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# Social representations of odors: case study in the Ñuble region, Chile (2019–2023)

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**Introduction:** The objective of this article is to analyze the social representation of odors and the identity of the population in the Ñuble region between 2019 and 2023. The research focuses on how industrialization and urban and rural development have altered the olfactory landscape of this region. This study seeks to understand how changes in the physical environment affect the representation of odors and how these, in turn, impact the daily lives of residents. The importance of smells is highlighted not only as sensory experiences, but also as social phenomena that influence the perception of the environment and community relationships.

**Methods:** The research adopts an interpretive approach, combining case studies and analysis of primary sources. The analysis is categorized into two main areas: public policy on odors and the situation of odors in the cities of Chillán Viejo and Chillán. Primary sources include government documents, technical reports, and interviews with residents and local authorities. The interpretive approach allows us to explore the perceptions and subjective experiences of odors among the residents of Ñuble.

**Results:** The study reveals that industrialization and urban and rural development have significantly transformed the olfactory landscape of the Ñuble region. In Chillán Viejo and Chillán, residents report changes in odors due to industrial expansion and urbanization. Public odor policy has attempted to mitigate negative impacts, but results have been mixed. While some measures have improved air quality, others have been insufficient to address community concerns.

**Discussion and conclusion:** Smells in Ñuble are not merely sensory experiences, but social phenomena that deeply affect the daily lives of residents. The perception of smells is closely linked to the identity and history of the region. Changes in the olfactory landscape have generated both adaptations and resistance among inhabitants. Public policies must consider not only the technical aspects of air quality, but also the social and cultural dimensions of odors. This study highlights the need to address odors as an integral part of urban planning and environmental policy to improve the quality of life of residents in Ñuble.

## KEYWORDS

social representations, odors, identity, Ñuble, Chile

## 1 Introduction

This study represents an initial exploration into the research on Olfactory memory and its identity relationship with places and non-places in Ñuble. The issue of odors has been analyzed as a significant social and environmental problem in several European and Asian countries, such as Germany, the Netherlands, and Japan. Over the past four decades, these nations have focused on this topic and incorporated it into their public agenda. However, in Latin America, specifically in Chile, the issue of odors has gained attention on the public agenda only in the past decade (Quilodrán, 2023).

Chile emerges as a prominent case in terms of mortality attributed to environmental pollution, with 240 deaths per million inhabitants, mainly linked to air pollution and exposure to fine particulate matter (MP 2.5). At a global level, Chile ranks 43rd in terms of air pollution with MP 2.5, showing a correlation between the presence of these pollutants and the mortality rate (Quilodrán, 2023).

The severity of atmospheric pollution in Chilean cities is alarming. According to the World Health Organization, 98% of the Chilean population resides in areas where the recommended limits for MP 2.5 are exceeded. In fact, nine of the 15 most polluted cities by MP 2.5 in Latin America are located in Chile, including Santiago.

These alarming levels of pollution have several sources, ranging from transportation and industrial activities to residential heating through wood combustion. The health effects resulting from this pollution are concerning, manifesting in premature

deaths, respiratory and cardiovascular diseases, cancer, eye irritation, cough, and cardiovascular dysfunctions, among other adverse effects.

These findings emphasize the urgency of addressing atmospheric pollution and its ramifications for human health in the Ñuble region and throughout the country (CHILE, 1980; Código Civil Publicado, 2001; López, 2002; Código Sanitario, 2005; Mardones, 2006; Nilo, 2010; Durán Sandoval, 2012; Subsecretaría del Medio Ambiente, 2013, 2019; Subsecretaría de Medio Ambiente, 2014; Subsecretaría de Medio Ambiente, 2021; Anenberg et al., 2015, 2019; Ministerio del Medio Ambiente, 2020; Ramos, 2020; Sicard et al., 2020a).

In the case of odors originating from livestock farming and landfills, these can significantly impact health and affect people's quality of life. The proximity of pig farms and landfills to urban areas in the Ñuble region, particularly in Chillán Viejo, has generated public concern due to bad odors. Although historically these facilities were located at approximately 3.5 to 3.8 kilometers, current standards reveal that the population now resides only 800 to 700 meters from homes. This region had a population of 517,508 inhabitants in 2021, facing several socioeconomic challenges, including the highest poverty rate in the country (12.1%), high rurality, and unemployment. Although primary, secondary, and tertiary activities dominate its economy, atmospheric pollution poses an additional challenge to the wellbeing and sustainable development of the region.

The choice of this topic is based on the following considerations:



FIGURE 1  
Location of the cities of Chillán Viejo and Chillán in the Ñuble region, Chile. Source: Google Maps (January 30, 2024).

- (1) **Figure 1** shows the urban conurbation of Chillán-Chillán Viejo<sup>1</sup> presents specific geographical, climatic, demographic, and economic characteristics (Salazar, 2003; Ortega, 2005) that influence the emission and dispersion of odors. Its Mediterranean climate and location in an area of high agricultural and livestock activity exacerbate the situation. Additionally, the population density and industrial concentration in the region increase the population's exposure to odors from livestock activities, landfills, and other sources (Subsecretaría del Medio Ambiente, 2019), offering an opportunity to analyze and address the issue of odor pollution, considering its effects on the health and well-being of the population (Howes, 2014; Mata-Codesal, 2018; Serna, 2019; Chacana, 2023).
- (2) The study of transformations in habits and customs regarding perfume and odors complements the changing nature of human emotionality, as noted by Corbin (1987). To address this topic, the guidelines of Gleichman (1982) and Corbin (1987) are followed from a historical and cultural perspective, focused on the process of cleaning up cities and eliminating bad odors. Additionally, the theoretical contributions of O'Connor (2017) and Martikainen and Sakki (2023) on the theory of embodied social representation are integrated, focusing on odors and their relationship with place stigma, to explore how visual and auditory signals of social disorder relate to neighborhood stigma and the concentration of inequality, which would identify ways in which odors can also be a signal that place-based stigma contributes to the geographic concentration of inequality (Sampson and Raudenbush, 1999, 2004; Sampson and Loeffler, 2010; O'Brien and Wilson, 2011; Hwang and Sampson, 2014; King, 2015; Schwarz, 2015; O'Brien et al., 2019a,b).
- (3) Moreover, some authors such as Largey and Watson (1972), Gleichman (1982), Corbin (1987), Le Guéer (1988), Mauss (1989), and Burke (1999) argue that odors should be studied as social representations (Chartier, 2005; Moscovici, 2008), whose consequences can be observed in civil society, where the control of spaces, the tentacular power of institutions such as prisons and hospitals, the hygienization of the control of bad odors in cities and the cultural construction around social criteria of good smell taste are effects of the modernizing process carried out by the State.

## 1.1 Odors and social problems

In the field of Social Sciences and Humanities, research on odor has experienced considerable growth, approaching the subject from a historical, social and cultural<sup>2</sup> perspective

1 Chillán, founded in 1580, emerges as a relevant case study. The city has been destroyed by indigenous attacks and earthquakes in 1751 and 1835. The latter seismic event led to the development of two urban centers: Chillán Viejo and Chillán Nuevo (Basterrica Sandoval, 2015; Parada Ulloa, 2018; Parada-Ulloa, 2020).

2 Odors constitute a pollution factor that in Chile has been treated tangentially within national legislation, focusing on current atmospheric

(Law 19.300, 2008; Merton, 2010). According to Burke (1999), odor is cultural and historical in the sense that it is imbued with cultural values, and its associations change over time. Studying odors involves understanding social problems in their context and their impact on people's quality of life. In this regard, odors should be analyzed from the social representations around the vital and cultural, not only as a phenomenon of organic repulsion, but as an indicator of the anomy experienced by the sectors of lower socioeconomic level, exposed to pollution, less access to opportune health care and healthy eating, which live in nauseating environments and inhabiting homes located near places with bad odors. A modern miasma is a result of the indiscriminate use of industrial technology, "constituting the impurities that corrupt the atmosphere producing diseases that are characterized mainly by their bad odor" (Larrea Killinger, 1997, p. 82).

Following the guidelines of Gleichman (1982) and Corbin (1987), a shift in the social perception of odor can be observed (Albert, 1990; Classen, 1992; Larrea Killinger, 1997), from the centrality of odor to the valuation of cleanliness in cities. This transition suggests a significant change in how societies perceive and prioritize odors and urban hygiene. Simmel (1986) highlighted the influence of odors on social interactions, identity and social stratification, which is relevant to understand their role in the configuration of urban life. The contributions of Mauss (1989) and Burke (1999) suggest that odors should be studied as social representations (Mora, 2002; Chartier, 2005; Villarroel, 2007; Moscovici, 2008), whose consequences can be observed in civil society. The control of spaces, the tentacular power of institutions such as prisons and hospitals, the sanitization of bad odors in cities and the cultural construction around the social criteria of the good taste of odor are effects of the modernizing process carried out by the State.

regulations that regulate particulate matter and the generation of gases released by mobile and industrial sources, with the goal of complying with the country's standards (Fernández Rojas, 2016). In this regard, the definition of nuisance odors from the current legal regulations is a problem addressed by MINSAL, the Municipal Ordinances and bulletin 4846-12 which sought to amend Law 19,300 regarding olfactory pollution. Furthermore, Article 69 of Law 19,300 states that the Environment Ministry is responsible for collaborating with the President of the Republic in the design and application of policies, plans and programs in environmental matters, as well as in the protection and conservation of biological diversity and renewable and hybrid natural resources, promoting sustainable development, the integrity of environmental policy and its normative regulation. In this regard, bulletin 4982-12 proposed a definition of odor pollution understood as that produced by bad odors. For its part, bulletin 6577-12 typifies air pollution by bad odors or olfactory pollution, with the only criteria being detectability by a nasal field olfactometer. Despite the regulatory problems regarding the definition of odors, there are some advances such as the Sanitary Code that allows the regional and local authority to dictate provisions to control the emission of nuisance odors and sanction them. These sanctions correspond to fines, closures, cancellation of operating authorization or permit, suspension of work depending on whether it is a first or repeated infraction (Fernández Rojas, 2016).



## 1.2 Social representations

The theory of social representations, developed by [Moscovici \(2008\)](#), offers a theoretical lens to examine how perceptions and meanings attributed to odors are socially constructed and culturally transmitted. This approach allows us to explore how odors are not simply sensory phenomena but are imbued with social and cultural meanings that reflect and perpetuate relations of power and inequality.

In this sense embodied social representations, brings an additional dimension to the study by considering how sensory and bodily experiences influence the formation of social representations. This approach connects classical theory with embodied social cognition, providing a framework for understanding how olfactory experiences are integrated into social practices and discourses ([O'Connor, 2017](#); [Sicard et al., 2020b](#); [Martikainen and Sakki, 2023](#)).

The study of odors in the Ñuble region also relates to the social psychology literature on place-based stigma. This line explores how signs of social disorder, such as visual impairment and noise, contribute to the stigma of specific neighborhoods and the concentration of socioeconomic inequalities ([Sampson and Raudenbush, 1999, 2004](#); [Hwang and Sampson, 2014](#)).

Odors can act as signals that contribute to place-based stigma. In this sense, how odors affect environmental perception and stigmatization dynamics may reveal how olfactory experiences are linked to other indicators of social disorder. This helps to explain the geographic concentration of inequality, as unpleasant odors can reinforce negative perceptions and social exclusion in certain areas.

## 1.3 Social representation and identity

The contributions of [Largey and Watson \(1972\)](#) have been fundamental in guiding this study, he focuses on the relationship between identity and social status. A key concept guiding our research is identity, which refers to the way in which both individuals and groups define themselves as they attempt to relate to or identify with certain characteristics. This approach contrasts the social representation of odors with identity and social status. To this end, we have highlighted two constitutive elements of identity. First, individuals define themselves or identify with certain qualities in terms of shared social categories. Second, by producing, possessing, acquiring, or modeling material things, people project their own selves, their own qualities, onto them and see themselves reflected according to their own image ([Larraín, 2001](#)).

The individual, as [Durkheim \(2001\)](#) pointed out, is a social being who perceives the world as a representation of subjective (physical-psychic) and objective organization and transforms these perceptions into images that explain the social construction from the horizon in which he is immersed. According to these ideas, society is defined as “the sum of those forms of relations by which society, in its first sense, emerges from individuals” ([Simmel, 1986](#), p.18), while culture plays a determining role in social cohesion ([Durkheim, 2001](#)).

From the perspective of [Gleichman \(1982\)](#), [Corbin \(1987\)](#), and [Le Guéer \(1988\)](#), as well as the works of [Batalhone et al. \(2002\)](#), as well as [López Oliveros and García Estévez \(2006\)](#), we are interested in the olfactory implications of industries in the urban environment, especially in areas such as wastewater treatment plants and landfills in urban areas.

Integrating the study of odors as a sociological phenomenon ([Mills, 2003](#)) in the city, understands that it cannot be separated from the type of person we are or want to be, the type of social relations ([Simmel, 1986](#)) with nature we value, the lifestyle we desire and the aesthetic values we respect ([Harvey, 1977](#)). It also allows to understand that the transformation of urban space is an intimate and constitutive combination of material processes and social representations<sup>3</sup> ([de Mattos, 2002](#); [Gorelik, 2003](#)).

This study offers a valuable perspective on the intersection between odors, regional identity and public policies in the Ñuble region between the years 2019–2023. By focusing on odors generated by industrial, swine and landfill activities, it provides a look at an under-explored aspect of daily life and the environment in that specific area.

From a sociological point of view, this study highlights the importance of considering odors as elements that influence the construction of identity and the social dynamics of a community. By analyzing how bad odors affect the coexistence between civil society and companies, the complexity of environmental problems and their impact on people's daily lives is revealed.

Therefore, the research problem lies in understanding, through social representations, how odors affect the daily life and wellbeing of people in the Ñuble region, specifically in the cities of Chillán Viejo and Chillán. These unpleasant odors from landfills, industries and agricultural activities impact the quality of life ([Simmel, 1986, 2002](#); [Bourdieu, 2007](#); [Durkheim, 2012](#)), especially in rural and urban areas ([Bravo Lira, 1995](#); [Wagner, 1997](#); [Habermas, 1999](#)). From the above, the research question arises: How do social representations of odors from landfills, industries and agricultural activities affect the daily life and wellbeing of people in the Ñuble region, especially in rural and urban areas?

The objective is to analyze the embodied social representation of odors and the identity of the population in the Ñuble region between 2019 and 2023, specifically in the cities of Chillán Viejo and Chillán. This social phenomenon is analyzed from social psychology and sociology.

The consequences of this relationship can be serious, including respiratory diseases, insecurity, substantial increase in health care costs, loss of green areas. In addition, it can influence work and school performance. These aspects are necessary to examine in the study area.<sup>4</sup>

<sup>3</sup> In Latin America, development theories attempted to restore, through a profoundly cultural and political conception of modernity, the possibility of controlling modernization, the search to recover the command that the developed world had lost over the processes it engenders.

<sup>4</sup> Regarding regional historiography, it has focused on sociocultural history. The work of [León \(2010\)](#) stands out, who analyzed the progress of Ñuble, showing that the advances in the area were controlled by the elites and the provincial authorities, who sought to maintain the practices of control

## 2 Methods and materials

The research approach is qualitative, its epistemic positioning is socio-historical, and with an interpretative and descriptive-dense approach (Gadamer, 1977; Geertz, 1983; Denzin and Lincoln, 2012; Gibbs, 2012). This methodological framework allows examining the social representations and identity in relation to the odors present in Chillán Viejo, such as *chancherías and landfill*, in the Ñuble region.

For the collection of information, criteria were established for the selection and access to the literature review and relevant primary sources. First, the literature review used the criteria of convenience and the judgment of the researchers, based on the proposal of Muñoz (2013). This was done using four databases: Wos; Scopus, ERIC and Google Scholar; in addition to an analysis with Nvivo 14, which allowed identifying those most relevant concepts that emerge in the study. The descriptors used for the collection of information were the following: public policy on odors, pollutants: pigsty, landfill, social problems and odors.

Secondly, the primary sources of information were identified: laws and ministerial documents and La Discusión Newspaper. Once the sources were identified, they were accessed systematically and exhaustively. Protocols were established for the search and retrieval of information, using digital databases (<https://www.ladiscusion.cl>), and the National Environmental Control Information System (Snifa) (<https://snifa.sma.gob.cl>). This allowed the identification of the source (authorship, context, and its role in the facts); identification of the purpose (norm, agreement, justify actions); reliability and value of the source (its origin, purpose and allows contracting with other sources) and criteria of relevance and pertinence. Adequate temporal and thematic coverage were ensured, covering the study period and the relevant aspects of the problem investigated.

The analysis of primary sources such as laws and ministerial documents, as well as the newspaper La Discusión de Chillán, corresponding to the period of 2019–2023, allowed providing information on odors from the population, the public policy around odors and their specific situation of odors in the region. These findings reveal a complex situation, characterized by citizen complaints, affectation of the quality of life of local inhabitants and conflicts between the population and the companies responsible for odor emissions.

The content analysis technique was used to extract both explicit and latent information from the collected texts. This analysis was carried out using the constant comparison method (Strauss and Corbin, 2002), which allowed an exhaustive exploration of the data

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of customs over the population aiming to form a good citizen, understood as a civilized man, i.e., a moral being. Parada-Ulloa et al. (2020) studied the relevance of sanitation in the city of Chillán at the end of the 19th century, investigating the hygiene policies of the local authorities regarding the regulation of spaces, the construction of public and private buildings (schools, parks and churches) to favor the hygienization of the different areas of the city.

and the identification of emerging patterns<sup>5</sup> (Taylor and Bogdan, 2013).

This methodological approach facilitated the evaluation of relevant categories, which addressed aspects such as (a) Public policy on odors, (b) Situation of odors in Ñuble. Through this method, it was possible to reveal a complex situation in the Ñuble region, specifically in relation to odor problems from agro-industrial activities, such as pig farms and landfills. These problems have generated citizen complaints, affecting the quality of life of the local inhabitants, as well as conflicts between the population and the companies responsible for the odor emissions.

### 2.1 Public policy on odors

The issue of odors has been subject of study and analysis as an important social and environmental problem in several countries around the world. Among them, there are notable differences between European and Asian countries, such as Germany, the Netherlands and Japan. Over the last four decades, these nations have devoted considerable attention to this matter and have incorporated it into their public agenda. In contrast, in Latin America, specifically in Chile, the problem of odors in the last decade has begun to receive attention in the public agenda, which has complicated the normative regulation and the evaluation of the effects they cause in civil society, both in urban and rural areas.

Disorder and incivility in urban environments, such as broken windows can lead to an increase in crime and deterioration in residents' quality of life. O'Brien et al. (2019a), point out that perceptual clutter, including odors, can affect the health and wellbeing of residents.

Odors affect people's daily activities, diminish their wellbeing and cause property damage and harm their quality of life.

According to data from the **Subsecretaría de Medio Ambiente (2021)**, odor complaints come from a variety of sources, both anthropogenic (produced by human activities) and biogenic (produced by biological processes), including agriculture, food processing plants, fishmeal plants, refineries, animal slaughterhouses, cellulose producers, solvent handling facilities, wastewater treatment plants and landfills.

Although the companies responsible for the odors have been subject to inspections and measures by the Superintendency

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<sup>5</sup> Content analysis is a research technique that seeks to achieve objectivity and systematicity in the study of the manifest content of communication. This approach involves a series of essential components in its process. First, it is crucial to clearly determine the object or subject of analysis, establishing the limits and specific focus of the research. This is followed by the definition of coding rules, establishing criteria and guidelines that will guide the assignment of codes to the elements identified in the analyzed content. The next stage involves the determination of a category system, organizing and classifying the information according to identified patterns. Finally, to guarantee the robustness and consistency of the analysis, verification of the reliability of the coding-categorization system is carried out, ensuring that different evaluators obtain coherent and replicable results (Taylor and Bogdan, 2013). These elements constitute fundamental pillars in the effective application of content analysis as a research tool.

of Environment, the persistence of problems and the delayed response from the authority suggest deficiencies in the monitoring mechanisms and in the capacity to apply effective sanctions.

Regarding citizen complaints about odors, they reflect social, cultural and health problems. For example, odors generated by sewage treatment facilities and animal husbandry can cause eye irritation, headaches, diarrhea, sleepiness, and aggravate the medical conditions of asthmatic people. Furthermore, these odors can also affect the value of homes in the areas where they are perceived. These situations affect children and adults equally.

In this regard, “the above deserves a reflection on how to meet the 2030 Agenda in Latin America. Political changes are quickly followed by a market deepening and a minimalist State, leaving a part of society undefended” (Girón, 2016, p. 3). This forces a political reading regarding the influence that European and Latin American countries have developed around environmental care. In Europe, the literature suggests “that some environmental movements end up institutionalized and having good relations with government agencies” (Maillet and Muñoz, 2023, p. 5), in Latin America “multiple deficiencies in management are evident, such as the lack of effective environmental plans and policies, poor preparation of authorities, and lack of strategic measures to reduce the environmental damage” (Gómez and Mozo, 2021, p. 14).

In the last few years, legislation on odors has experienced constant progress, with the existence of regulations including laws, decrees and municipal bylaws to address the problem of bothersome odors. Chile is moving forward with a law that regulates and controls the emission of bothersome odors, which is reflected in several legal documents, such as the current Constitution (1980) (Article 19°, paragraph 8°), the Civil Code (Article 937°), *Ministerio de Salud. Resolución No. 1215 (1978)*, Decrees 144/977, and the Sanitary Code (1968 modified by law 20.029 of 2005).

The Constitution (1980), in its article 19, No. 8, protects the environmental heritage as part of the social function of property. The *Código Sanitario (2005)* focuses on preserving and maintaining the purity of the air and preventing the presence of materials or odors that endanger the health, safety or welfare of people. It is the only regulatory entity that specifically regulates the issues related to the presence or generation of odors, due to the risk they represent to health and the population’s quality of life (Fernández Rojas, 2016, p. 29).

The *Código Sanitario (2005)* establishes provisions to penalize violators and aims to eliminate or control all environmental factors that affect the health and welfare of the inhabitants. However, a problem arises due to the constitutional guarantees of the right to property and the right to live in a pollution-free environment. Those who initiate an economic activity that is not prohibited could affect the right to live in an unpolluted environment.

Chile has environmental management instruments recognized in *Law 19.300 (2008)* to reduce and control pollution levels. Among them are environmental quality standards, emission standards and Atmospheric Prevention and/or Decontamination Plans (PPDA), most of which are interrelated (Pérez, 2023).

This law regulates the right to live in a pollution-free environment and considers that projects or activities with potential

environmental impact must be evaluated to prevent health risks, damage to natural resources and significant alterations in the cultural life of human groups, “who give meaning to their actions from a socio-historical perspective, especially those that relate their daily lives to smell, memory and emotions” (Mandiola et al., 2014; Ministerio del Medio Ambiente, 2018; Ramos, 2020, p. 12).

According to the interpretation of the law, the presence of contamination is only established when the maximum or minimum levels defined by environmental quality standards are exceeded. However, this interpretation implies a problem: even if these limits are not exceeded, there could be other unregulated components that affect people’s health.

According to Pérez-Serrano (2007), Pérez-Agote (2017), Pérez (2023), the Atmospheric Prevention and Decontamination Plans (PPDA) are environmental management tools designed to avoid exceeding environmental quality standards and to recover acceptable levels of pollution in saturated zones. These plans are a direct consequence of the declaration of an area as saturated or latent and are based on parameters established in the environmental quality standards.

In Chile there are 20 environmental quality standards that regulate pollutants such as PM10, PM2, benzene, SO2, CO, O3, among others. However, there are numerous unregulated pollutants that lack a Prevention and Decontamination Plan to address high pollution levels, each one adapted to the characteristics of the different regions. For example, in the central zone, where the PPDA is located for the communes of Concón, Quintero and Puchuncaví, measures are established to control emissions of particulate matter, sulfur dioxide and nitrogen oxide, mainly from industrial complexes. Calama still does not have a PPDA after 13 years. It is an important area of industrial activities that contribute particulate matter, associated to mining, aggregate extraction, suspended dust from transportation, lead smelting, among others. In 2018 the PPDA of Concón, Quintero and Puchuncaví was approved:

“However, it must meet the environmental principles recognized in our regulations, conform to the law and adopt the international standards to actually take care of the serious air pollution, which, as already mentioned, besides diseases, brings a large number of deaths in the population” (Pérez, 2023, p. 5).

Actions should include measures to compensate for emissions, manage critical episodes, monitor air quality, and carry out outreach and environmental education activities.

Moreover, Pérez (2023) emphasizes that the PPDA face a series of problems that make them susceptible to becoming obsolete and inadequate tools to address the problem of atmospheric pollution. It is essential to highlight that, in their elaboration, public consultation processes are carried out in which both legal and natural persons participate. The main observations of these consultations usually focus on the need for more information from the regulator, distrust in the usefulness of the plans and concern for the living conditions of the people living in the affected areas.

It is crucial that the PPDA reflect a territorial problem that requires the implementation of effective measures, with citizen

participation essential in the preparation of these plans. However, when analyzing the incidence of citizen participation in the preparation of the PPDA, a mismatch is evident between what is foreseen in the legal rules and the reality of the level of participation. The public figure proves to be insufficient, since the State does not adequately manage the comments collected during this process. This limits the possibilities of success in terms of obtaining information, social legitimacy and the capacity of citizens to have an impact on public policies through this mechanism (Schorr, 2018; Pérez, 2023).

Air pollution in Chillán and Chillán Viejo reached a critical point in 2013 due to high concentrations of respirable particulate matter. This led to the promulgation of the PPDA in 2013. The plan includes prevention, control and coordination measures among different institutions to reduce critical pollution episodes, which are days with high concentrations of fine particulate matter (PM 2.5). These episodes are associated with respiratory problems and occur mainly between April and September. The Critical Episode Management (GEC) period was implemented in 2018 to manage these higher risk months in a coordinated manner.

In 2023 there was an increase of 26.32% of critical episodes compared to the previous year but reflecting an overall decrease of 58% from 2018. A reformulation of the decontamination plan is being considered to improve air quality, highlighting measures such as environmental education, housing improvement and replacement of heaters to reduce pollution.

The proximity of pig farms and landfills to urban areas in Ñuble, particularly in Chillán Viejo, has generated concern due to odors perceived by the population. Although historically these facilities were approximately 3.5 to 3.8 kilometers away, current standards reveal that the population is only 800 to 700 meters away.<sup>6</sup>

Decreto (1961) and Decreto 977 (1996) do not establish a minimum distance between industries and urban areas. Decree Force of Law (DFL 1, 2006) No. 1 of 2006 grants municipalities the faculty to regulate environmental issues, but they cannot set specific parameters of physical-chemical compounds, which exceeds their regulatory framework.

Despite the mitigation measures implemented, control and monitoring have not been effective in solving the odor problem (Henríquez, 2022). Although surveys, electronic noses and odor panels have been implemented in the field, the lack of industrial criteria, such as cellulose factories and animal slaughterhouses. Decreto 9 (2022) establishes pollutant emission standards for pig farms, classified into three categories according to size: small, with 750 to 25,000 animals; medium, with 25,001 to 50,000 animals; and large, with more than 50,000 animals. However, it is noted that these farms continue to generate odor disturbances and pose a risk to the quality of life of the affected population.

<sup>6</sup> In the Chilean context, there are different interpretations of the regulations and sanitary resolutions regarding the allowed distance for solid waste from homes (300 m) and towns (600 m). Also, cemeteries must be located at a distance of at least 25 meters from a residence.

The *Código Sanitario* (2005), in its Article N° 67, establishes that it is responsibility of the sanitary authority to eliminate or control environmental factors that affect the health, safety and welfare of the inhabitants. This is complemented by *Law No. 20,417* (2010) and *Law No. 21,600* (2023), which requires the environmental assessment of different territorial plans and the creation of the Biodiversity and Protected Areas Service.

Municipalities are also empowered to address the odor problem through ordinances, although these tend to be general and lack technical specifications. *Decreto* (1961) of the Interior Ministry prohibits unpleasant odors and toxic gases that disturb citizens and establishes that hazardous industries must be in industrial zones. This Decree considers that the location of industrial zones must consider the direction of the prevailing winds and the course of the waters, and once established, it cannot be modified for 10 years. In addition, it classifies industries as hazardous, unhealthy and uncomfortable, based on the damage they may cause to people and property, the emanations affecting public health and the inconvenience they cause to neighbors, respectively.

*Law 19.300* (2008) does not stipulate emission limits for any type of pollutant, instead they are developed through Supreme *Decreto Supremo No. 93* (1995) of the Ministry General Secretariat of the Presidency, which regulates environmental quality and emission standards, involving a series of stages of scientific studies, technical and economic analysis, consultations with public or private agencies and appropriate advertising of all stages.

The growing social concern about environmental issues, including the inconvenience caused by facilities located near homes, makes it not only the National Environmental Commission's responsibility to demand that regulations are enforced, but also the responsibility of citizens to advance toward public policies that address these problems and allow demands to be adequately channeled.

## 2.2 Odor situation in Ñuble

In the last 5 years, the local press has published neighborhood complaints and verified in the field at least 30 cases of odor contamination in different communes of the region, although most have come from Chillán Viejo and Chillán. This is due to poor management of riles from agro-industrial plants and the use of guano as fertilizer for agriculture, which appear as the most common alleged causes, while the inconveniences to people's wellbeing are proportional to the proximity to the source and range from impregnation in clothing, headaches, eye irritation and dizziness, to vomiting (*La Discusión*, 2022, 2023a, 2024).

In this context, Chillán Viejo concentrates five of the 52 sources emitting bad odors. Complaints for violations of environmental laws add up to a total of 540 open cases from 2014 to date (*Ahumada*, 2023). The Superintendency of the Environment works with companies to control emissions.

El Quillay area is home to approximately 400 families and the company Agrícola y Ganadera Chillán Viejo S.A., owned by Maxagro (*Figure 2*). This company raises and fattens 112,800 pigs



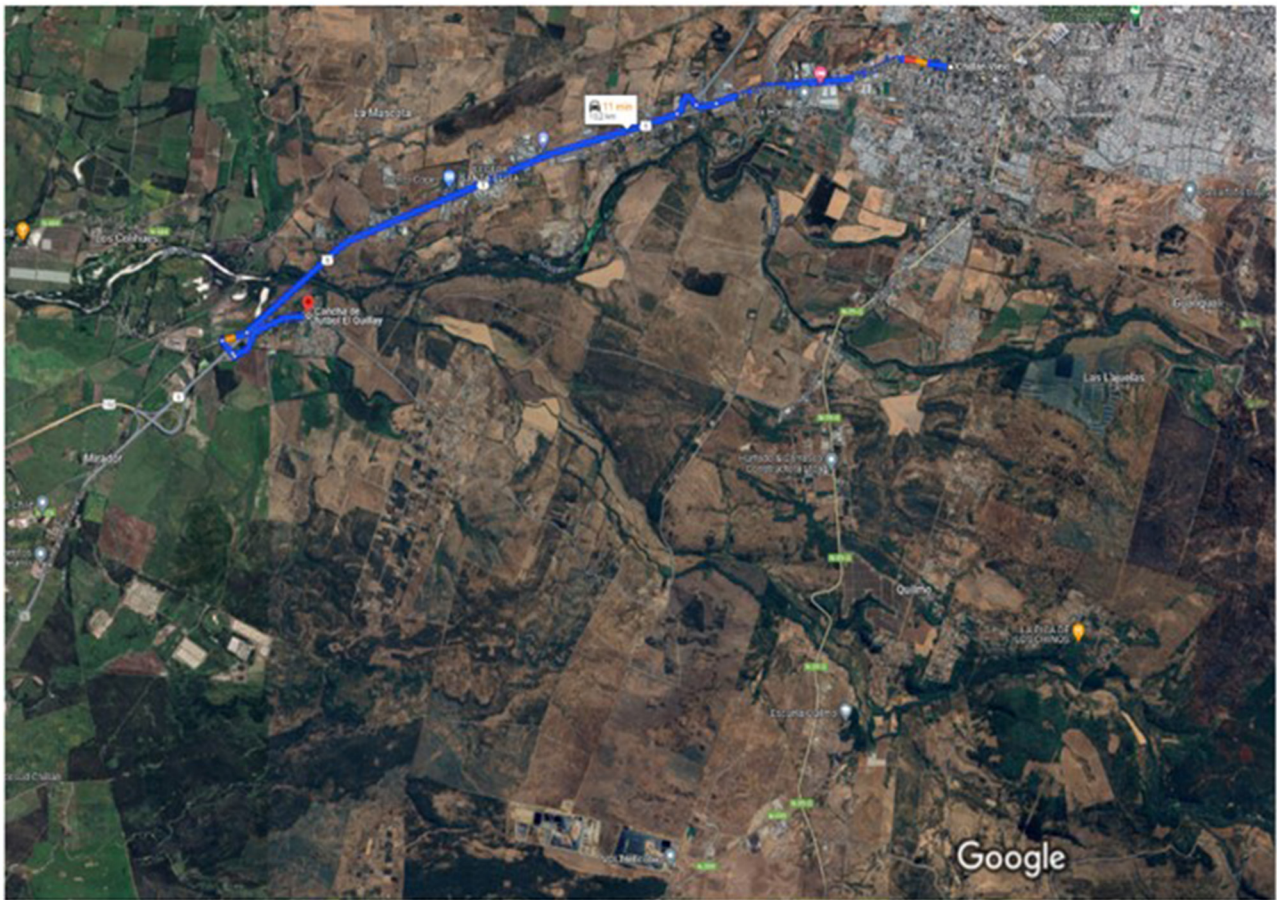


FIGURE 2  
Location of the Maxagro plant in Ñuble. Source: Google Maps (January 30, 2024).

at two farms called Rucapequén 1 and 2, located at kilometer 415 of south Route No. 5 (Henríquez, 2022). This company has more than 300 complaints about odor problems. Furthermore, there is “the Ecobío sanitary landfill, where episodes of bad odors directly affect the neighbors of the Llolincó area, and a few kilometers away, but always in the southern zone of the historic commune, there is the Essbio sewage processing plant, which also eventually “produces bad odors” (Galarza, 2023).

Odors from the pig farm have persisted since its construction in the 1980s until it was acquired by Maxagro in 2014 and in 2016 began construction of the biodigesters, which are responsible, in part, for decomposing organic matter to generate biogas (Figure 3). The residue of this process, “the so-called digestate, is used as biofertilizer. This process can be efficient at the moment of installing a company of this kind, but if not treated correctly, it can end up in biochemical disasters, such as affecting the soil or the emission of hydrogen sulfide” (Galarza, 2023, p. 35).

Residents have constantly complained about the presence of strong and unpleasant odors in their homes, which have caused headaches, vomiting, and even fainting. These odors emanate from animal breeding, gestation, maternity, rearing, raising and fattening animals for meat production.

In this regard, the perception of odors and their impact on people’s quality of life is influenced by sociocultural factors.

Research suggests that minorities and socially disadvantaged groups tend to perceive their environments negatively due to the combination of physical conditions of the place and the stigma associated with their neighborhoods (King, 2015). In the case of the Ñuble Region, these dynamics may be at stake exacerbating negative perceptions and social discomfort among residents of odor-affected areas, which may lead to a devaluation of properties and a decrease in quality of life, creating a cycle of deterioration and abandonment similar to the one described by the broken windows theory. The lack of a proper and centralized planning to address odors in the community can turn affected areas into non-places, areas that lose their social and economic value due to the perception of abandonment and contamination (Augé, 1992).

The effects of odors on the population are evidenced by the complaints made by residents of the affected areas at both rural and urban levels. For example, some residents have recorded the times when the bad odors are perceived, which are sometimes present throughout the day, especially in the mornings between 7 and 8 a.m., then from 12 to 1 p.m., from 4 to 6 p.m., and in the afternoons, at approximately 7 p.m., persisting until midnight. To address this situation, the neighbors of the area have organized themselves through a WhatsApp group to alert about the presence of odors and have made complaints on a local platform (Henríquez, 2021).





FIGURE 3  
Interior of the Maxagro plant, Ñuble. Source: [La Discusión](#) (2021).

The effects that these odors cause are serious, causing health problems such as headaches, vomiting and even fainting, affecting both adults and children ([Henríquez, 2021](#)). In addition, the “stress and depression generated by this situation can disintegrate the family nucleus and seriously affect social well-being” ([Pozo, 2018](#), p.5). Carlos Venegas, social leader and member of the environmental committee of the commune of Chillán Viejo, points out that “the bad odor is putrefying, it is like rotten eggs, this comes from the liquid effluent, from the digestate. There are days when you can’t be outside, 10 to 15 min go by and your throat starts to itch” ([Henríquez, 2021](#)).

Karen Alarcón, a local resident, noted that the odors have led to the arrival of flies, which has become a problem for the entire neighborhood. To deal with this situation, residents have had to seal doors and windows with tape and silicone, as the flies become an inconvenience when carrying out daily activities, such as eating or drinking ([Henríquez, 2021](#)). This type of disturbance causes environmental impacts around “the air purity, affecting quality of life and social coexistence, as it causes discomfort when eating and sleeping, and interrupts people’s daily lives” ([Romero Tovar, 2019](#), p. 21).

As a result of the complaints filed by residents of the Cumbres de Quillay area since 2018, the Maxagro company has been submitted to multiple inspections by the Superintendencia of the Environment (SMA). In 2021, SMA issued provisional measures based on Article 48 of the Organic Law of the Environmental Superintendency, where the company, Agrícola y Ganadera Chillán Viejo S.A, Maxagro, is instructed for a period of 15 business days, for damage to the environment and people’s health, due to the use of raw digestate for irrigation. Measures include conducting

a dynamic olfactometry study of the farm, identifying each of the sources, work on the effects on the population involved and at the same time complement with mass balances associated with the use of water resources, in order to analyze the possibility of applying a dilution factor to the effluent from the biodigester system used to treat the slurry and feces from the fattening and rearing of the farm ([La Discusión, 2021](#)).

The following year, as a result of the improvement process, a continuous odor and air quality recording station was installed. The company has implemented improvements in its production process, such as the use of biodigesters “that allow treating and valorizing waste; automated ventilation systems; hermetic covering of lagoons, wells and ditches; implementation of the Envirosuite system, which allows detailed monitoring of odors, among others” ([Ahumada, 2023](#)).

The companies and waste facilities that generate this type of contamination claim that they were installed decades before the area became populated. This argument does not absolve them of their responsibility to meet environmental standards. The Environmental Superintendent, Marie Claude Plumer, emphasizes that the companies that generate bad odors must invest in technology, they must be updated and adapt to the norms and environmental compliance ([Ahumada, 2023](#)).

The above does not mean that the total reduction or complete elimination of odors arising from any residual organic mass will be required, but rather the aim is to control their intensity through current regulations, in such way that businessmen and facility owners must guarantee the necessary treatments to avoid the poor quality of life of the current inhabitants or those who may potentially arrive at the place ([Ahumada, 2023](#)).

With the increase in population in the area and the company's expansions, coexistence between Maxagro and the neighbors has become increasingly difficult and complex. Accelerated urbanization in the region has also exacerbated the conflict associated to unpleasant odors (La *Discusión*, 2023b). Jorge del Pozo notes that the explosion in housing development on the periphery of the Chillán Viejo commune, driven by "informal lots, water shortages, deteriorating roads, waste management problems and now, the emission of odors from pig facilities," has been a significant factor (Ahumada, 2022). Ulises Lari, president of the Chillán Viejo Environmental Committee, points out that this phenomenon of subdivision and land sales, both legal and illegal, has caused an explosive increase in the population of El Quillay and Quilmo Bajo. "It was predictable, given that the population of Chillán Viejo is growing toward the south," he says (Galarza, 2023).

The Mayor Del Pozo emphasizes to those who are planning to live outside the city to "consider well and with knowledge the advantages and disadvantages that each sector may have. Here there is already a company that has been established for a long time with neighbors from Quillay of Rucapequén who work there" (Ahumada, 2022).

The implementation of effective public policies to regulate and mitigate offensive odor emissions is crucial to prevent the social and physical degradation of affected communities.

### 2.3 Landfill: Ecobio

A second source of bad odors is the Ecobio landfill located in Chillán Viejo. According to Luis Mendoza, Chillán Viejo is the backyard of Ñuble, due to "poor urban planning, as it has the most polluting industries in the entire region (Brizuela, 2021a). Near

the Ecobio landfill, there is an algae drying plant; on the road to Yungay, a forestry company incorporated a white product with nauseating odors on the land adjacent to the highway, in addition to a poultry farm (Brizuela, 2021b).

The Ecobio company's landfill, located in Llolinco, has been subject of complaints about odors and contamination (Figure 4).

Between 2013 and 2022, more than 50 reports of serious violations have been registered, leading to the revocation of its Environmental Qualification Resolution (RCA), closures and fines. Manganese measurements in groundwater have far exceeded the limits allowed by regulations, reaching exorbitant levels. Although the Environmental Superintendency has charged the company, the odor and contamination situation persist until 2021. The president of the Chillán Viejo Environmental Committee, Ulises Lari, highlights the seriousness of the contamination and the late response of the authorities.

The Ecobio company has been detected with storage and leachate handling problems, which have led to seepage and leaks into the soil. In addition, the pipelines were in poor condition and liquids were found around the accumulation ponds. The lack of an adequate Environmental Impact Assessment has also troubled the company, as when they failed to report the bird mortality in the leachate storage ponds in 2017, despite what was stipulated in the Environmental Qualification Resolution. This defines the fiscal will of the State, which according to Figueroa Benavides and Hervés Beloso (2006), "maintains a model that has not been effective or efficient in protecting the environment, although the progress in the introduction of an institutional and environmental management system, nonexistent in the country before the last decade, is recognized" (p. 10).

A study carried out in 2019 in Chillán Viejo by the regional delegation of the Environmental Superintendency (SMA) and the

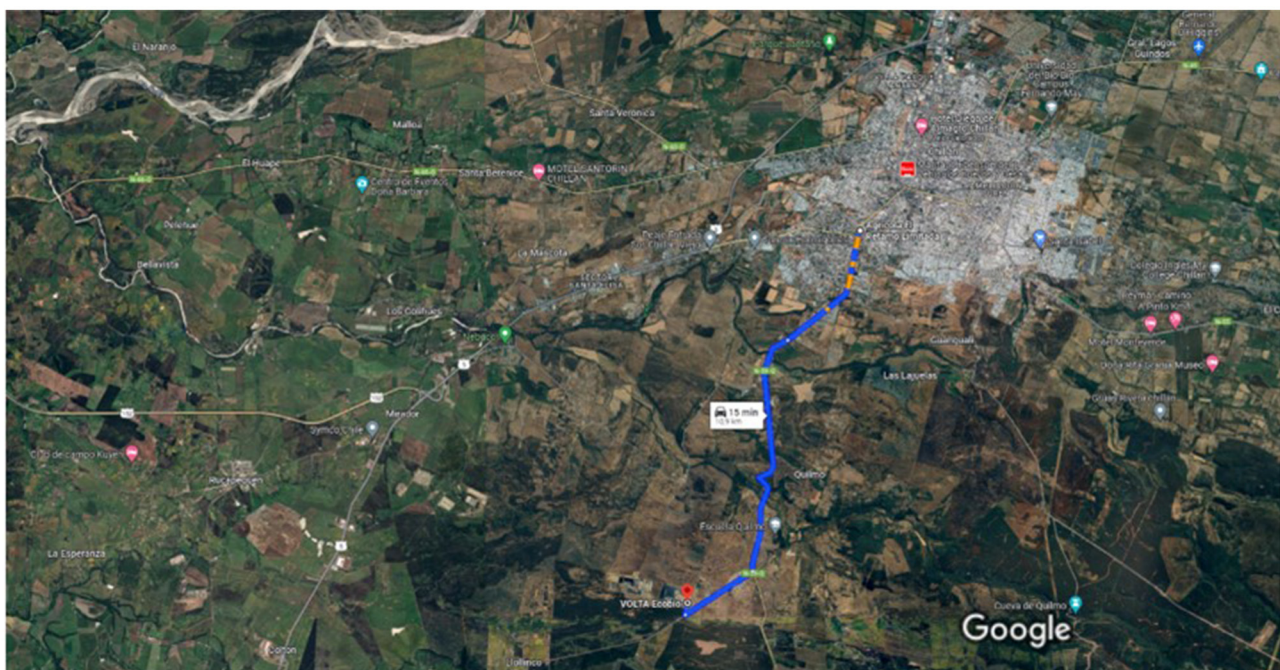


FIGURE 4  
Location of the Ecobio plant in Ñuble. Source: Google Maps (January 30, 2024).



Agriculture and Livestock Service (SAG), who in the investigation of bad odors applied a technique that consists of taking samples of insects to know the origin of these and how they are associated with the area where they reproduce. The objective was to find out if the flies come from the sanitary landfill, the algae drying plant or another type of industry in the rural area of Chillán Viejo.

Therefore, the social representation embodied around the landfill by rural residents is marked by a perception of distrust. Public health problems, the lack of an effective response from the authorities, the company's environmental management problems, and the perception of an ineffective institutional model contribute to this representation.

By analyzing the socio-cultural factors that affect the representation of odors among various age groups and evaluating how industrialization and urban development have altered this social presentation, but may also influence life quality and regional identity, similar to how perceptions of disorder affect investment and neighborhood stigma, this is possible to observe in the Ñuble region, and to draw parallels with the findings of Sampson and Raudenbush (2004). The hypothesis that transformation in the social representation and perception of odors is a direct consequence of industrialization and urban development, reflects the idea that sensory perceptions, as well as perceptions of disorder are influenced by structural and social changes in the environment. This is evidenced from a worrying case which is the situation of Lilian Sandoval, she lives in Llollinco, where the landfills, the algae drying plant and the rest of the sources emanate odors disturbing the air, and repeatedly becomes unbreathable, to the point of using a mask. Living in the sector has had an impact on the quality of life. Lilian says that the bad odors significantly affect the quality of life of the residents. The nuisance caused by the odors stands out, which, according to the neighbor, seem to contain liquid elements and are particularly noticeable in the lower areas.

The neighbor is concerned about the health of the residents and suggests that the current controls are not sufficient. She proposes health check-ups for the neighbors and highlights the uncertainty about the long-term health impact of living in such an environment.

The presence of bad odors has led the neighbor and her family to change aspects of their daily lives. For example, she uses face masks when approaching the site and has decided to change the nephews and nieces' schools to avoid exposure to the contaminated air.

The neighbor recognizes that the land in the area is devalued due to the presence of companies that handle household and industrial waste. The approval of landfill expansion projects by local authorities negatively affects the perception of property values in the area.

Despite the adversities, the neighbor does not intend to move or sell her land. She faces the dilemma that, although the area is devalued, it is difficult to sell and find new housing elsewhere because of the stigma of living near a landfill. The Chillanvejana is reluctant to move elsewhere but does not lose hope that the authorities will do justice and will turn their eyes to the Llollinco area and remember the people living there impregnated with nauseating odors (Meleán, 2019).

The Superintendencia del Medio Ambiente (SMA) carried out inspections at the Ecobio plant and detected the presence of leachate liquids that generated an environmental risk due to the

management of dangerous waste. As a result, in August 2022, 8 provisional pre-procedural measures were issued, including the characterization of the contaminants present in the leachates,<sup>7</sup> the development of a work plan to identify and evaluate the contaminated areas, and the implementation of remediation techniques in each affected area, for example: elaborate a work plan identifying the contaminated sites, such as Zone 1, Zone 2 and Zone 3, which should include a risk evaluation for each of them, identifying type of contaminants, transport power, exposure scenarios, in addition to remediation techniques associated with each identified zone, including soil and water component, among other measures.

It also includes eliminating all the hazardous waste storage areas identified in the report dated August 4th, 2022, which did not have basal waterproofing, security parapets and were in conditions of exposure to rainwater. Furthermore, the safety pools in the hazardous waste storage areas must be repaired, eliminating rainwater and improving their anchors. In addition, the entry of any kind of waste into the CITA Ecobio is prohibited until the leachate reports are submitted. This prohibition came into effect on the fifth calendar day after the notification of this act, which took place on Friday, 19th August 2022, in order to provide sufficient time for the waste that is currently in transit to the CITA module of the Fundo Las Cruces Landfill in Chillán Viejo to be properly managed.

Emanuel Ibarra, Superintendent of the Environment (S), explains that the measures instructed by the SMA are derived from an exhaustive inspection process, where important deficiencies in safety standards have been found due to the accumulation levels of leachates in the bifunctional cells and accumulation lagoons, in addition to other matters associated to the control and improvement of areas of transitory disposal of hazardous waste, areas of contact with rainwater, among others.

These measures are aimed to avoid the environmental risk generated by the accumulation of leachate liquids in the waste management area. They seek to ensure that operational conditions are maintained in a way that minimizes the environmental risk related to the management and disposal of hazardous waste. Furthermore, these measures seek to ensure that safety standards are met and to protect the environment.

It is important to note that the regulation of regulatory impact analysis in Chile has been implemented to improve public conditions, especially those related to environmental matters. This allows the identification of the effects of a regulatory change proposal and more informed and consistent decision making by the State.

Cristián Lineros, head of the Ñuble Regional Office, comments that "during this last period this Superintendency had access to part of the data investigated by the Prosecutor's Office through the PDI's

<sup>7</sup> This is a safety deposit or landfill, with annexed facilities for the reception, conditioning, treatment, inertization and disposal of solid and liquid, hazardous and non-hazardous industrial waste. The disposal technique is at height, with a liquid waste treatment plant using reverse osmosis, a reception and transfer station, and an inertization facility. As a safety deposit, this project is authorized to receive and dispose regional and interregional industrial waste, the characteristics of which have been regulated by environmental approvals since 2003 and subsequent modifications.



BIDEMA, which allowed it to consolidate the file, highlighting the order to stop the reception of hazardous waste (RESPEL), giving ECOBIO a period of four days for its execution, in order to organize the logistics of transport plans and to be able to transfer the waste to other nearby disposal centers. With this background, the company must adopt the necessary measures in the following days to restore the safety levels of its leachates in line with the standards of the environmental assessment, given that the center disposes of 45,000 m<sup>3</sup> of industrial waste per year” (*Superintendencia del Medio Ambiente, 2022*).

### 3 Discussion and conclusion

An analysis of the data reveals a complex framework that defines the conditions in which the subjects involved operate: a city in constant expansion toward the peripheries, where the market and private actors play an influential role. On the other hand, a rurality whose productive base has become industrial, with a significant concentration of land in the hands of large, highly polluting companies. Both territories are linked by a public policy that seems to act more by omission than by presence, evidencing the ineffectiveness of a State that has failed to consolidate itself as a strong actor in crucial issues, such as environmental policy (*Fonseca et al., 2023*).

The regulation established in Decree 9 aims to regulate emissions of pollutants from pig farms, particularly those that generate disturbances due to their odors. This decree seeks to address the negative impacts that these emissions can have on the quality of life of the population, recognizing the risks associated to exposure to unpleasant odors from swine facilities.

By establishing emission standards, the goal is to control and reduce the emission of odorous pollutants in order to mitigate the harmful effects on the health and welfare of the surrounding community. This type of regulation tends to contribute to a healthier environment and to prevent possible conflicts between swine activities and local communities.

The community’s expectations around these companies are not positive, especially when public policy has functioned for them as a complex web of relationships rather than a mandate that comes down directly from the entities in charge of formulating and applying them to provide solutions to environmental contamination, which would be expected to be a priority.

The environmental policy, therefore, as a State matter, and as a tool for the integral development of citizens, is strained by these shortcomings that do not allow an effective solution to pollution and the abuses of the business community regarding the environment. One aspect to consider is the environmental impact. The local community has expressed concerns about the pollutants generated by both the pig farm and the landfill, the latter being a greater concern, to the point that it could affect human and animal health, contaminate the waters of estuaries, vegetation, soils and groundwater.

A second aspect is regulatory responses, such as the actions taken by the SMA and the provisions included in the pre-procedural interim measures issued in August 2022 seek to address these environmental risks and ensure compliance with safety standards. These measures can have a positive impact on the local community by minimizing environmental risk, protecting the health and well-being of residents.

An analysis with Nvivo 14 allows us to identify the most relevant concepts that emerge in the study. As can be seen in

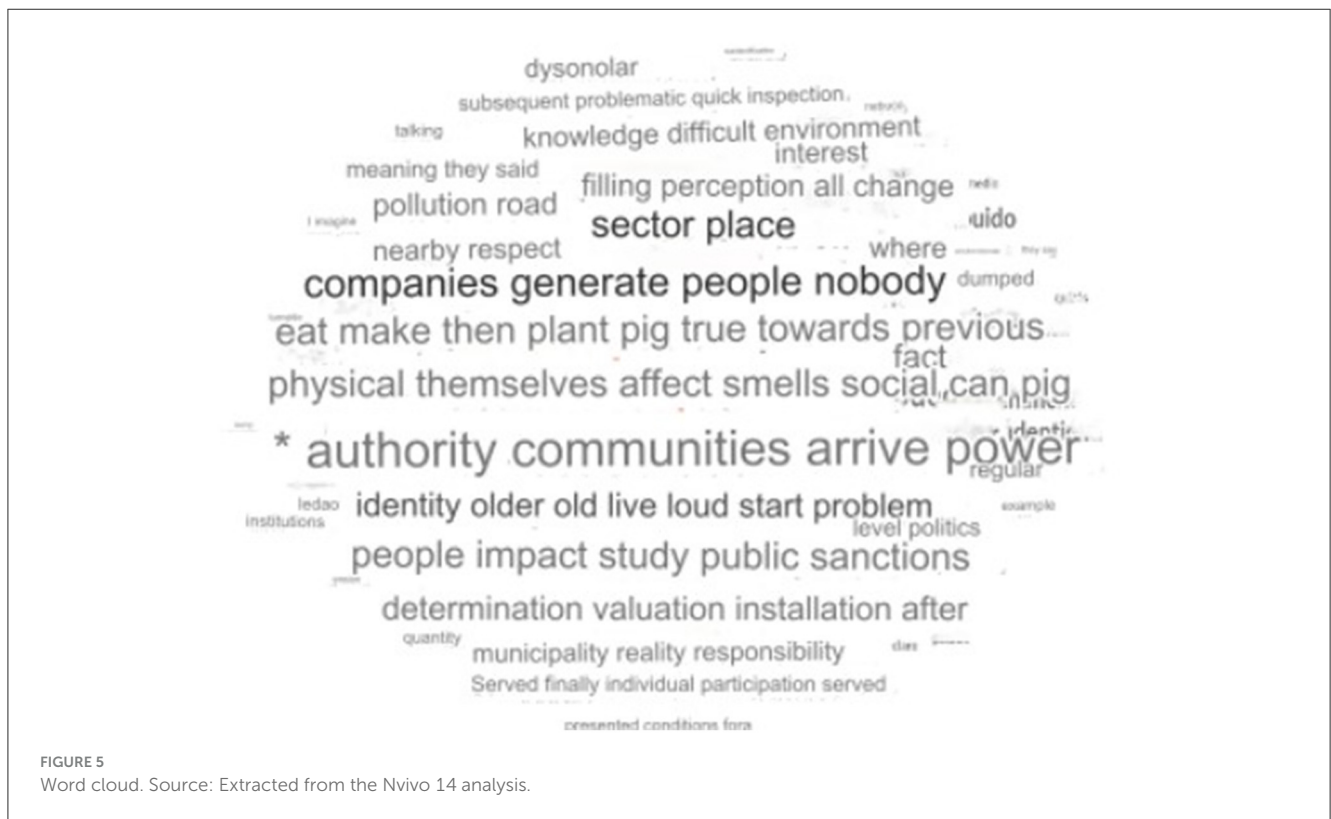


Figure 5, the words “affects—odors—social” and “communities” have a central and significant place in people’s minds. This result evidence that the social representation of odors in Chillán Viejo as the most affected territory agrees that the whole commune of Chillán Viejo is affected by odors, and the direction of the wind and other natural factors make the affected population to be in constant redefinition. It is not easy to determine the geographic extent of the impact.

It should be noted that the magnitude of the environmental impact generated by these projects has not been adequately evaluated, in addition to the lack of a clear and categorical environmental policy from the business conglomerate and the State entity in the approach to environmental issues.

Table 1 shows the situation in the Ñuble region illustrates how changes in the physical and social environment alternate the embodied olfactory experiences of its inhabitants, affecting the cultural representation and valorization of these odors. This link

TABLE 1 Challenges associated with the regulation and management of nuisance odors in the Ñuble region.

Public policy	Challenges around odors
Legislation and regulations	The existence of several regulations and laws that seek to address the problem of nuisance odors is highlighted, including provisions in the Constitution, the sanitary code, and Law 19.300. However, it is noted that the application and effectiveness of these regulations may be compromised due to the lack of comprehensive environmental assessments and the absence of clear limits for the emission of odorous pollutants.
Challenges in environmental assessment	The diagnosis highlights deficiencies in the evaluation of projects, where potential odor problems are underestimated. It is noted that the description of the area of influence regarding the odor component is not clear, and the predominant direction of the air on inspection days is not established with precision. In addition, the lack of exposure or impact criteria is highlighted in order to evaluate and give rise to odor emissions.
Retroactivity in regulations	The regulations applied to swine farms have had changes, such as the Odor Management Strategies in Chile and <a href="#">Decreto 9 (2022)</a> . These regulations establish standards of impact and categorize the facilities according to their size. However, it is evident that the perception of impact can change over time and population growth, generating conflicts.
Urban-rural coexistence problems	Urban growth in the region and the proximity of industrial and agroindustrial facilities to residential areas have generated conflicts, especially in the case of the Maxagro pig farm. The lack of central planning and the lack of attention to odor problems affect the quality of life of residents and can generate social inequity.
Monitoring and response to complaints	The intervention of the Environmental Superintendency, which has applied provisional measures and inspections to companies such as Maxagro and Ecobio. However, the responses to complaints and the sanctioning processes may not be sufficiently effective, and odor problems persist despite the measures taken.
Impact on health and quality of life	The population affected by odors experiences negative health effects, including headaches, vomiting and irritation. Moreover, the impact on the quality of life and property values in affected areas is highlighted.
Challenges in community coexistence	Conflicts between Maxagro and residents are evident, generating desperation and social inequity. The lack of effective communication between authorities, companies and the community aggravate the situation.

Source: Own elaboration.

between corporeality and social representations allows us to argue that industrialization and urban development have modified the olfactory landscape of the region, impacting regional identity and the quality of life of its residents. People feel stigmatized and live in a sacrifice zone.

The case of Ñuble illustrates the complexity of nuisance odor management, where the existing legislation faces challenges in its implementation and adaptation to changes in the population and the environment. The coexistence between industrial activities and local communities requires planning and effective enforcement of regulations to ensure the quality of life and health of the population. The experience of Lilian Sandoval in Llolincó, affected by bad odors, reflects this reality and the negative perception of the insufficient actions taken by the authorities.

Industrial operations, in addition to their environmental impact, can generate a socioeconomic impact. Regulatory responses to their environmental violations also have economic repercussions in the local community. The local economy plays a role in the socioeconomic development of communities; as it thrives, jobs are generated, business growth is encouraged, and the quality of life of individuals is improved. However, when industries fail to meet environmental regulations, penalties and closures can lead to job losses and economic decline.

The situation analyzed allows the identification of the effects of a regulatory change proposal and how more informed and consistent decisions by the State can mitigate the negative impacts. Residents in this area have been severely affected by odors coming from the landfill and other industrial facilities.

Waste management and storage problems, impacts on the environment and wildlife, and an inefficient institutional model have exacerbated the situation. There is an urgent need for comprehensive planning that considers the coexistence of industrial activities and residential areas. This should address aspects such as wind direction,<sup>8</sup> distance between odor-generating companies and residential areas, as well as the implementation of technologies and practices that reduce emissions. Adopting these

8 The relationship between prevailing winds and the main pollution transmitters is crucial to understand how the dispersion of pollutants can affect the receiving population, especially when considering the distance between these sources and urban centers. Seasonal wind patterns, as observed in Ñuble, show a clear influence on the direction and intensity of atmospheric flows. During summer, southern (S) and southwestern (SW) winds predominate, while, in winter, northern (N), and northwestern (NW) winds become more important ([Rebolledo, 2015](#)). This seasonal variability may affect the dispersion of pollutants emitted by Maxagro and Ecobio. The relief dispersion, with the presence of the Andes mountain range and the Coastal mountain range, also plays a crucial role. These geographical features limit the dominance of certain surface winds, which can influence the direction of pollutant dispersion. In addition, thermic effects generated by the relief, such as the channeling of winds along narrow valleys and orographic shading, can modify the distribution of pollutants in the study area. It is concerning to note that, although historically Maxagro and Ecobio were at a distance of ~3.5–3.8 kilometers from urban centers, current standards reveal that the population is much closer, at only 800–700m. This proximity increases the risk of exposure of the population to pollutants emitted by these sources, highlighting the need to monitor and regulate emissions to protect public health and the environment.

measures can improve the quality of life of residents and promote sustainable development that respects the natural environment and the health of the community.

This study integrates theories and methodologies from the sociology of odors and social psychology to analyze how sensory perceptions are related to social stratification, stigma, and urban and rural inequality. This enriches the field by showing how odors are not only sensory experiences, but also social phenomena that influence perceptions of the environment and community relations.

## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## Author contributions

MP-U: Conceptualization, Funding acquisition, Investigation, Methodology, Writing – original draft, Writing – review & editing, Formal analysis, Supervision. JB: Formal analysis, Investigation, Methodology, Visualization, Writing – original draft, Writing – review & editing. GM-L: Formal analysis, Investigation, Methodology, Writing – original draft, Writing – review & editing. KV-B: Conceptualization, Methodology, Writing – original draft, Writing – review & editing, Investigation. OV: Formal analysis, Investigation, Writing – original draft, Writing – review & editing, Conceptualization, Methodology, Visualization. JM-S: Conceptualization, Formal analysis, Investigation, Methodology, Writing – original draft, Writing – review & editing. JL-H: Writing – review & editing, Conceptualization, Formal analysis, Project administration, Validation. HS: Conceptualization, Formal analysis, Writing – review & editing,

Investigation. IM: Formal analysis, Writing – review & editing, Conceptualization, Investigation.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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