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ENTRE MUDANÇAS E RESISTÊNCIAS: ADAPTAÇÃO E RESILIÊNCIA DE ATORES SOCIAIS ÀS TRANSFORMAÇÕES DOS PARQUES EÓLICOS

BETWEEN CHANGES AND RESISTANCE: ADAPTATION AND RESILIENCE OF SOCIAL ACTORS TO THE TRANSFORMATIONS OF WIND FARMS

ENTRE CAMBIOS Y RESISTENCIAS: ADAPTACIÓN Y RESILIENCIA DE LOS ACTORES SOCIALES A LAS TRANSFORMACIONES DE LOS PARQUES EÓLICOS

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Abstract

This study analyzes the perceptions, adaptation strategies, and resilience mechanisms of three groups of social actors: the local community (n=26), municipal government authorities (n=5), and wind energy sector companies (n=3), in response to the socioecological transformations produced by wind farms in Campo Formoso, Bahia. The research employs a sequential explanatory mixed-methods design, integrating: (a) quantitative analysis using a 15-item Likert scale per group, a Composite Socio-Environmental Impact Index (ICIS), ordinal logistic regression, and non-parametric tests (Kruskal-Wallis and Mann-Whitney U), with internal validation via Cronbach's alpha; and (b) qualitative analysis grounded in Critical Discourse Analysis (CDA), following Fairclough's (2001, 2003) three-dimensional model. Given the small sample size in two of the three groups, the results are exploratory in nature and do not support statistical generalization. The findings reveal perceptual asymmetries across groups: companies demonstrate high self-assessment (ICIS=4.22), government authorities record ambivalent perceptions (ICIS=3.05), and the local community expresses considerably less favorable assessments (ICIS=2.68). CDA

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identified distinct discursive patterns: a corporate discourse of managed proximity; a governmental discourse characterized by critical awareness combined with inverted accountability; and a community discourse marked by majority normalization (53.8% of respondents) and critical minority voices. The study concludes that the community develops passive resilience through normalization, without strengthening collective adaptive capacity, thereby configuring a situation of silent vulnerability that demands academic and political-institutional attention.

Keywords: Wind energy; Socio-ecological resilience; Environmental perceptions; Environmental justice; Human Ecology.

Resumo

Este estudo analisa as percepções, estratégias de adaptação e mecanismos de resiliência de três grupos de atores sociais: a comunidade local (n=26), poder público municipal (n=5) e empresas do setor eólico (n=3), frente às transformações socioecológicas provocadas por parques eólicos em Campo Formoso, Bahia. A pesquisa adota métodos mistos em desenho explicativo sequencial, integrando: (a) análise quantitativa por escala Likert de 15 itens por grupo, Índice Composto de Impacto Socioambiental (ICIS), regressão logística ordinal e testes não paramétricos (Kruskal-Wallis e Mann-Whitney U), com validação interna por Alpha de Cronbach; e (b) análise qualitativa fundamentada na Análise Crítica do Discurso (ACD) segundo o modelo tridimensional de Fairclough (2001, 2003). Dado o tamanho amostral reduzido em dois dos três grupos, os resultados têm caráter exploratório e não permitem generalização estatística. Os achados revelam assimetrias perceptuais entre os grupos: as empresas apresentam autoavaliação elevada (ICIS=4,22), o poder público registra percepção ambivalente (ICIS=3,05) e a comunidade manifesta percepções consideravelmente menos favoráveis (ICIS=2,68). A ACD identificou padrões discursivos distintos: discurso empresarial de proximidade gerenciada, discurso do poder público com consciência crítica associada a responsabilização invertida, e discurso comunitário marcado pela normalização majoritária (53,8% dos respondentes) e por vozes críticas minoritárias. Conclui-se que a comunidade desenvolve resiliência passiva por normalização, sem fortalecimento da capacidade adaptativa coletiva, configurando situação de vulnerabilidade silenciosa que demanda atenção acadêmica e político-institucional.

Palavras-chave: Energia eólica; Resiliência socioecológica; Percepções ambientais; Justiça ambiental; Ecologia Humana.

Resumen

Este estudio analiza las percepciones, estrategias de adaptación y mecanismos de resiliencia de tres grupos de actores sociales: comunidad local (n=26), autoridades públicas municipales (n=5) y empresas del sector eólico (n=3), frente a las transformaciones socioecológicas provocadas por los parques eólicos en Campo Formoso, Bahía. La investigación adopta métodos mixtos en un diseño explicativo secuencial, integrando: (a) análisis cuantitativo mediante escala Likert de 15 ítems por grupo, Índice de Impacto Socioambiental Compuesto (ICIS), regresión logística ordinal y pruebas no paramétricas (Kruskal-Wallis y Mann-Whitney U), con validación interna por Alfa de Cronbach; y (b) análisis cualitativo basado en el Análisis Crítico del Discurso (ACD), siguiendo el modelo tridimensional de Fairclough (2001, 2003). Dado el reducido tamaño muestral en dos de los tres grupos, los resultados tienen carácter exploratorio y no permiten generalización estadística. Los hallazgos revelan asimetrías perceptuales entre los grupos: las empresas presentan una alta autoevaluación (ICIS=4,22), las autoridades públicas registran percepciones ambivalentes (ICIS=3,05) y la comunidad expresa percepciones considerablemente menos favorables

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(ICIS=2,68). La ACD identificó distintos patrones discursivos: discurso empresarial de proximidad gestionada, discurso del poder público con conciencia crítica asociada a responsabilización invertida, y discurso comunitario marcado por la normalización mayoritaria (53,8% de los encuestados) y voces críticas minoritarias. Se concluye que la comunidad desarrolla resiliencia pasiva a través de la normalización, sin fortalecer la capacidad adaptativa colectiva, configurando una situación de vulnerabilidad silenciosa que demanda atención académica y político-institucional.

Palabras clave: Energía eólica; Resiliencia socioecológica; Percepciones ambientales; Justicia ambiental; Ecología humana.

1. Introduction

The expansion of wind energy in Brazil, particularly in the northeastern region, constitutes a phenomenon that extends well beyond the energy sector, imposing profound transformations on the territories where such projects are established. Wind farms simultaneously represent advances in the energy transition and in climate change mitigation, yet they also generate significant challenges for local communities, government authorities, and industry companies alike, demanding continuous processes of adaptation and the construction of socioecological resilience.

Recent scientific literature has demonstrated that the impacts of wind energy projects are not limited to environmental and economic dimensions, but also involve complex reconfigurations of social relations, territorial identities, and the ways of life of affected populations (Gorayeb et al., 2018; Brannstrom et al., 2017). In this context, understanding how different social actors perceive, respond to, and adapt to these transformations becomes fundamental to the construction of more equitable and sustainable development models.

The perspective of Human Ecology presents itself as an appropriate analytical framework for examining these dynamics, given its consideration of the interactions between social and ecological systems and its recognition of the centrality of local actors' perceptions and adaptive capacities (Moran, 2010; Berkes and Folke, 1998). This approach enables the analyst to move beyond reductionist views that treat communities as passive recipients of external impacts, recognizing them instead as active agents in processes of territorial transformation.

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The study area, Campo Formoso in the state of Bahia, stands as one of the principal wind energy generation hubs in northeastern Brazil, characterized by territorial dynamics shaped by the overlapping of multiple land uses, the socio-environmental vulnerability of rural communities, and the complexity of relations among diverse social actors. Understanding how these actors build their adaptive capacities within a context of accelerated transformation constitutes a relevant contribution both to the academic field and to the formulation of sound public policies and responsible business practices.

Despite the growth of wind energy research in Brazil, studies adopting integrated and multidimensional approaches to understanding the socioecological transformations produced by these projects remain scarce (Juárez et al., 2019). Most existing research focuses on specific dimensions, without integrating perspectives that simultaneously address perceptions, adaptive capacities, and resilience across different stakeholder groups. This study seeks to fill that gap by proposing a systemic analysis that articulates environmental, social, economic, and political dimensions through the lens of Human Ecology.

The general objective of this research is to analyze the perceptions, adaptation strategies, and resilience mechanisms of three groups of social actors — the local community, municipal government authorities, and wind energy sector companies — in response to the socioecological transformations brought about by wind farms established in Campo Formoso, Bahia. The results may inform policies and practices that promote a more equitable distribution of the benefits and risks associated with wind energy expansion, contributing to an energy transition that does not reproduce or deepen existing social and territorial inequalities (Porto and Finamore, 2012).

2. Theoretical Framework

2.1 Human Ecology and Socioecological Systems

Human Ecology is an interdisciplinary field dedicated to understanding the complex and dynamic relationships between human populations and their environments, transcending traditional dichotomies between nature and society (Moran, 2010; Steiner and Nauser, 1993). This theoretical perspective is particularly relevant to the analysis of transformations

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produced by wind farms, insofar as these projects profoundly reconfigure the interactions between social and ecological systems in the territories where they operate.

In the context of wind farms, the Human Ecology approach allows for an understanding of how environmental transformations — alterations in landscape, impacts on flora and fauna, microclimatic changes — are intrinsically related to social transformations (changes in ways of life, reconfiguration of territorial identities, new power arrangements) and economic transformations (job creation, tax revenue, land value appreciation or depreciation). Most critically, this approach emphasizes that social actors are not passive recipients of such transformations, but active agents who perceive, interpret, and respond to change in diverse ways (Adger, 2000).

2.2 Socioecological Resilience

The concept of resilience originated in systems ecology, initially referring to a system's capacity to absorb disturbances and maintain its basic functions (Holling, 1973). Over the past decades, this concept has been substantially expanded, particularly through its application to socioecological systems, generating approaches that emphasize not only absorptive capacity, but also adaptive and transformative capacity (Folke, 2006, 2005; Walker et al., 2004).

Walker et al. (2004) define socioecological resilience as "the capacity of a system to absorb disturbances and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks." This definition incorporates the idea that resilience also entails learning capacity, innovation, and adaptive transformation (Folke et al., 2010). Three aspects are particularly relevant: latitude, resistance, and precariousness — the latter referring to the system's proximity to critical thresholds.

Berkes and Ross (2013) propose a conceptual model of community resilience that identifies multiple interconnected factors, including: local knowledge and learning, community organization, leadership, economic resources, infrastructure, and connections with external institutions. In the context of large energy projects, the literature has emphasized that resilience also depends on governance structures, participation mechanisms, and institutional arrangements that mediate relations among different social actors (Adger et al., 2005; Smit and Wandel, 2006; Lemos and Agrawal, 2006).

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Adaptive capacity refers to the attributes of a system that enable it to adjust to change, moderate potential damage, take advantage of opportunities, or cope with the consequences of disturbances (Smit and Wandel, 2006; Engle, 2011). Brooks et al. (2005) identify its key determinants: economic resources, technology, information, infrastructure, institutions, and equity. In the context of wind farms, these determinants manifest differently for each stakeholder group: communities frequently face scarce economic resources, limited access to information, and institutional fragility, while companies and government authorities possess greater resources, though they contend with challenges related to institutional rigidity or a disconnect between planning and implementation.

Adaptive capacity is closely linked to the concept of vulnerability, understood by the IPCC (2007, p. 883) as "the degree to which a system is susceptible to, or unable to cope with, adverse effects," as a function of exposure, sensitivity, and adaptive capacity itself (Adger, 2006). Crucially, vulnerability and adaptive capacity are dynamic processes, shaped by historical, political, and economic factors (Eakin and Luers, 2006). In the case of rural communities in northeastern Brazil, longstanding patterns of marginalization and inadequate public services configure contexts of vulnerability that predated the installation of wind farms (Gorayeb et al., 2018).

2.3 Socio-Environmental Perceptions, Participation, and Environmental Justice

The perceptions that different social actors construct about territorial and socio-environmental transformations are not simple reflections of objective reality, but social constructions mediated by values, experiences, social positions, and power relations (Hannigan, 2006; Buttel, 1987). White (2004) argues that environmental perceptions are always socially and culturally situated, reflecting structurally distinct positions with respect to natural resources and development processes.

Social participation in decision-making processes that affect territories and ways of life is a central element both for building resilience and for promoting environmental justice (Arnstein, 1969; Reed, 2008; Pretty, 1995). Pretty (1995) distinguishes between passive forms of participation — limited to the receipt of information — and active forms, grounded in collective learning and the capacity to influence decisions, a distinction that proves analytically relevant for interpreting the data of this study.

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Arnstein (1969) proposes a “ladder of citizen participation” ranging from non-participation to citizen control. In the context of wind farms in Brazil, research has shown that consultation processes are frequently limited to the lower rungs of this ladder, functioning more as strategies for legitimizing decisions already taken than as genuine processes of collective construction (Gorayeb and Brannstrom, 2016; Brannstrom et al., 2017).

Environmental justice places at the center of analysis questions of equity in the distribution of risks and benefits, recognizing that socially vulnerable groups tend to be disproportionately affected by negative impacts and underrepresented in decision-making processes (Acselrad et al., 2009; Schlosberg, 2007). In the context of wind energy expansion in Brazil — particularly accelerated from the 2000s onward (Araújo and Freitas, 2008; GWEC, 2020) — socio-environmental conflicts and challenges to the implementation models adopted have been well documented (Gorayeb et al., 2018), including land disputes marked by asymmetries of power and information in negotiations between companies and communities (Juárez et al., 2019; Pasqualetti, 2011; Dunlap, 2018). Dunlap (2018) goes further, arguing that the narrative of wind energy as an environmental “solution” may obscure processes of territorial colonization that disproportionately affect rural and indigenous populations, replicating extractivist logics under a new technological guise.

The concept of wind energy “territorialization,” proposed by Brannstrom et al. (2017), captures the idea that wind farms produce new territorialities, reconfiguring power relations, identities, and spatial practices. The territorial perspective adopted here draws on the understanding of territory as a dynamic and plural social construction, traversed by power relations and by simultaneous processes of territorialization, deterritorialization, and reterritorialization (Haesbaert, 2004). In Brazil’s semi-arid northeast, the transformations brought about by these projects are superimposed on historically existing contexts of vulnerability, including recurrent droughts, environmental degradation, rural poverty, and institutional fragility (Marengo et al., 2011).

3. Methodology

3.1 Research Design and Ethical Approval

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This research employs a sequential explanatory mixed-methods design (Creswell and Clark, 2017). The quantitative phase, through the application of a Likert scale and ordinal logistic regression analysis, allows for the identification of patterns in the perceptions of different social actors (Agresti, 2007). The qualitative phase, grounded in Critical Discourse Analysis following Fairclough (2001, 2003), deepens the understanding of the meanings, contexts, and power relations underlying those perceptions. The results of both phases were integrated through methodological triangulation.

The research was approved by the Research Ethics Committee of the Universidade do Estado da Bahia (CEP/UNEB) under protocol CAAE 89595125.9.0000.0057, in accordance with the guidelines set forth in CNS Resolutions no. 466/2012 and no. 510/2016.

3.2 Context and Participants

The research was conducted in the municipality of Campo Formoso, located in the semi-arid region of Bahia, one of the state's principal wind energy generation hubs. The selection of this site is justified by the quantitative significance of its wind generation output, the diversity of projects and companies operating there, the presence of rural communities directly affected by the installations, and its potential to illuminate comparable contexts across the northeastern semi-arid region.

Participants were selected through purposive sampling, encompassing three distinct groups of social actors: (a) the local community (n=26), composed of residents of communities directly affected by wind farms; (b) municipal government authorities (n=5), composed of public managers working in the environmental sector; and (c) wind energy sector companies (n=3), represented by managers or technical coordinators of operating wind farm companies.

The small sample size in two of the three groups — municipal government (n=5) and companies (n=3) — constitutes a central limitation of the study. This constraint stemmed from the effective availability of qualified informants within each category in the investigated context, and is a recurring characteristic of research involving specific institutional actors. As a result, comparative analyses across groups are exploratory in nature, and inferences must be appropriately tempered: the results describe the perceptions of the participants

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contacted, are not statistically representative of their respective categories, and do not permit generalization beyond the studied context.

3.3 Quantitative Instrument: Likert Scale and ICIS

The data collection instrument consists of a Likert scale structured around three sub-dimensions of five items each, totaling 15 items per group, thematically adapted for each respondent category. The scale uses five response points, ranging from 1 (Strongly Disagree) to 5 (Strongly Agree).

For the local community, the sub-dimensions were:

- Participation and Engagement (the degree of community involvement in decision-making processes related to the wind farm);
- Cultural Adaptation (transformations in the community's cultural heritage); and
- Community Resilience (the community's capacity to adapt and respond to transformations).

For the municipal government authorities, the sub-dimensions were:

- Adaptive Capacity (institutional changes in response to transformations);
- Change Management (planning, monitoring, and socio-environmental mediation mechanisms); and
- Governance (institutional arrangements and decision-making processes).

For the wind energy companies, the sub-dimensions were:

- Community Relations (strategies for engagement with the local community);
- Adaptive Management (capacity to monitor and adjust practices in response to impacts); and
- Sustainability (long-term commitment to territorial sustainability).

The Composite Socio-Environmental Impact Index (ICIS) was constructed as the arithmetic mean of the means of the 15 scale items for each group, aggregating the three sub-dimensions with equal weighting (weight 1/3 per sub-dimension). This methodological decision — based on equal weights — reflects the absence of prior theoretical criteria that would justify differential weighting among sub-dimensions, which were conceived as equivalent and complementary dimensions of the actors' socio-environmental experience.

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The validity of this structure was verified through internal consistency analysis (Cronbach's alpha). ICIS cut-off points were established based on the categories of the underlying Likert scale: values of 1.0 or below indicate null or negligible impact; between 1.1 and 2.0, low impact; between 2.1 and 3.5, moderate impact; and above 3.5, high impact.

3.4 Quantitative Analyses Performed

The following quantitative analyses were performed using R software: (a) descriptive statistics (means, standard deviations, and medians) by item, sub-dimension, and group; (b) scale reliability analysis via Cronbach's alpha coefficient; (c) ICIS calculation by sub-dimension and by group; (d) ordinal logistic regression to model the relationship between the actor group (categorical independent variable, with the community as the reference category) and perception categorized across four ICIS levels (ordinal dependent variable: Null, Low, Moderate, High), using the logistic link function of the proportional odds model; and (e) non-parametric tests (Kruskal-Wallis for global comparison across the three groups and Mann-Whitney U for pairwise comparisons) as a complementary analysis given the limitations imposed by sample size.

Since the sample size of the Municipal Government (n=5) and Company (n=3) groups precludes stable estimation of the ordinal logistic regression coefficients — for which conventional assumptions require a minimum of 10 to 15 observations per category — the modeling results are presented with interpretive reservations. Non-parametric tests, being less dependent on distributional assumptions, provide more robust exploratory indications in this context.

3.5 Critical Discourse Analysis: Corpus, Criteria, and Operationalization

The qualitative analysis followed the principles of Critical Discourse Analysis (CDA) according to Fairclough's (2001, 2003) three-dimensional model, which integrates three analytical levels:

1. Text – Analysis of the linguistic characteristics of the narratives, including lexical choices, metaphors, modalization, naming processes, and argumentative structure;

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2. Discursive practice – Modes of discourse production and consumption, including the conditions under which utterances were produced; and

3. Social practice – Articulation of discourses with structures of power, inequality, and ideology.

The CDA corpus was constituted by the open-ended responses collected during the qualitative phase of the instrument, obtained through semi-structured interviews conducted across the three actor groups. All utterances that, in the initial coding process, contained content related to at least one of the following thematic axes were included in the corpus: (a) perceptions of the wind farm's socio-environmental impacts; (b) adaptation or resilience strategies; (c) relations among social actors; and (d) participation and access to information. The selection of excerpts prioritized those with the greatest thematic density and representativeness of the discursive pattern identified in each group, as well as utterances that presented relevant internal divergence or tension.

Transcripts were organized and coded in NVivo software, with the creation of thematic nodes corresponding to the CDA analytical axes. The analytical operationalization included: identification of modality markers (verbs and expressions indicating obligation, possibility, or certainty); analysis of agency choices (who acts, who is acted upon); mapping of generalization and universalization processes; identification of legitimation and accountability strategies; and analysis of the quantitative distribution of utterances as a complementary analytical datum. The integration of quantitative and qualitative results followed a triangulation strategy, seeking convergences, complementarities, and contradictions between the two methods (Creswell and Clark, 2017).

4. Results and Discussion

4.1 Quantitative Analysis

The research instrument was evaluated using Cronbach's alpha coefficient. Values above 0.70 are considered acceptable, above 0.80 good, and above 0.90 excellent (Hair et al., 2009). The results demonstrate high internal consistency across most scales, with values ranging from 0.9259 to 0.9897, all classified as excellent. The total scales for each group

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yielded particularly robust coefficients: Community (α=0.9833), Municipal Government (α=0.9897), and Company (α=0.9590), as shown in Table 1 and Figure 1.

Table 1 – Cronbach's Alpha Coefficients by Sub-dimension and Actor Group

Group	Sub-dimension	α	Classification
Community	Participation and Engagement	0,9496	Excellent
Community	Cultural Adaptation	0,9738	Excellent
Community	Community Resilience	0,9658	Excellent
Community	**Total Scale (15 items)**	**0,9833**	**Excellent**
Municipal Government	Adaptive Capacity	0,9826	Excellent
Municipal Government	Change Management	0,9639	Excellent
Municipal Government	Governance	0,9717	Excellent
Municipal Government	**Total Scale (15 items)**	**0,9897**	**Excellent**
Company	Community Relations	0,5357	Poor*
Company	Adaptive Management	0,9259	Excellent
Company	Sustainability	0,9722	Excellent
Company	**Total Scale (15 items)**	**0,9590**	**Excellent**

* The reduced alpha in this sub-dimension results from the combination of n=3 and the absence of variability (three of the five items received the maximum score from all respondents). As Tavakol and Dennick (2011) note, Cronbach's alpha is particularly sensitive to small samples and low variability, tending to artificially deflate the coefficient. The result indicates near-absolute convergence in corporate perceptions, and does not invalidate the sub-dimension.

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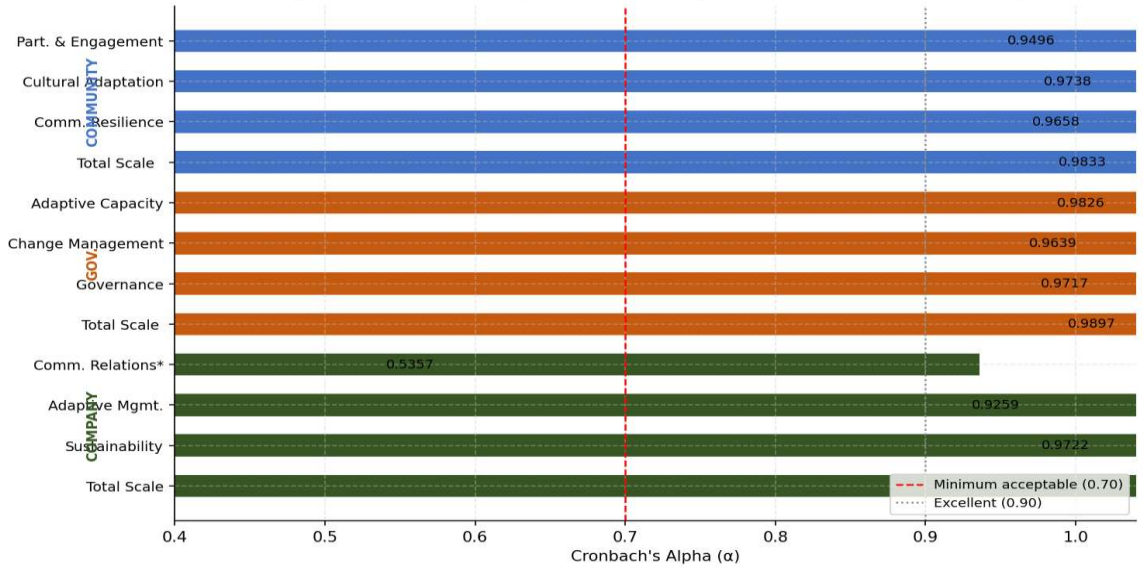
Figure 1 – Cronbach's Alpha Coefficients by Sub-dimension and Actor Group

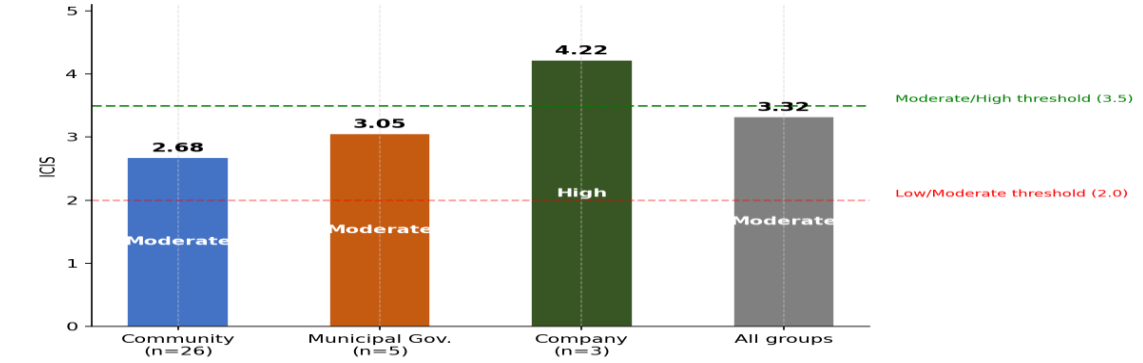


** Reduced α explained by n=3 combined with zero variability on three items (see Table 1).*

Source: Research data.

The ICIS was calculated as the arithmetic mean of the means of the 15 items in each group's scale, classified according to the following categories: ≤1.0 (Null/Negligible), >1.0 to ≤2.0 (Low), >2.0 to ≤3.5 (Moderate), and >3.5 to ≤5.0 (High). The results reveal significant perceptual asymmetries across groups. The overall ICIS was 3.32 (Moderate), but this aggregate masks profoundly distinct perceptions: companies recorded an ICIS of 4.22 (High), government authorities 3.05 (Moderate), and the local community 2.68 (Moderate), approaching the lower threshold of that range, as shown in Figure 2 and Table 2.

Figure 2 – Composite Socio-Environmental Impact Index (ICIS) by Actor Group



. Source: Research data.

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Table 2 – Composite Socio-Environmental Impact Index (ICIS) by Group and Sub-dimension

Group	Sub-dimension	ICIS	Classification
Community	Participation and Engagement	2,47	Moderate
Community	Cultural Adaptation	3.19	Moderate
Community	Community Resilience	2,38	Moderate
Community	**Group ICIS**	**2,68**	**Moderate**
Municipal Government	Adaptive Capacity	2,68	Moderate
Municipal Government	Change Management	3,24	Moderate
Municipal Government	Governance	3,24	Moderate
Municipal Government	**Group ICIS**	**3,05**	**Moderate**
Company	Community Relations	4,67	High
Company	Adaptive Management	4,20	High
Company	Sustainability	3,80	High
Company	**Group ICIS**	**4,22**	**High**
All groups	**Overall ICIS**	**3,32**	**Moderate**

Source: Research data.

The sub-dimension analysis reveals additional notable patterns. Within the community, the Community Resilience sub-dimension recorded the lowest ICIS (2.38), with the items “Emergence of new local leaders” (M=1.77) and “Strengthened community organization” (M=1.69) yielding the lowest means of the entire study, both classified as Low — signaling

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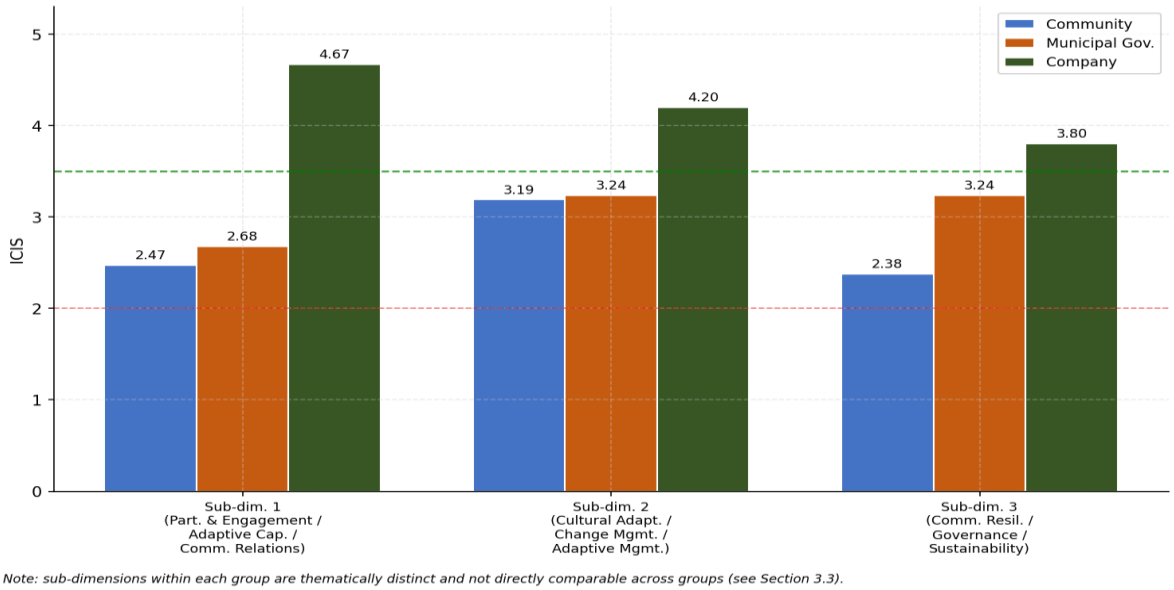
a perceived erosion of community social capital. By contrast, the companies' Community Relations sub-dimension reached an ICIS of 4.67, the highest in the study, with three items scoring the maximum (5.0): communication, environmental education, and community events, as presented in Table 3 and Figure 3.

Figure 3 – ICIS by Sub-dimension and Actor Group



Note: sub-dimensions within each group are thematically distinct and not directly comparable across groups (see Section 3.3).

Source: Research data.

Table 3 – Distribution of ICIS Categories by Actor Group

Group	Null	Low	Moderate	High
Community (n=26)	1 (3,8%)	10 (38,5%)	7 (26,9%)	8 (30,8%)
Municipal Government (n=5)	0 (0,0%)	1 (20,0%)	2 (40,0%)	2 (40,0%)
Company (n=3)	0 (0,0%)	0 (0,0%)	0 (0,0%)	3 (100,0%)

Source: Research data.

The distribution of categories reveals distinctive patterns, as illustrated in Figure 4: within the community, 42.3% of respondents fell in the Null or Low ranges, while 100% of company representatives were situated in the High range. The municipal government showed an intermediate distribution, with 40% in Moderate and 40% in High.

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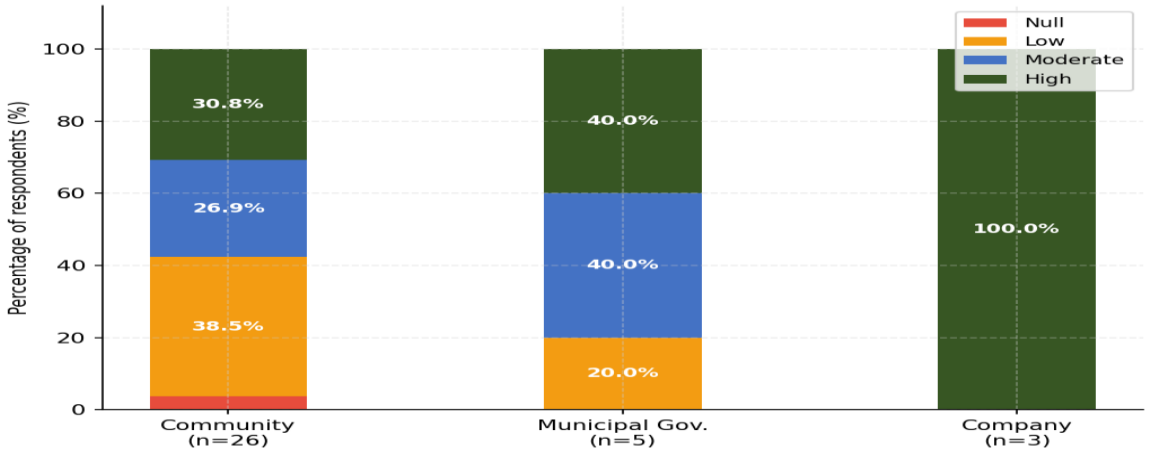
Figure 4 – Distribution of ICIS Categories by Actor Group



Source: Research data.

To complement the ordinal logistic regression and address the limitations imposed by sample size, non-parametric tests were conducted. The Kruskal-Wallis test revealed a globally non-significant difference across groups (H=3.544; p=0.170). Pairwise comparisons (Mann-Whitney U) indicated a marginal trend toward difference between the Community and Company groups (U=14.0; p=0.079; r=0.326), with a medium effect size, suggesting practical relevance even in the absence of conventional statistical significance. This result must be interpreted with caution given the low statistical power associated with the Company group's n=3 (Tables 4 and 5).

Table 4 – Non-Parametric Tests for Between-Group Comparison

Test	Statistic	p-value	Effect Size (r)
Kruskal-Wallis (global)	H = 3,544	0,170	–
Community vs. Municipal Government	U = 53,5	0,554	0.106 (small)
Community vs. Company	U = 14,0	0,079	0.326 (medium)
Municipal Government vs. Company	U = 3,0	0,250	0.407 (medium)

Source: Research data.

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Table 5 – Descriptive Statistics for Local Community Items

Item	Mean	SD	Median	Classification
Participation and Engagement				
Community consulted from the outset	3.73	1.34	4.0	High
Suggestions taken into consideration	2.96	1.43	3.0	Moderate
Participation in decision-making	1.73	1.04	1.0	Low
Effective communication channels	2.08	1.41	1.0	Moderate
Access to project information	1.85	1.43	1.0	Low
Cultural Adaptation				
Local traditions preserved	3.73	1.56	5.0	High
Sacred sites respected	3.38	1.77	4.5	Moderate
Traditional festivities continue	3.19	1.83	3.5	Moderate
Traditional way of life maintained	3.42	1.65	3.5	Moderate
Cultural identity strengthened	2.23	1.53	1.0	Moderate
Community Resilience				
Positive adaptation to changes	3.35	1.23	3.0	Moderate
Development of new skills	2.23	1.50	1.5	Moderate
Strengthened community organization	1,69	1.12	1.0	Low
Emergence of new local leaders	1.77	1.31	1.0	Low
Community prepared for change	2.88	1.66	3.0	Moderate

Source: Research data.

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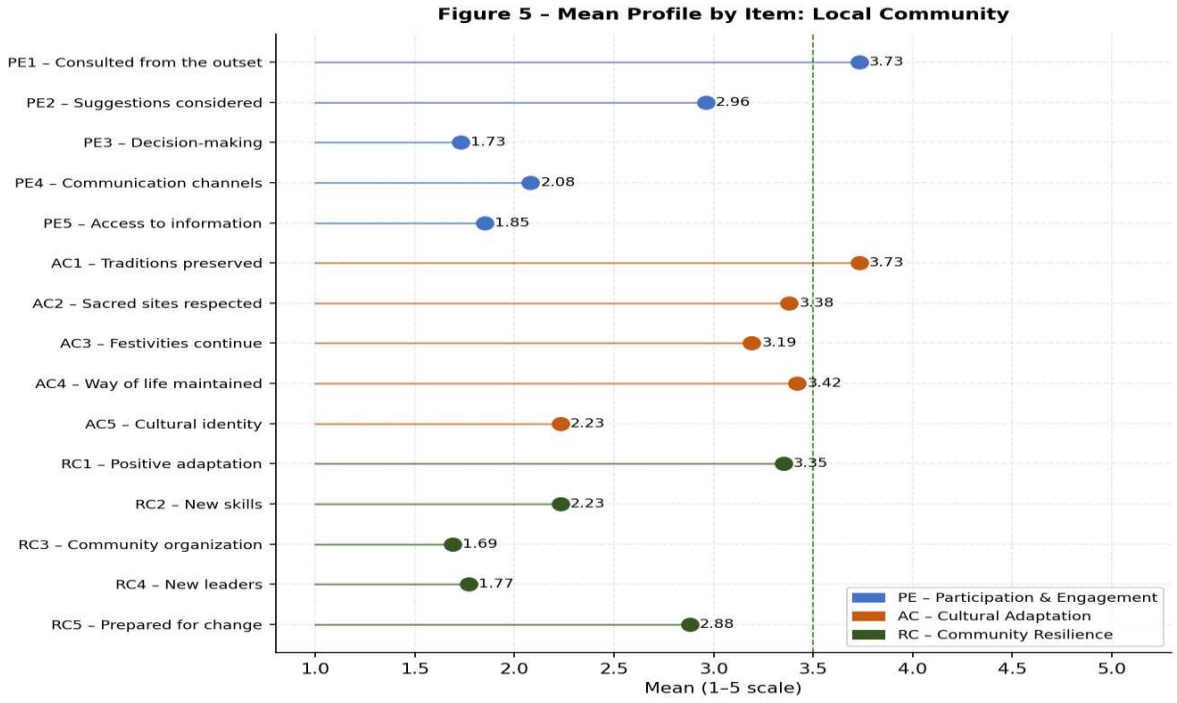
Analysis of the community's response profile, presented in Figure 5, reveals a bimodal pattern across several items, particularly within the cultural adaptation dimension. Items such as "Local traditions have been preserved" (M=3.73; Mdn=5.0) and "Sacred sites have been respected" (M=3.38; Mdn=4.5) present high medians alongside high dispersion (SD>1.5), indicating polarization of perceptions within the community itself. In the Participation and Engagement dimension, a notable discrepancy emerges between the item "Community consulted from the outset" (M=3.73) and the items related to effective participation in decision-making (M=1.73) and access to information (M=1.85). This suggests that the community recognizes the existence of initial consultations but does not perceive them as genuine participation in decision-making — a pattern consistent with the lower rungs of Arnstein's (1969) "ladder of citizen participation."

Figure 5 – Mean Profile by Item: Local Community



Source: Research data.

4.2 Critical Discourse Analysis

CDA, grounded in Fairclough (2001, 2003), treats discourse as a social practice that simultaneously reflects and reconstitutes power relations, identities, and social structures.

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The utterances collected from the three groups were analyzed across three dimensions: the textual (lexico-grammatical choices), the discursive (modes of discourse production and consumption), and the social (articulation with structures of power and inequality).

An analytically significant element is the asymmetric distribution of qualitative responses from the Community: 14 of the 26 respondents (53.8%) shared a common discursive core — the absence of major changes and the consequent absence of any need for adaptation. This concentration is not statistically trivial: it constitutes significant qualitative data that orients the entire subsequent interpretation.

4.2.1 Wind Energy Company: The Discourse of Managed Proximity

The three company respondents collectively construct a cohesive and strategically aligned discourse centered on two axes: the accessibility of dialogue and the continuity of relational effort. Their utterances were as follows.

[Respondent 1] "Dialogue is easily accessible, with direct contact in person or via WhatsApp."
[Respondent 2] "All companies always seek to maintain relations with the community, striving to keep a good relationship."
[Respondent 3] "There is a listening channel through in-person visits, and people are able to have their questions answered about the program, the project, and its management. As a way of improving the field of communication, a model using a public address vehicle that passes through the communities every two weeks to share information was adopted."

At the lexico-grammatical level, the first utterance is constructed through affirmative assertions with no modalization ("dialogue is," rather than "can be" or "seeks to be"), conferring the character of established fact. The mention of WhatsApp presupposes universal access to technology and connectivity — a condition by no means guaranteed in rural communities in the semi-arid region of Bahia.

The second utterance presents a generalization: "all companies always seek to maintain relations." The universalization of the subject and the temporal totalization produce an effect of naturalizing good corporate practice. The repeated use of the present participle ("striving to maintain") constructs continuous and intentional action, without necessarily asserting concrete outcomes.

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The third utterance is the most complex. The expression “listening channel” suggests reciprocity, but the sequence “people are able to have their questions answered” reveals the actual communicative flow: from the company to the community, in a unidirectional direction. The biweekly public address vehicle confirms this asymmetry, as it is a device that provides no mechanism for response, debate, or collective construction.

In sum, the corporate discourse operates through what Fairclough (2003) terms discursive hegemonization: the company occupies the position of sole agent in the relational process, while the community is positioned as a passive receiver. Participation is replaced by managed communication — a strategy consistent with what the critical corporate social responsibility literature calls relational greenwashing (Frankental, 2001).

4.2.2 Municipal Government: The Discourse of Critical Awareness with Inverted Accountability

The municipal government respondents produced utterances that, taken together, reveal an ambivalent discourse: on one hand, there is explicit acknowledgment of institutional shortcomings and social asymmetries; on the other, a tendency to displace responsibility for impacts onto the affected communities themselves.

[Respondent 1] “The municipality needs to propose more legislative projects with a view to adapting new technologies, and the environmental and social impacts, to improve the living conditions in traditional communities.”
[Respondent 2] “Technical skills come from outside; basic ones come from the community.”
[Respondent 3] “There were new prospects for professional growth, but they have not lived up to the initial expectations.”
[Respondent 4] “The perception depends on each territory of implementation, since the majority of local citizens are uninformed about their rights and duties.”
[Respondent 5] “In recent years, the municipal government has prioritized the training of public servants in general, which ends up benefiting the entire population.”

The first utterance displays critical self-awareness: the use of “needs” constitutes a deontic modality — an obligation recognized but not yet fulfilled. The expression “living conditions in traditional communities” confines the impacts to the physical-territorial domain, potentially rendering invisible the symbolic, cultural, and identity-related dimensions.

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The second utterance reproduces a hierarchical division of labor: technical (coming from outside) versus basic (from the community). This opposition devalues local knowledge and naturalizes the export of qualified competencies out of the territory, perpetuating structural dependency.

The fourth utterance is the most problematic from a CDA standpoint. By attributing the variable perception of impacts to community members' lack of knowledge, the discourse displaces attention away from governance failures and participation deficits and onto the cognitive limitations of those affected — a strategy Ryan (1971) terms victim blaming. The fifth utterance presents the training of public servants as an indirect compensatory policy, yet the speaker's own use of "ends up benefiting" reveals their awareness of the mediated and unintentional nature of this benefit for the community.

In sum, the governmental discourse oscillates between critical awareness of institutional shortcomings and the reproduction of logics that hold communities accountable. This ambivalence is symptomatic of a local state that has not developed its own socio-environmental governance instruments adequate to the new realities brought by wind farms.

4.2.3 Local Community: Majority Normalization and Critical Minority Voices

The most relevant datum for the analysis of community discourse is the quantitative distribution of responses: 14 of 26 respondents (53.8%) spontaneously shared the same core utterance:

[14 respondents - 53.8%] "There were no major changes, and therefore no need for any adaptations."

Minority voices (individual respondents):

"There were adaptations, including in relation to the noise."
"I don't think people have fully adapted because of the noise."
"There was no engagement or participation."
"Initially there were complaints, mainly about noise, animals, and deforestation, but there were adaptations."
"Near the wind farm there is a lot of noise, which increases the likelihood of depression."
"At the time of installation there were impacts, but afterwards there were no major changes. Just temporary ones."
"The adaptations are not yet fully consolidated, especially regarding the noise."

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"There was no participation from the community — only from people from outside."
"Things are improving; people are pursuing greater educational advancement, and generally improving their lives."
"There is a great lack of information regarding some of the wind farm's operations."

The logical-causal structure of the majority utterance — that is, the negation of change as a premise that implies the needlessness of adaptation — reveals, at the discursive level, what the Human Ecology literature terms passive resilience through normalization. Three interpretive hypotheses, not mutually exclusive, guide the analysis: (a) the real invisibility of impacts for those segments of the community that are geographically more distant from the turbines; (b) naturalization and resignation, with the repetition of the utterance by 14 respondents indicating the internalization of a collective narrative that cognitively resolves the dissonance between the promise of development and the experience of minimal change — what Bourdieu (1989) calls doxa; and (c) strategic silence in contexts of economic or social dependence on the projects.

The critical minority voices are analytically rich. Noise emerges as a central empirical marker, present in at least four individual utterances and, in one case, associated with the risk of depression, an association consistent with the literature on the psychosocial effects of turbines on nearby communities (Shepherd et al., 2011; Knopper and Ollson, 2011). The mentions of animals and deforestation point to impacts on local fauna and on the Caatinga biome, which are frequently underestimated in the environmental licensing processes for wind projects in the Northeast (Espíndola and Arruda, 2020). At the ecological level, the international literature has documented that wind turbines generate functional habitat loss for migratory birds and other species sensitive to landscape alteration (Marques et al., 2020), a dimension rarely addressed in the environmental impact studies conducted in the Brazilian semi-arid region.

The utterance "There was no participation from the Community, only from people from outside" names, without ambiguity, a process of participatory exclusion, converging with Arnstein's (1969) concept of tokenism and with the obligation of Free, Prior, and Informed Consent (FPIC) established by ILO Convention No. 169, ratified by Brazil in 2002. The lack of information about wind farm operations directly contradicts the corporate discourse of an

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efficient listening channel: what the company describes as guaranteed access, the community experiences as operational opacity.

4.3 Triangulation: CDA, ICIS, and Likert Means

Methodological triangulation (Creswell and Clark, 2017) reveals significant convergences and divergences between what the groups say (CDA) and what the quantitative data measure (ICIS and Likert means).

The most robust convergence occurs in the participation dimension. The utterance “There was no participation from the Community, only from people from outside” is confirmed by the lowest means in the instrument: Participation in Decision-Making (M=1.73) and Access to Project Information (M=1.85). The community’s ICIS for Participation and Engagement (2.47) is pulled downward precisely by these two structural items.

The corporate narrative of efficient and accessible communication (ICIS Community Relations=4.67) contrasts symmetrically with the community’s perception of those same channels (Communication Channels, M=2.08). The differential of 2.59 points between these values is the largest intergroup gap identified in the study and constitutes an indicator of structural socioecological distance.

The community’s majority normalization (“there were no major changes”) is numerically coherent with the distribution of Likert responses: in the Cultural Adaptation dimension, the items on traditions, festivities, and way of life are concentrated between scores 3 and 5, indicating that deeper elements of cultural identity were relatively preserved. Both methods converge in diagnosing that the impact on culture was less intense than the impact on participation and empowerment.

The main divergence occurs between corporate discourse and community experience. While the company self-reports environmental education programs at maximum scores and regular consultations (CR2=4.33), the community records a perception of participatory exclusion close to the minimum of the scale. This divergence cannot be explained by measurement error: it reflects genuinely distinct perspectives on what constitutes participation. For the company, the holding of events and the availability of communication

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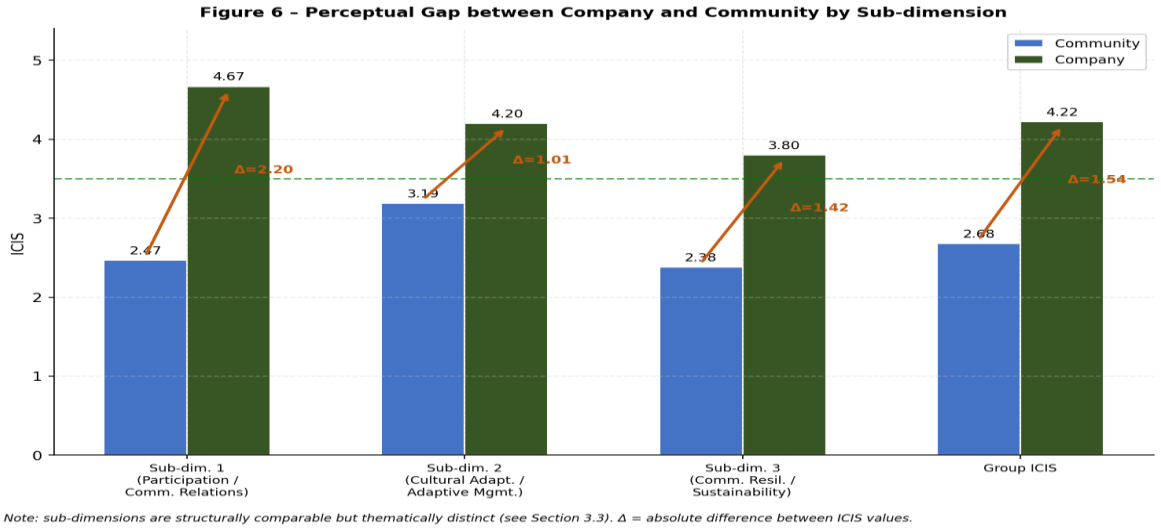
channels is equivalent to participation; for the community, participation entails real influence over decisions, as shown in Figure 6.



Source: Research data.

Table 6 – Synthesis Matrix: CDA × ICIS × Likert Means

Analytical Axis	Company (ICIS=4.22; High)	Municipal Government (ICIS=3.05; Mod.)	Community (ICIS=2.68; Mod.)
Adaptation	Self-perception of high efficiency (AM=4.20)	Reactive; legislative gaps (AC=2.68)	Majority normalization (n=14; CR=2.38)
Participation	Unidirectional communication (CR=4.67 vs. PE=2.47)	Ritual/formal: public hearings (CM3=4.20)	Perceived exclusion (PE3=1.73; PE5=1.85)
Information	Declared listening channel (CR2=4.33)	Recognized gaps (AC2=2.20)	Perceived absence; 1 critical respondent
Dominant impact	No negatives mentioned	Unequal qualification:	Noise (4 utterances); mental health risk

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Analytical Axis	Company (ICIS=4.22; High)	Municipal Government (ICIS=3.05; Mod.)	Community (ICIS=2.68; Mod.)
		external technical vs. local basic	
Resilience	Proactive and institutional	Reactive and structurally limited	Passive: normalization and resignation (n=14)
Expectations	Self-fulfilled; internally consistent	Frustrated: technical employment externalized	Low or absent; 1 positive voice

Source: Authors' own elaboration.

Note: Abbreviations refer to sub-dimensions (ICIS by group) and individual scale items. Sub-dimensions: CR = Community Relations (Company); AM = Adaptive Management (Company); PE = Participation and Engagement (Community); CR = Community Resilience (Community); AC = Adaptive Capacity (Municipal Government); CM = Change Management (Municipal Government). The number following the abbreviation indicates the sequential item within the sub-dimension (e.g., CR2 = 2nd item of Community Relations; PE3 = 3rd item of Participation and Engagement). Values in parentheses correspond to the item or sub-dimension means. See Tables 2 and 5.

5. Study Limitations

This study presents limitations that must be explicitly considered when reading and applying its findings.

The first and most central limitation is the small sample size in two of the three groups investigated: municipal government authorities (n=5) and wind energy sector companies (n=3). These sizes preclude stable estimation of ordinal logistic regression coefficients and significantly reduce the statistical power of the non-parametric tests, rendering any inference about between-group differences based on conventional significance testing tenuous. Results from the group comparisons should be read as exploratory indications, not as confirmatory evidence.

The second limitation concerns the use of purposive sampling, which, although justified by the objective of specifically targeting key actors within each category, precludes any form of

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statistical generalization to broader populations. The findings describe the perceptions of the participants contacted in the context of Campo Formoso and are not necessarily representative of similar actors in other contexts across the northeastern semi-arid region.

The third limitation relates to the partial comparability of the instruments applied to the three groups. Although all instruments share a common structure (15 items across three sub-dimensions of five items each, using a 5-point scale), the sub-dimensions were thematically adapted for each group, which constrains item-by-item comparisons across distinct groups. The ICIS aggregates perceptions about analytically related but not identical dimensions, so the observed between-group differences reflect both perceptual divergences and differences in each instrument's object of evaluation.

The fourth limitation is the cross-sectional nature of the study: data were collected at a single point in time, precluding analysis of changes in actors' perceptions and strategies over time. Longitudinal research would be necessary to track the evolution of community resilience and to determine whether the majority normalization observed is sustained, deepened, or transformed in response to new perturbations.

Finally, the CDA corpus, although analytically rich, is constrained by the number of respondents who produced extensive qualitative utterances, particularly in the smaller groups. Future studies incorporating in-depth interviews and ethnographic analysis could deepen the discursive dimensions identified here.

6. Concluding Remarks

The results reveal a socioecological territory marked by deep asymmetries at the level of perceptions, practices, and discourses across the three actor groups investigated. The convergence between quantitative data (Cronbach's alpha, ICIS, Likert means) and qualitative data (CDA) allows for the construction of a methodologically triangulated diagnosis, albeit exploratory in character given the sample limitations.

The most significant empirical finding is the tri-layered perceptual asymmetry expressed by the ICIS per group: Company (4.22) > Municipal Government (3.05) > Community (2.68). This hierarchy describes the perceptions of the participants contacted and does not constitute statistically representative evidence for the categories as a whole. Even with this

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caveat, the patterns identified are analytically consistent with the literature on energy projects in vulnerable territories: direct economic beneficiaries tend to assess their own practices positively; institutional mediators occupy an ambivalent position; and communities that experience the everyday impacts register the most moderate and heterogeneous perceptions.

The largest differential occurs between the Company's ICIS for Community Relations (4.67) and the Community's ICIS for Participation and Engagement (2.47): a gap of 2.20 points on a 5-point scale. This divergence suggests, as a plausible interpretive hypothesis, a rupture in the socioecological interface between the two groups, mediated by distinct conceptions of what participation means: for companies, making channels available and holding events is equivalent to engagement; for the community, participation entails effective influence over decisions that affect their territory and way of life.

The fact that 53.8% of community respondents spontaneously shared the utterance "there were no major changes, and therefore no need for any adaptations" admits non-exclusive readings: it may indicate an actual absence of perceived impacts among those segments of the population more distant from the turbines; it may reflect the naturalization of pre-existing vulnerability conditions; or it may function as strategic silence in the presence of actors wielding greater economic and political power. The impossibility of resolving this interpretive ambiguity without longitudinal research is, in itself, a relevant finding: it points to the need for instruments and approaches more sensitive to the distinction between the apparent absence of conflict and the actual absence of impact.

The critical minority voices, though numerically small, carry methodological relevance in mixed-methods research (Creswell and Clark, 2017): they enrich the picture constructed by the majority data and prevent normalization from becoming analytical invisibilization. The noise produced by the turbines, associated by one respondent with the risk of depression is consistent with the international literature on the psychosocial effects of wind turbine noise pollution (Shepherd et al., 2011; Knopper and Ollson, 2011). The participatory exclusion and lack of operational information identified in the findings point to possible violations of the principles of democratic environmental governance, including the Free, Prior, and Informed Consent established by ILO Convention No. 169.

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In theoretical terms, the findings contribute to three lines of discussion. Within Human Ecology, the perceptual asymmetry across groups reflects structurally distinct positions at the interface between the social system and the natural system, mediated by the relations of energy production and by inequalities of power. Within the framework of socioecological resilience, the community's majority normalization constitutes passive resilience an adaptation through inertia that, in the terms of Folke (2006) and Walker et al. (2004), weakens the socioecological system in the face of future perturbations, given that it does not strengthen collective adaptive capacity. Within the framework of environmental justice and participation, the measured participatory exclusion (PE3=1.73; PE5=1.85) and the discursive patterns of community invisibilization constitute procedural environmental injustice, reflecting the absence of genuine participation in decision-making processes that affect the territory and ways of life of traditional communities.

Taken together and within their acknowledged limitations, these findings suggest that the prevailing energy development model in Campo Formoso tends to treat communities as passive beneficiaries of wind expansion rather than as rights-bearing subjects with decision-making power over the uses of their territory. Future research with larger samples, longitudinal designs, and more in-depth qualitative instruments will be needed to confirm, refine, or contest the interpretive hypotheses advanced here.

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