box 1. Description of the coding tree

Thematic Units	Present themes
Thematic Unit I: Vulnerability processes and impacts on human health	Hearing problems, noise impacts, dermatological changes
Thematic Unit II: Wind turbines and the repercussions on quality of life	Changes in quality of life, Displacement

Source: Own elaboration.

In the results treatment and interpretation stage, the contents present in the material collected through the instrument were captured and the meanings were studied, interpreting them through reading the material.

The information in this research preserved the confidentiality of the data and the non-identification of the participants. Therefore, numbers from 1 to 7 were designated to reference the participants' discourses.

Results and discussion

Seven people participated in the study, four who declared themselves cisgender women and three cisgender men. Regarding race/color, all participants declared themselves as brown/black. Regarding age, 1 peasant was between 20 and 29 years old; 2 peasants, between 30 and 39 years old; 2 peasants, between 40 and 49 years old; 1 peasant,

between 60 and 69 years old; and 1 peasant, between 70 and 79 years old.

With regard to marital status, it was observed that five interviewees were married, one was divorced and one was widowed.

Regarding education, it was found that most of the research participants had not completed their studies, with four interviewees having incomplete primary school, one with incomplete middle school and only two interviewees had completed high school.

Regarding occupation, the majority did not have a paid occupation, six being subsistence farmers, who received financial assistance through an income distribution program from the federal government, with a monthly income lower than the minimum wage, and one participant who worked paid occupation of director of a workers' organization, according to the Brazilian Occupation Classification¹², with an income of less than two monthly minimum wages.

Table 1. Sociodemographic and economic characteristics of the study population

Characteristics	Nº	%
Gender (n = 7)		
Cisgender Woman	4	57.1
Cisgender man	3	42.8
Race/color (n = 7)		
Brown/Black	7	100
Age (n = 7)		
20 years – 30 years	1	14.2
31 years – 40 years	2	28.5
41 years – 50 years	2	28.5
51 years – 60 years	0	0
61 years – 70 years	1	14.2
71 years – 80 years	1	14.2
Occupation (n = 7)		
Subsistence farmer	6	85.7
Director of a workers' organization	1	14.2
Marital Status (n = 7)		
Married	5	71.4
Divorced	1	14.2
Widowed	1	14.2
Education (n = 7)		
Incomplete primary school	4	57.1
Incomplete middle school	1	14.2
Complete High School	2	28.5
Income (n = 7)		
< 1 minimum wage	6	85.7
< 2 minimum wage	1	14.2

Source: Own elaboration.

Vulnerability processes and impacts on human health

The arrival of wind farms in traditional communities brings socio-environmental changes, such as changes in the way of life, territorial dispossession and changes in local fauna and flora¹³⁻¹⁵. In addition to these disorders, there is another area that is heavily affected: health. After the arrival of the wind farm, changes were observed in the peasants' organism:

After this wind farm, I'm a bit deaf. I went to the doctor, the doctor prescribed meds! He said... look,

do this treatment for three months, then you come back, I'm going to have to come back again because I'm not listening properly. You talk like that, close, sometimes I say 'ahem', but I didn't hear what you said. And the 'thyroid' problem has also changed. Sleep, we don't even talk about it, no one sleeps anymore. (Participant 1).

What I have been experiencing most frequently is hearing loss [...]. I'm having very, very bad hearing loss. (Participant 2).

My issue is the migraine and dizziness, I feel it a lot after them [the towers]. (Participant 3).

After them I feel sick, headache and earache. (Participant 4).

Lots of headache, dizziness. I go to the doctor and they say it's nothing, that I don't have a problem. Just yesterday I went to get some imbu, I went from here to there, I was already dizzy. (Participant 5).

Such changes may be related to the effects of noise and vibrations on the human body, specifically on the vestibular system, located in the inner ear. Signs of vestibular disorders involve imbalance, gait deviations, instability in walking, rotating sensation and falls¹⁶.

The absence of damage to the auditory system characterizes hearing as normal. However, when any type of injury occurs, hearing will be impaired. Furthermore, injuries to the inner ear are irreparable, as they damage sensory or nervous structures¹⁷.

It is observed that vulnerable participants feel uncomfortable with this exposure to noise, as it was not something that was part of their routines. From a physiological point of view, noise is defined as any acoustic phenomenon that produces an unpleasant or unwanted auditory sensation¹⁷. In this way, the perception of noise becomes individual and subjective, varying according to its characteristics of intensity, spectrum and frequency and the particularities of the individuals who receive this stimulus, such as age, emotional state, beliefs and way of life.

Participants report that they had illnesses diagnosed after the arrival of the wind towers or the worsening of previously identified health problems:

I didn't have a diagnosis after them [the towers], but what I already had, the migraine, got worse. (Participant 3).

I was diagnosed with thyroid and anxiety. I didn't have anxiety or thyroid, I only had it after they [the towers] arrived (Participant 4).

I already had diabetes before them [...], but after them it got much worse. The doctor himself said that my diabetes wasn't just about food. (Participant 5).

I have this skin disease, but they still don't know what it is. I know it was because of them [the towers]. (Participant 6).

The autonomic nervous and endocrine system is excited after exposure to noise, presenting physiological, biochemical and cardiovascular changes in response. Studies have been developed with the aim of investigating the non-auditory effects of human exposure to noise, such as changes in the cardiovascular system, diabetes and stress⁷.

The wind farms were inaugurated at Sítio Sobradinho, on September 29, 2015, and since the beginning of operation and the contact of the local population with the noise, changes have been felt in their bodies:

Every now and then I feel something on my feet, like a shock. Right from the beginning that they [the towers] arrived, I already felt it, after just a few days. (Participant 6).

For about three years now, I've been feeling tremors, palpitations, stitches. (Participant 7).

When they are creaking and shaking, it feels like it's inside my head, my heart races. (Participant 5).

As previously mentioned, exposure to noise is harmful to human health. It is not possible to say for sure after how long of exposure an observer can perceive such changes, but exposure for at least two weeks may be capable of triggering such senses¹⁸.

Noise, despite being made up of sound waves, can be captured through solid structures and cause vibrations, thus being called Low Frequency Noise (RBF) or infrasound. The human body has different natural frequencies, which vary depending on location.

However, it becomes extremely serious when the body is directly exposed to a frequency that differs from its own, which can cause permanent damage to organs, triggering headaches, tremors, fatigue and insomnia¹⁷.

The destructive effects of noise can be avoided or minimized even in the planning phase of the construction of wind farms. The further away wind towers are installed from homes, the lower the chances of nuisance. The Brazilian Institute of the Environment and Renewable Natural Resources, through the National Environmental Council (CONAMA) and through Resolution No. 462, of July 24, 2014, established mechanisms for the environmental licensing of electricity generation projects on land¹⁹. The document determines that an environmental diagnosis must be carried out, provided by the company, which, among its specifications, requires information regarding noise produced by wind farms that are less than 400 meters away from isolated residences or communities. Until the year 2023, the participants or authors of this research did not have access to any document confirming the making of such a study.

In Brazil, unlike other countries, such as Belgium, Denmark, France and Sweden, there is no legislation that specifies the distance between houses and the insertion of wind towers. In Pernambuco, there is Ordinary Law Project No. 620/2019, which proposes determining the minimum distance for installing wind turbines in relation to buildings for public, collective and private use. The indicated distance was 500 meters. This bill was presented after exposing the impacts of wind towers in a public hearing at the Legislative Assembly of the State of Pernambuco (ALEPE)²⁰.

The presence of an unidentified, fine and white, powder was also observed, which settles in the waters of cisterns, tanks, dams and mud pits, accumulating on any flat surface. In large quantities and when humidified, this product forms a homogeneous and dense mass. The origin of this material was not identified, but

it is known that it appeared in the region after wind farms began operating:

We see people saying that that material is carcinogenic, that it is a fiber that we see from afar, that has already faded, that has already flown on our land, on top of our house, this dust is flying. Even the water for us to drink today, the water is contaminated. If we plant, it's also the same thing, the water goes to the dam, it goes to the barreiro too. (Participant 1).

If you turn on a flashlight at night, outside, it's not fog or anything, it's just a very fine dust. From there it falls into the cistern, which we see at the bottom when we clean it. It looks like a lump in the gutter, it's not normal dirt. The only dust that kicks up here is from the school bus. (Participant 7).

There is dust released from them that falls into the cistern. Because the cistern is completely closed, right? It's nothing that falls into it, it comes from the gutter. Then it comes into the house too, picking up the clothes on the line. (Participant 3).

Both the water from the clay pit and the cistern. The water passes through the pipe and falls into the cistern, dirty with the dust that comes from the tower. It falls on the tile, from the tile to the gutter and from the gutter to the cistern. There we drink, wash clothes, take baths, the animals drink, everything suffers. (Participant 5).

Participants report that after discovering the presence of this material on their lands and waters, wounds and spots appeared on their skin, with a rough consistency and that itch.

I went to São Paulo and the doctors said that my skin was like that because of a powder. [...] I live in their direction, of the towers, right? She said it was a powder that was causing this to me. (Participant 6).

I can't prove it, but I got the itch, my skin was all stained, as if it had burst. (Participant 7).

Over the years, wind towers, which operate almost uninterruptedly, end up wearing out. It is likely that, from this degradation, elements will be released from its structure and carried away by the air, such as the reported dust. The materials most used to manufacture wind turbine blades are steel, aluminum and a combination of materials (wood, fiberglass and carbon fiber). The ideal material for manufacturing the shovel must have good resistance and meet cost and ease of manufacturing requirements; therefore, fiberglass meets these needs²¹.

The type of glass fiber most used in the manufacture of blades is type E. It is composed of silicon dioxide (SiO₂), aluminum oxide (Al₂O₃), boron oxide (B₂O₃), magnesium oxide (MgO), calcium oxide (CaO) and sodium oxide (Na₂O). Carbon fiber is also widely used as it gives more stability to increasingly longer blades²².

Studies prove the link of these components to health problems, such as SiO₂ associated with fibrosing lung disease, AlO₃ and MgO linked to skin irritation and difficulty breathing, CaO correlated with hives and eye burns and Na₂O linked to disorders in the nose and throat, digestive, dermatological and ocular changes^{23,24}.

Wind turbines and the repercussions on quality of life

In 1946, the World Health Organization (WHO)²⁵ defined health as an absolute state of physical, mental and social well-being, and not just the absence of disease. However, this determination becomes insufficient, since health has as determinants and conditions, among others, food, housing, basic sanitation, the environment, work, income, education, transport, leisure and access to essential goods and services²⁶. Health can be understood as a phenomenon, and not as a stagnant event, as it is linked to different individual and collective aspects.

The concept of health can be related to that of quality of life, also proposed by the WHO, as the individual's vision and its incorporation

into life, in the context of the culture and value systems in which they are inserted and the equivalence to their objectives, expectations, standards and concerns.

The term quality of life is complex and subjective, portraying individual responses to the physical, mental and social aspects that constitute a normal routine²⁷. In this way, the definition of quality of life is linked to the context in which the person is inserted and all the experiences lived in that space, making it something subjective and complex to define precisely.

In the case of the participants, the different dimensions need to be considered, since they are people with a traditional and well-defined way of life, who were surprised by companies that invaded their lands with the intention of staying and enjoying what the territory could offer, without measuring the consequences that this movement could cause for the population, subjecting peasants to situations that caused physical and mental discomfort.

Some authors argue that wind energy and the supposed profitability for the local population result in an improvement in quality of life²⁸. However, it was not possible to find benefits or improvements in the participants' reports, as the majority emphasized that only by moving away from the wind towers would they be able to have quality of life:

I went out for a while, went to São Paulo and got well, I felt fine, I didn't feel anything. They [the towers] harmed my life. (Participant 6).

If I left there, we would even be able to worry about other things. The person is there, then it's an explosion, a crack. If we leave the house, we worry about whoever stayed behind, whether everything is at peace with whoever stayed behind. (Participant 5).

If I wasn't here, my life would have gotten better. I already asked my son to leave [...] I say 'my son, let's go to São Paulo', and he says 'mom, there in São Paulo, the rent near where I was working is a thousand reais, mother. There's nowhere for us to go'. (Participant 4).

Participant 2 reports that he felt an improvement in his quality of life after leaving his property:

I left my property in search of, as they say, peace and quiet, because I didn't have any there. My wife got sick, she has depression. Everything after wind farms. (Participant 2).

This improvement can be considered relative, because when they move away from the wind towers, the discomfort and constant fear cease, making the peasants experience a certain well-being. However, as a consequence of this separation, other problems may arise, given that this displacement distances the peasants from their territory and all the symbolism of the place, which can cause trauma and vulnerability.

The term quality of life is complex and subjective, portraying individual responses to the physical, mental and social aspects that constitute a normal routine²⁹. It is clear that the quality of life of the participants is impaired, as factors such as health, physical and mental well-being have been severely affected since the arrival of wind farms.

Conclusions

It was observed that the arrival and operation of the wind turbines coincided with the emergence of signs and symptoms, such as hearing and skin problems, anxiety, dizziness and headache. This situation allows us to consider a probable connection between the impacts caused by wind towers, already described in the literature, and those present in the participants' reports. Prudence is necessary when planning and building wind farms, since such health problems can be temporary or permanent, leading the local community to constant suffering. The need for new studies focused on the effects of wind farms on human health is highlighted.

Collaborators

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