State Capacity and Environmental Regulation: The Case of Air Pollution in La Oroya, Peru (1922–1927)

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Abstract

This study evaluates the Peruvian state's resolution of the La Oroya emissions conflict (1922–1927), assessing whether it demonstrated state capacity by incorporating environmental considerations and effectively implementing the measures adopted. Using a historical-institutional approach based on the qualitative analysis of historical sources—bulletins and reports of the Corps of Mining Engineers of Peru (CIMP), established in 1902 to manage mineral resources, official bulletins of the Ministry of Development, and secondary literature—the analysis applies Carpenter's concept of bureaucratic autonomy (legitimacy, organizational capacity, and political differentiation) to examine the CIMP's role during its first decades. The results show that, despite its political support, legitimacy, and technical capacity, the CIMP's bureaucratic autonomy was constrained on the criterion of political differentiation. Its Report on La Oroya's Emissions (1926) identified the problem and proposed technical solutions, but the CIMP lacked the authority to enforce them: the Cerro de Pasco Copper Corporation complied only partially, installed filters only between 1936 and 1942, and purchased much of the affected land at low prices. In La Oroya, the resolution favored corporate interests over environmental and community concerns, reflecting Peru's broader trend of prioritizing economic growth over environmental protection. The findings reveal limitations in state capacity to enforce environmental policies. While the CIMP exhibited bureaucratic autonomy, its actions were constrained by political and economic interests. The La Oroya case highlights ongoing challenges in Peru's environmental governance, illustrating the persistent tension between economic development and sustainability, and offers a historical precedent for understanding contemporary resource conflicts.

Keywords: environmental conflicts; state capacity; environmental policies; Peru.

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Since its early colonial period, Peru has played a central role in the global economy as an exporter of raw materials, initially centered on precious metals such as gold and silver and later expanded to copper, zinc, and other minerals as the country's economic and political landscape evolved. Mining has remained a cornerstone of Peru's economic development, but also a source of environmental conflict, particularly amid industrialization and climate change. Today, environmental degradation, public health hazards, and threats to biodiversity underscore the urgency of regulating the extractive sector.

This centrality persists: according to MINEM, mining exports reached US$62.8 billion in 2025 (+27.2 percent over 2024), about 67.5 percent of Peru's exports;[2] the BCRP attributes much of this growth to high export prices for gold and copper, which rose 43.6 and 24.2 percent, respectively.[3] Yet this growth has long coexisted with tensions between economic development and environmental protection, and with limits on the state's capacity to enforce environmental rules—as the case of La Oroya illustrates.

La Oroya is one of the most emblematic cases of mining-related environmental conflict in Peru and has been recognized as one of the world's most polluted sites.[4] The conflict dates back to the early 20th century, when advances in metal refining generated what economists term "negative externalities," the most notorious being the so-called "Smoke Conflict," which significantly affected the livelihoods of surrounding communities, particularly by degrading pasturelands and harming livestock.

This backdrop raises crucial questions about the state's role in environmental governance. Specifically, this research investigates whether state capacity influenced the environmental policy decisions related to the "Smoke Conflict" in La Oroya between 1922 and 1927. The study employs a historical approach, integrating economic theory with insights from other social sciences. It reviews the state's response to La Oroya's environmental pollution, evaluating the extent of state capacity to establish and enforce a resolution.

[2] Ministerio de Energía y Minas, *Boletín Estadístico Minero* (balance anual 2025) (Lima: MINEM, 2026).
[3] Banco Central de Reserva del Perú, "Balanza comercial: diciembre de 2025," *Notas de Estudios del BCRP*, no. 11 (2026), https://www.bcrp.gob.pe/docs/Publicaciones/Notas-Estudios/2026/nota-de-estudios-11-2026.pdf.
[4] Blacksmith Institute, *The World's Worst Polluted Places: The Top Ten* (Blacksmith Institute, October 2006). On the continuing relevance of the case, see Corte Interamericana de Derechos Humanos, *Caso Habitantes de La Oroya vs. Perú. Excepciones Preliminares, Fondo, Reparaciones y Costas*, Sentencia de 27 de noviembre de 2023, Serie C No. 511.

To assess state capacity, this research focuses on the Cuerpo de Ingenieros de Minas del Perú (CIMP), the institution responsible for mineral resource management, and analyzes its functions and competencies during its first decades, using the concept of bureaucratic autonomy as defined by Carpenter.[5] According to this framework, bureaucratic autonomy is determined by three main criteria: (a) legitimacy, (b) capacity and organization, and (c) political differentiation.

This study is relevant for three reasons. First, the literature on La Oroya has focused mainly on clinical and environmental studies, neglecting institutional analyses of state action and rule-making. Second, it introduces a historical perspective on the period before the mid-20th century, largely overlooked by previous studies, which tend to focus on Doe Run's 1997 entry.[6] Third, it contributes to the neo-institutionalist debate on institutions as rules that reduce transaction costs and structure social interactions.[7] It explores whether such rules were effectively implemented and what shaped their enforcement.

The remainder of this article is structured as follows. The next section presents the historical background of mining in Peru and of pollution in La Oroya; the following one reviews previous research on La Oroya and identifies knowledge gaps. The article then outlines the theoretical framework, centered on bureaucratic autonomy, and presents the historical-institutional methodology. Finally, it presents the results of the analysis, discusses them, and offers the conclusions.

[5] D. Carpenter, *The Forging of Bureaucratic Autonomy: Reputations, Networks, and Policy Innovation in Executive Agencies, 1862–1928* (Princeton, NJ: Princeton University Press, 2001).
[6] J. C. Orihuela, "Context Matters: The Significance of Non-economic Conditions for Income–Pollution Relationships in Chile and Peru," *Journal of Environmental Studies and Sciences* 3, no. 4 (2013): 391–403; J. C. Orihuela, "Las reglas ambientales del desarrollo económico: la regulación de la contaminación del aire generada por las fundidoras de Chuquicamata y La Oroya," *Economía* 37, no. 74 (2014): 213–46.
[7] D. North, *Institutions, Institutional Change and Economic Performance* (Cambridge: Cambridge University Press, 1990).

HISTORICAL BACKGROUND

MINING IN PERU: A HISTORICAL OVERVIEW

MINING BEFORE THE 20TH CENTURY

Mining has been a cornerstone of Peru's economy since colonial times, initially centered on precious metals. While the Incas exploited surface deposits, the Spanish expanded mining operations—especially in Porco and Potosí—and integrated production into the mercantilist system, monopolizing foreign investment. After independence, the sector declined due to war-related disruptions, although political discourse continued to frame mining as vital to national development.[8]

According to Ugarte,[9] the Republican period saw two mining phases: (1) 1821–1884, marked by colonial continuity and slow recovery due to inherited stagnation, war destruction (e.g., Pasco), the abolition of the mita system, and competition from guano; and (2) post-1884, driven by technological advances and foreign capital. Exports remained reliant on gold and silver, but by 1860 copper, coal, and petroleum began gaining relevance. State efforts under President Balta—such as railway expansion, mining education, and regulatory reforms—sought to modernize the sector, but the War of the Pacific (1879–1883) disrupted progress.

Silver production resurged in the 1870s due to currency devaluation, and discoveries like Casapalca (1880) and Morococha (1890), along with new refining techniques, revitalized the industry. Foreign experts played a key role in introducing modern methods, including smelting innovations and leaching technologies, often under foreign control.[10] Technologies such as Bessemer converters, introduced by U.S. firms like the Cerro de Pasco Copper Corporation (CPC; later Cerro de Pasco Corporation), deepened Peru's technological dependence.

[8] E. Romero, *Historia económica del Perú: 1899–1993*, vol. 2 (Buenos Aires: Sudamericana, 1949).
[9] C. Ugarte, *Bosquejo de la historia económica del Perú* (Lima: Banco Central de Reserva del Perú, 1980).
[10] Ibid.

By the late 19th century, mining—fueled by foreign capital, education, and infrastructure—reasserted its centrality to the national economy, even as other sectors like agriculture and hydrocarbons gained ground.

Copper and the 20th Century

The post–War of the Pacific era left Peru's productive sectors in crisis. Mining was particularly affected by the 1895 decline in silver prices and the 1897 suspension of silver coinage.[11] However, rising global demand for copper transformed the landscape: between 1894 and 1900, copper prices nearly doubled, drawing investor attention. New minerals like vanadium and tungsten also gained importance.

Until 1900, mining was largely a decentralized, small-scale activity focused on precious metals.[12] The capital-intensive nature of copper extraction led small miners to sell their operations to foreign firms, triggering the denationalization of the sector and its regional concentration.

Three major shifts reshaped the industry:

1. **Resource control** passed to foreign companies.
2. **Legal reforms**—especially the Mining Code of 1900, promulgated on July 6, 1900, and in force from January 1, 1901[13]—facilitated industrial expansion and removed investment barriers.[14]
3. **Foreign capital** brought modern technology and infrastructure, especially railways like Central Railway extended to La Oroya in 1893.[15]

CPC became a dominant force, beginning operations in 1902 and quickly expanding across the central highlands. It emphasized vertical integration by acquiring other firms and installing advanced refining plants at Tinyahuarco (1906) and La Oroya (1922), the latter becoming Latin America's largest smelting complex.[16]

[11] E. Dore, *Acumulación y crisis en la minería peruana, 1900–1977* (Lima: Universidad Nacional Mayor de San Marcos, 1986).
[12] R. Thorp and G. Bertram, *Perú: 1890–1977: Crecimiento y políticas en una economía abierta* (Lima: Mosca Azul Editorial, 1985).
[13] J. Morales and A. Morante, "Aciertos y debilidades de la legislación minera actual," *Revista de Derecho Administrativo* 8 (2009): 137–47.
[14] Dore, *Acumulación y crisis*; Ugarte, *Bosquejo*.
[15] M. Samamé, *El Perú minero*, vol. 1 (Lima: INCITEMI, 1979).
[16] D. Sulmont and M. Valcárcel, *Vetas de futuro: educación y cultura en las minas del Perú* (Lima: Pontificia Universidad Católica del Perú, 1993).

CPC functioned as a classic economic enclave: foreign-owned, autonomous from local laws, and regionally hegemonic.[17] It reshaped social life by fostering company towns where economic, urban, and cultural life revolved around mining.[18]

Pollution and Industry in La Oroya

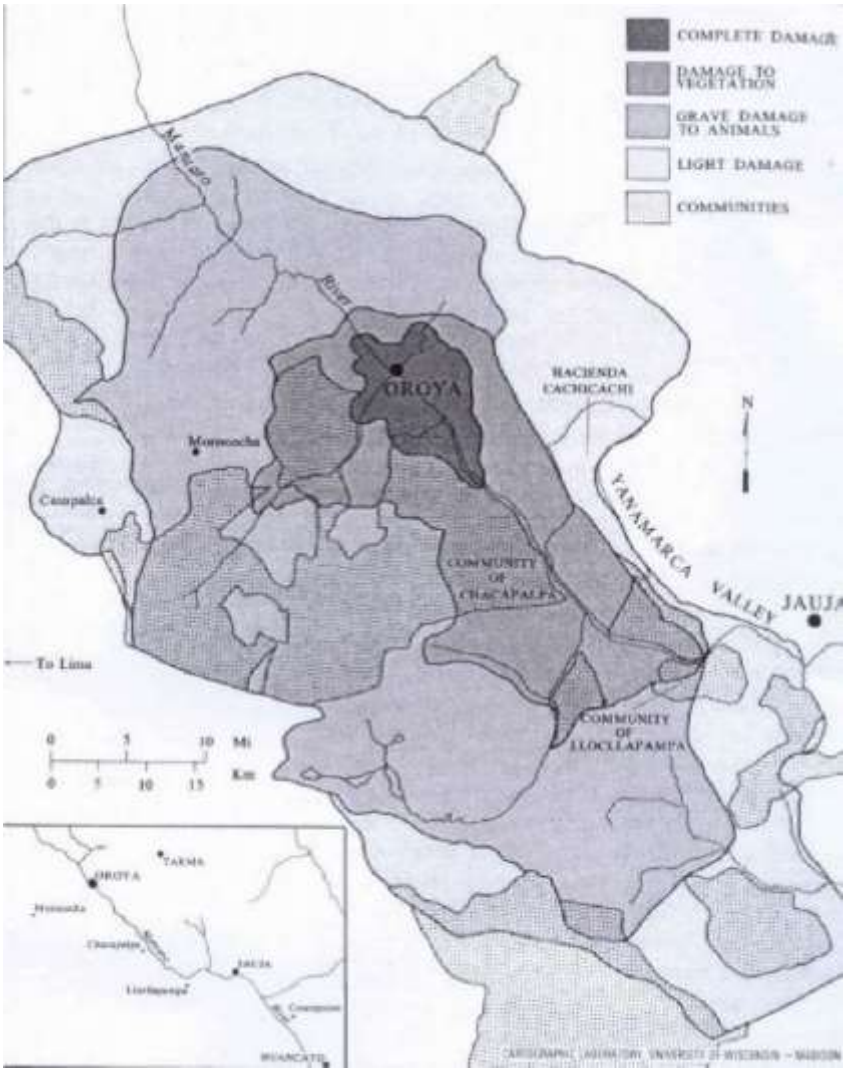
Signs of smoke pollution appeared within a few months of the start of operations at the La Oroya refinery in 1922. Smelter fumes and mining waste contaminated water and destroyed the productive capacity of farmland, causing the disappearance of crops and of the pastures that sustained the peasants' livestock.[19] Figure 1 shows the areas adjacent to the smelter that were damaged by the emissions in the 1920s.

Pollution also spread to other natural sources. Evidence of contamination has been documented in three rivers of the Central Highlands: Mantaro, Rímac, and San Juan. By 1924, "the adjacent communities, Huaynacanchas, Huay Huay, Huari, and the Quimila estate were already completely devastated: there was no grass left, and the livestock had died. A similar fate befell the lands somewhat farther away, almost reaching Cerro de Pasco."[20]

By affecting livelihoods, pollution also altered rural social dynamics: it facilitated the proletarianization of Peruvian peasants and weakened their resistance to leaving their villages and agricultural towns.[21] In the first three decades of the 20th century, the forced migration and recruitment of peasants who had lost their resources became the mines' main source of labor, as survival through traditional activities became unviable.[22]

[17] A. Flores Galindo, *Los mineros de la Cerro de Pasco, 1900–1930* (Fondo Editorial Pontificia Universidad Católica del Perú, 1983).
[18] C. Chuquimantari, *Yauli-La Oroya: Minería y ciudades empresa* (Adec-ATC, 1992).
[19] H. Bonilla, *El minero de los Andes: una aproximación a su estudio* (Lima: Instituto de Estudios Peruanos, 1974), 40; F. Bravo Alarcón, "El problema ambiental de La Oroya y su construcción social y política a través del análisis de las propuestas institucionales, legales y participativas de remediación" (master's thesis, Pontificia Universidad Católica del Perú, 2012), https://tesis.pucp.edu.pe/repositorio/handle/123456789/1550.
[20] D. Kruijt and M. Vellinga, *Estado, clase obrera y empresa transnacional: el caso de la minería peruana, 1900–1980* (Siglo XXI, 1983), 54, quoted in Bravo Alarcón, "El problema ambiental de La Oroya," 65.
[21] J. Deustua, "Guano, salitre, minería y petróleo en la economía peruana, 1820–1930," in *Compendio de historia económica del Perú*, vol. 4, ed. C. Contreras (Lima: Banco Central de Reserva del Perú e Instituto de Estudios Peruanos, 2011), 165–237.
[22] Bonilla, *El minero de los Andes*; Bravo Alarcón, "El problema ambiental de La Oroya"; P. Vega Centeno, "El ocaso de un modelo de ciudad minera: una mirada a Cerro de Pasco y La Oroya," *Cuadernos Arquitectura y Ciudad*, no. 7 (Lima: PUCP, 2007).

Figure 1: Map of Adjacent Areas Damaged by Emissions from the La Oroya Smelter in the 1920s



Source: Florencia E. Mallon, *The Defense of Community in Peru's Central Highlands: Peasant Struggle and Capitalist Transition, 1860–1940* (Princeton: Princeton University Press, 1983).

This process benefited mining companies, which had faced labor shortages and instability due to farmers' initial resistance to leaving their land and now absorbed the newly available workforce. "The landscape polluted by smoke emissions with high sulfuric acid concentrations paradoxically also reflects industrial development, turning La Oroya into a setting similar to that of the early European industrial revolution during the first half of the 19th century."[23]

[23] Vega Centeno, "El ocaso de un modelo."

Local populations initially did not oppose the establishment of mining operations, since no negative environmental effects were foreseen; over time, however, social perceptions of environmental degradation and loss of livelihoods emerged, and the social structure of the population shifted from an agricultural peasant community to one predominantly engaged in mining.

In this context, the conflict did not revolve around a conservationist view of the environment but rather around the deterioration of the living conditions in which people resided. Before examining how the state responded to this conflict, the next section reviews how previous research has studied La Oroya and identifies the gaps that this article addresses.

STATE OF THE ART ON LA OROYA

The conflict described in the previous section has been studied from technical, clinical, environmental, and institutional perspectives, mostly for periods later than the one examined here. This section reviews previous studies on La Oroya to situate this research and identify gaps in the literature on the conflict, using the classification of the state of the art proposed by Bravo Alarcón as an initial framework.[24]

The thematic categories are a) technical studies, b) clinical studies, and c) environmental studies, plus a fourth category, d) institutional studies, relevant to the focus of this research.

A temporal classification is also employed, based on the main historical milestones of La Oroya:

- **First period (1900–1974):** Presence of the CPC.
- **Second period (1974–1990):** Nationalization of CPC and creation of the Empresa Minera del Centro del Perú (CENTROMIN).
- **Third period (1997–present):** Presence of the Doe Run company.

[24] Bravo Alarcón, "El problema ambiental de La Oroya."

This dual classification provides a more precise view of the literature and its evolution; the reviewed studies may fall into more than one category.

Technical Studies

Technical studies on La Oroya's environmental issues, particularly during the first period, include a report prepared between 1923 and 1925 by engineer José Julián Bravo[25]. This study, entrusted to the Corps of Mining Engineers of Peru (CIMP), was published in the institution's Bulletin No. 108.[26]

Examined in detail in the Results section, this report was a pioneering technical analysis of environmental pollution in La Oroya: using empirical methods, the technical team evaluated the impact of emissions from the smelting plant and proposed technical solutions to mitigate them.

The report was structured into six chapters:

1. Description of the La Oroya smelting plant.
2. Characteristics of the produced emissions and evacuation conditions.
3. Modifications of emissions after exiting the chimneys.
4. Harmful effects of emissions.
5. Measures to mitigate the damage.
6. Conclusions.

Its main conclusions included:

- The smelting plant emitted 38 million cubic meters of smoke daily.
- The emissions contained solid particles and condensed vapors totaling approximately 80.5 tons per day.

[25] A mining engineer who graduated in 1894 from the School of Engineers, he was a member of the CIMP from 1902 and its director from 1909 to 1927, and a professor at the School of Engineers and the National University of San Marcos; his notable contributions include studies on vanadium in Minas Ragra and the report on the fumes of La Oroya. He died in a car accident in Akron, Ohio, on May 18, 1927. See A. M. Ueda, *Historia del Cuerpo de Ingenieros de Minas del Perú (1902–1950)* (Universidad Nacional de Ingeniería, Proyecto Historia UNI, 2002); M. Samamé, "La minería en la década del 20," *Revista de la Universidad Católica*, no. 5 (1979): 75, 80.
[26] J. J. Bravo, *Informe sobre los humos de La Oroya* (Imp. Americana, 1926).

- The primary pollutants identified were sulfur dioxide, arsenic trioxide, and lead compounds.
- The smelter had no device whatsoever to capture the harmful elements of the smoke or to prevent their damage.[27]
- The presence of lead and arsenic was detected in the soil and pastures, affecting livestock health.
- The report recommended implementing technologies to reduce pollution, including the Cottrell electrostatic precipitation method.
- It argued that the valuable substances recovered from the waste could make the required investment profitable for the company.
- It suggested that the government require CPC to adopt technical measures within six months.

Clinical Studies

Clinical studies have analyzed the effects of pollution on the health of La Oroya's population, particularly exposure to heavy metals. The first recorded medical study, conducted in 1926 by surgeon César Amaya,[28] complemented Bravo's technical analysis by identifying the contaminating metals and their effects on the health of local inhabitants.

During the second period, the First Peruvian Congress on Occupational Health (1967) presented five investigations on La Oroya, which, according to Bravo Alarcón, demonstrated scientific interest and validated evidence on the health effects of pollution.[29]

[27] Ibid., 104.
[28] S. Tácunan Bonifacio, "Contaminación ambiental en el valle del Mantaro. Informe médico (La Oroya, 1926)," *Investigaciones Sociales* 16, no. 29 (2012): 83–88.
[29] Bravo Alarcón, "El problema ambiental de La Oroya," 39.

Table 1: Research Studies from the First Peruvian Congress on Occupational Health (1967)

Research Title and Authors	Metal	Topic
Environmental pollution by cadmium in a metallurgical city - Augusto Ramírez	Cadmium	Occupational health problems in La Oroya due to cadmium presence.
Control of lead poisoning in La Oroya Metallurgical Complex - Harris & Posadas	Not specified	Description of operations and processes as the main causes of lead poisoning in the area.
Ferrokinetics studies in individuals exposed to lead in La Oroya - H. Villanueva Meyer	Iron and radioactive chromium	Results of studies using radioactive tracers in subjects exposed to lead: biological half-life of plasma iron, its incorporation into bone marrow, and iron dynamics in storage organs.
Control of environmental lead pollution in La Oroya Metallurgical Complex - P. Jiménez	Lead	Description of measures taken by CPC to control occupational lead poisoning.
Medical aspects of lead pollution in La Oroya - H. Ghersi	Lead	Study on lead emissions from various metallurgical processes in La Oroya.

Source: Author's elaboration based on Bravo Alarcón, "El problema ambiental de La Oroya," 39.

During the third period, clinical studies have deepened in measuring lead levels in the population. For example, Ramírez, Cam Paucar, and Medina analyzed lead levels in four Peruvian cities (Lima, Huancayo, La Oroya, and Yaupi) and concluded that La Oroya had the highest blood lead concentration, averaging 348 ± 240 µg/L.[30]

Additionally, UNES conducted a study on lead levels in pregnant women and children under three years old, though no direct cause-effect relationship was found.[31] Pebe et al. analyzed blood samples from newborns in La Oroya (2004–2005) and found elevated lead concentrations.[32]

[30] A. V. Ramírez, J. Cam Paucar, and J. M. Medina, "Plomo sanguíneo en los habitantes de cuatro localidades peruanas," *Revista Panamericana de Salud Pública* 1 (1997): 344–48.
[31] UNES, *Evaluación de niveles de plomo y factores de exposición en gestantes y niños menores de 3 años de la ciudad de La Oroya* (La Oroya: UNES, 2000).
[32] G. Pebe et al., "Niveles de plomo sanguíneo en recién nacidos de La Oroya, 2004–2005," *Revista Peruana de Medicina Experimental y Salud Pública* 25, no. 4 (2008): 355–60.

Other relevant studies include Centro Labor's (2002) study on the adverse effects of lead on target organs in populations of three localities in Pasco and in Yauli (La Oroya).[33] Reuer et al. expanded the analysis beyond lead to include arsenic and cadmium, concluding that the main sources of childhood diseases in La Oroya were contaminated soils and dust generated by minerals, leading to high lead concentration levels.[34]

Environmental Studies

Environmental studies emerged as environmental awareness gained importance. This does not mean that environmental concerns were absent in earlier conflicts, but no environmental studies were conducted during the first period: the only close reference is Bravo's report, which mentioned harmful effects on pastures and livestock, leaving a significant gap regarding the early stages of such conflicts.

Relevant studies began to appear in the second period, but tangible concern over environmental issues became evident only in the third.

In their book, Cederstav and Barandiarán[35] tracked Doe Run Peru's atmospheric reports over five years, examining lead, arsenic, sulfur, and cadmium. Without relating these environmental variables to social, political, or economic factors, they critiqued the inadequacy of environmental monitoring and proposed recommendations for the Ministry of Energy and Mines, DIGESA, CONAM, and Doe Run.

Another relevant environmental study is the Human Health Risk Assessment Report - La Oroya Metallurgical Complex,[36] which concluded:

"This risk assessment confirms previous studies identifying lead exposure as the primary health risk for La Oroya's population due to emissions from the metallurgical complex. Virtually all children living in Old La Oroya are at risk of neurological behavioral effects. Many adults in Old La Oroya and nearby communities are also at

F. Bianchini, *Evaluación de la calidad de los recursos hídricos en la provincia de Pasco y de la salud en el centro poblado de Paragsha* (Cerro de Pasco: Asociación Civil[33] Centro de Cultura Popular Labor, 2009), 10.
[34] M. K. Reuer et al., "Lead, Arsenic, and Cadmium Contamination and Its Impact on Children's Health in La Oroya, Peru," *ISRN Public Health* (2012).
[35] A. K. Cederstav and A. Barandiarán, *La Oroya Cannot Wait* (Peruvian Society of Environmental Law, 2002).
[36] Integral Consulting, *Informe del estudio de riesgo para la salud humana. Complejo Metalúrgico de La Oroya* (prepared for Doe Run Perú, December 2005).

risk. Emissions of sulfur dioxide and sulfuric acid cause adverse effects in most of the population. Pulmonary irritation induced by these chemical agents is usually transient; however, there is also an increased risk of non-specific morbidity and mortality associated with high exposures."[37]

Institutional Studies

The fourth category comprises studies of institutional dynamics within conflicts. Although institutions are widely debated, here the term refers to the formal rules the state established to govern the issues that emerged in La Oroya and how they evolved. This relatively recent line of research, relevant across periods, was not extensively explored in the first two but received slightly more attention in the third.

At the core of this classification is Bravo Alarcón's study,[38] the source of the initial classification, which integrates social, environmental, and political perspectives through a historical review, analyzing institutional, legal, and participatory proposals aimed at mitigating environmental impacts. He concludes that, given the complexity of La Oroya's environmental challenges, these proposals have been insufficient, and that remediation requires a coordinated rather than isolated approach.

Orihuela,[39] also within the third period, contributes to the institutional analysis by comparing the income-pollution relationship in Chile and Peru, two countries with similar characteristics; he attributes Chile's more effective environmental controls to ecological, cognitive, and political conditions that shaped each country's approach to governance.

Another study by Orihuela compares environmental regulations in Chuquicamata (Chile) and La Oroya (Peru).[40] It attributes Chile's success to political agency, institutional legacy, and opportunities for regulatory change—conditions

[37] Ibid., 131.
[38] Bravo Alarcón, "El problema ambiental de La Oroya."
[39] Orihuela, "Context Matters"; Orihuela, "Las reglas ambientales."
[40] Orihuela, "Las reglas ambientales."

absent in Peru, limiting its environmental governance—and Orihuela later extends this perspective to the formation of a "green state" for mining in Colombia, Chile, and Peru.[41]

> In terms of coverage, clinical studies are the most extensive, followed in decreasing order by environmental, institutional, and technical studies—especially from the late first period onward. However, the first period and the institutional analysis of the conflict remain largely unaddressed, a gap that this research seeks to fill. The next section presents the theoretical framework that guides it.

THEORETICAL FRAMEWORK

Interpreting the conflict described in the Historical Background and addressing the gap identified in the State of the Art require concepts suited to the early twentieth century rather than categories taken from contemporary environmental debates. This study analyzes the relationship between state capacity and environmental policy in the conflict over smoke emissions in La Oroya (1922–1927). Given that a consolidated notion of environmental policy did not exist at the time, this research examines how state intervention incorporated environmental elements and the role of bureaucratic autonomy in its implementation.

The study is structured around three key conceptual axes: (i) environmental conflict, defining its meanings and relevance during the period under study; (ii) public and environmental policy, understood as the state's response to pollution-related issues; and (iii) state capacity, with a focus on the autonomy of the Corps of Mining Engineers.

THE ISSUE OF ENVIRONMENTAL CONTENT IN THE EARLY 20TH CENTURY

The emergence of an environmental perspective in Latin America has been shaped by shifts in the worldview of industrialized nations. The guano export boom (1840–1880) played a crucial role in the region's economy, and in the early 20th century agro-exports—mainly coffee in Brazil, cocoa, and sugar in Cuba—became key economic

[41] J. C. Orihuela, "The Environmentalization of Mining in Colombia, Chile, and Peru: A Comparative Analysis of Green State Formation," *The Extractive Industries and Society* 8, no. 4 (2021): 100829, https://doi.org/10.1016/j.exis.2020.10.012.

drivers. This expansion of agricultural frontiers led to deforestation, triggering both economic and ecological transformations.

During this period, new sources of energy and materials emerged, driven by both domestic and foreign demand.[42] The exploitation of natural resources was consolidated under ideologies of progress, promoted by business elites and deeply tied to international markets. Expressions such as *"without sugar, there is no progress"* (Cuba) or *"mining could lay the foundation for national prosperity"* (Peru)[43] reflect an anthropocentric perspective, where resources were seen as tools for national development.

In this context, conflicts arose from opposing interests, often between foreign companies and local communities, becoming environmental conflicts when they involved motivations such as recreational use, conservation, competition over scarce resources, or threats to livelihoods. In the Latin American sense, an environmental conflict is a dispute triggered by environmental impact or damage between actors with conflicting interests.[44] This discourse has evolved with how society perceives and values its relation to nature[45].

Moreover, "it is not enough for an actor to cause environmental deterioration for a conflict to arise; rather, there must be another actor who becomes aware of the environmental damage occurring in their surroundings and is willing to defend or protect the affected environment."[46] This implies that environmental conflict is not merely the result of environmental harm but also of a social construction process. As stated by Lezama, "before being socially recognized and accepted as such, the environment and environmental damage undergo a process of valuation, filtration, and social construction."[47]

[42] J. Martínez-Alier, M. Baud, and H. Sejenovich, "Origins and Perspectives of Latin American Environmentalism," in *Environmental Governance in Latin America* (London: Palgrave Macmillan, 2016), 29–57.
[43] Romero, *Historia económica del Perú*.
[44] C. Padilla, "El pecado de la participación ciudadana," in *Conflictos ambientales en Chile* (Santiago de Chile: Observatorio Latinoamericano de Conflictos Ambientales, 2000).
45 This excerpt is based on the Chilean experience, but we believe it can be extended to Latin America, as discussed in M. Folchi, "Conflictos de contenido ambiental y ecologismo de los pobres: no siempre pobres, ni siempre ecologistas," *Ecología Política*, no. 22 (2001): 79–100.
[46] P. San Martín, *Conflictos ambientales en Chile* (Santiago: Observatorio Latinoamericano de Conflictos Ambientales, 1997).
[47] J. L. Lezama, *La construcción social y política del medio ambiente* (El Colegio de México, 2004).

Thus, the mere presence of pollution or environmental damage—whether in the air, water, or soil—does not trigger a conflict; how the population perceives its impact on their lives is a necessary factor. In this sense, environmental phenomena become risk events "to the extent that they become socially relevant [...] that is, insofar as they are socially perceived and recognized as such."[48]

Once awareness of environmental damage emerges, its nature and underlying causes can vary. Bebbington and Humphreys Bebbington categorized environmentalism into five types[49] to show that environmental conflict is not unidimensional but manifests in diverse ways with different motivations[50]. For example, while the conflict in La Oroya could be associated with environmentalism focused on defending livelihoods—where "concerns about the quality and accessibility of resources sustaining various sectors of the population take precedence, making the primary actors those who perceive their natural resources as being threatened"[51]—this framework does not necessarily apply to earlier environmental issues of the 20th century.

In fact, early 20th-century environmental conflicts may not align with contemporary notions of "defending livelihoods." Folchi[52] argues that what is commonly called an "environmental conflict" is more accurately a conflict with environmental elements rather than for the environment[53]. He characterizes these conflicts as "a tension between incompatible interests, where the environment serves as a backdrop rather than the central ethical concern. In such cases, there is no inherent ethical stance advocating for environmental protection because it is just or noble, but rather a struggle for material well-being on both sides." These conflicts may not involve a

48 Bravo Alarcón, "El problema ambiental de La Oroya," 17.
49 A. Bebbington and D. Humphreys Bebbington, "*Actores y ambientalismos:* conflictos socio-ambientales *en Perú*," *Íconos: Revista de Ciencias Sociales*, no. 35 (2009): 117–28.
50 According to Bebbington and Humphreys Bebbington, environmentalism comprises five categories: (a) Conservationist, (b) National-Populist, (c) Livelihood Defense, (d) Socio-Environmental Justice, and (e) Deep Ecology. See Bebbington and Humphreys Bebbington, "*Actores y ambientalismos*."
51 Bebbington and Humphreys Bebbington, "*Actores y ambientalismos*."
52 Folchi, "Conflictos de contenido ambiental."
53 Folchi critiques the concept of "environmentalism of the poor" through Chilean environmental conflicts dating back to the 18th century (see Folchi, "Conflictos de contenido ambiental"), to assess the validity of this theory over time. See also M. Folchi, "Hornos, relaves y pobreza. El lado ingrato de la historia del cobre en Chile" (paper presented at the 5ª Bienal de la Sociedad Internacional de Economía Ecológica, Santiago de Chile, 1998).

modern environmentalist ideology but be shaped by social issues, economic interests, and power struggles.

Folchi[54] critiques the "Environmentalism of the Poor" theory proposed by Guha and Martínez-Alier,[55] particularly regarding the channels and motivations through which conflicts arise: they are not always driven by the defense of livelihoods or framed as a struggle between corporations and communities, but can also involve the state, disputes between companies, or conflicts between communities with limited economic or political power—evidence of the complex multiplicity of factors that shape environmental conflicts, against a linear, one-dimensional view of powerful actors exploiting the environment while the poor resist to conserve it.

This matters because, during the period under study, concepts such as ecosystem impact (flora and fauna), sustainable development, conservationism, or nationalism had not yet emerged; the pollutants generated by smelting directly affected people's livelihoods. Therefore, the classification of environmentalisms proposed by Bebbington and Humphreys Bebbington, as well as Guha and Martínez-Alier's concept of the Environmentalism of the Poor, cannot be applied beyond contemporary conflicts.

An alternative is to recognize an environmental component in these conflicts, a notion with a broader chronological scope that does not necessarily imply an underlying ideology, such as sustainable development or a justice-driven defense of the environment.

Concern over environmental issues began to emerge around the mid-twentieth century, as the environment-economy relationship came into focus amid population growth, urbanization, new fuels and extraction techniques (e.g., cyanide), and the expansion of the automotive industry. Environmental challenges, however, existed since the colonial period, particularly through amalgamation in silver mining, and only intensified with the technological advances and large-scale mining of the republican

[54] Folchi, "Conflictos de contenido ambiental."
[55] R. Guha and J. Martínez-Alier, *Varieties of Environmentalism: Essays North and South* (London: Earthscan, 1997), 109–27.

era.[56] The first technical report providing evidence on this issue was the Bravo Report, examined below.

State Intervention

State policy, also referred to as government policy or public policy, can be defined as "the set of activities carried out by government institutions, either directly or through agents, aimed at exerting a specific influence on citizens' lives."[57] Similarly, Pallares conceptualizes public policies as a "decision-making process, shaped by a series of decisions taken over a period of time, beyond the initial policy formulation stage. These decisions are executed by government institutions, which possess a set of instruments to achieve specific outcomes and results."[58]

Public policies can also be understood as "courses of action and flows of information related to a public objective—developed by the public sector, the community, and the private sector—including guidelines or content, instruments or mechanisms, and institutional modifications."[59] Since policies shape the expectations of economic and social agents, they should exhibit characteristics such as "stability, adaptability, coherence and coordination, effective implementation, efficiency, and a focus on public interest."[60]

From a public economics perspective, Stiglitz[61] defines public policy as state intervention—stabilizing, allocative, redistributive—aimed at improving social welfare when the assumptions of perfect competition fail: imperfect competition, externalities, imperfect information, and public goods[62]. Public economics thus justifies state intervention and policy instruments to mitigate these failures.

[56] In the mining sector, one of the most significant environmental impacts was that of Southern Peru Copper Co. in Moquegua in 1952: the plant in Ilo displaced local agriculture, continues emitting sulfur dioxide, and its tailings have further harmed the region. See L. Seiner, *Estudios de historia medioambiental. Perú, siglos XVI–XX* (Universidad de Lima, Fondo Editorial, 2002).
[57] B. G. Peters, *American Public Policy* (New York: Franklin Watts, 1982).
[58] F. Pallares, "Las políticas públicas: el sistema político en acción," *Revista de Estudios Políticos* 62 (1988): 141.
[59] E. Lahera, *Introducción a las políticas públicas* (Santiago de Chile: Fondo de Cultura Económica, 2002).
[60] Banco Interamericano de Desarrollo, *La política de las políticas públicas: Progreso económico y social en América Latina y el Caribe* (México D.F.: Banco Interamericano de Desarrollo – Planeta, 2006).
[61] J. Stiglitz, *La economía del sector público*, trans. E. Rabasco and L. Toharia (Barcelona: Antoni Bosch, 2000).
[62] In microeconomic theory, perfect competition assumes homogeneous consumers and firms, free entry and exit, price-taking firms, identical goods, and no transaction costs or asymmetric information.

The analysis of public policies focuses primarily on "how governments adopt certain measures and whether they act or fail to act."[63] From the definitions above, it can be preliminarily concluded, for this research, that public policies "allow for the organization of laws, ministerial goals, administrative practices, and budget allocations according to their purpose or objective."[64] State intervention can also be classified by domain, such as the economy, health, education, environment, housing, among others.

Today, policymakers within the public administration lead the formulation and implementation of public policy. Historically, however, the Enlightenment, by revaluing scientific and rational knowledge in governance, fostered the belief that experts in each field were best suited to provide solutions within their domain.

State intervention in environmental matters generally provides regulatory instruments or direct action to mitigate pollution and, today, typically sanctions polluting companies; but for the period under study it is not possible to speak explicitly of an environmental intervention. As Deustua notes, "between 1820 and 1930, Peru was still a 'nation in formation.'"[65] Key economic instruments—taxes, subsidies, property rights—only emerged in the 1920s with Pigou's studies,[66] followed by Coase's contributions[67] in the 1960s[68].

Within the historical scope of this research, therefore, state intervention in policy formulation to address the damage caused by industrial emissions had an environmental component, because the conflict involved air pollution and its impact on the agricultural and livestock resources of affected communities. It was primarily a conflict of interest between economic development and environmental conservation, particularly concerning the livelihoods of local populations.

Moreover, state intervention in public policy during this period may have been directed not by a traditional policymaker but by technical experts in the mining sector,

[63] A. Heidenheimer, H. Heclo, and C. Teich Adams, *Comparative Public Policy: The Politics of Social Choice in America, Europe and Japan*, 3rd ed. (New York: St. Martin's Press, 1990); T. Dye, *Policy Analysis* (Alabama: The University of Alabama Press, 1976).
[64] Lahera, *Introducción a las políticas públicas*.
[65] Deustua, "Guano, salitre, minería y petróleo."
[66] A. C. Pigou, *The Economics of Welfare* (London: Macmillan, 1920).
[67] R. H. Coase, "The Problem of Social Cost," *Journal of Law and Economics* 3 (1960): 1–44.
[68] Deustua also dates to the 1940s the emergence in Peru of concerns about the relationship between the environment and the economy, driven by the factors listed in the subsection "The Issue of Environmental Content in the Early 20th Century." See Deustua, "Guano, salitre, minería y petróleo".

which highlights the evolving nature of environmental governance and the role of expertise in shaping state responses to environmental challenges.

THE STATE AS AN INSTITUTION: CHARACTERISTICS AND ROLES

There is no consensus on how to define institutions, but their conceptual foundation largely rests on North's work, which defines them as the "rules of the game" that regulate human behavior within a society.[69] Institutions also reduce transaction costs between individuals, facilitating economic interactions, and can be formal or informal. "Formal institutions are created by actors who control power resources and take the form of legal norms, while informal institutions are unwritten codes of conduct that regulate everyday practices."[70]

The relevance of studying institutions and incorporating them into economic theory lies in their empirically demonstrated role as key determinants of a country's development[71] and growth.[72] To fulfill this role, institutions must meet criteria of quality that determine their success or failure and their impact on economic agents. Institutions act as "determinants of economic outcomes at different levels of analysis, including individuals, firms, and the design of economic policies."[73]

However, the literature presents a gap: although formal rules, remediation measures, and compensation mechanisms exist, it remains unclear who enforces them. Institutional theory, a critique of neoclassical economics for ignoring market failures, asymmetric information, and moral hazard, does not explicitly address the state's role in ensuring compliance, even though the state is not merely a rule-setter but also has agency to enforce regulations effectively.

[69] North, *Institutions, Institutional Change*.
[70] R. López and C. Tecco, "El papel de las instituciones formales e informales en la gobernabilidad local" (paper presented at the Segundo Congreso Argentino de Administración Pública, Córdoba, 2003).
[71] S. Engerman and K. Sokoloff, "Factor Endowments, Institutions, and Differential Paths of Growth among New World Economies: A View from Economic Historians of the United States," NBER Historical Working Paper no. 66 (1994); D. Rodrik, "Institutions for High-Quality Growth: What They Are and How to Acquire Them," *Studies in Comparative International Development* 35, no. 3 (2000): 3–31; J. H. Coatsworth, "Structures, Endowments, and Institutions in the Economic History of Latin America," *Latin American Research Review* 40, no. 3 (2005): 126–44; A. Greif, *Institutions and the Path to the Modern Economy: Lessons from Medieval Trade* (New York: Cambridge University Press, 2006), chap. 1.
[72] D. Acemoglu, S. Johnson, and J. A. Robinson, "Institutions as a Fundamental Cause of Long-Run Growth," *Handbook of Economic Growth* 1 (2005): 385–472; R. J. Barro, "Determinants of Economic Growth: Implications of the Global Evidence for Chile," *Cuadernos de Economía, Latin American Journal of Economics* (1999); E. L. Glaeser et al., "Do Institutions Cause Growth?," *Journal of Economic Growth* 9, no. 3 (2004): 271–303.
[73] I. Carrasco Monteagudo and M. S. Castaño Martínez, "La nueva economía institucional," *Información Comercial Española. Revista de Economía*, no. 865 (2012): 43–53.

In this regard, Orihuela and Paredes highlight a definitional issue: most scholars understand institutions as "the rules of the game," following North, while Thelen and Streeck and Thelen specifically examine formalized rules that can be enforced by appealing to a third party.[74] However, most authors do not clearly identify this "third party," presumably the state. Going beyond the establishment of rules therefore requires a broader concept: state capacity.

State capacity can thus be considered a key factor influencing the implementation of public policies,[75] and empirical studies highlight it as a determinant of both economic growth and national development. A fundamental question is: "Does state capacity play a role, and if so, to what extent does the role of the State influence policy enforcement?"[76]

State capacity is commonly defined as "the ability of states to implement official objectives, particularly in the face of opposition from powerful social groups or under challenging economic circumstances."[77] Cingolani[78] takes a multidimensional approach, classifying state capacity into the following categories:

i. Coercive/military
ii. Fiscal
iii. Administrative/implementation
iv. Transformative/industrialization
v. Territorial coverage
vi. Legal
vii. Political

[74] J. C. Orihuela and M. Paredes, "Fragmented Layering: Building a Green State for Mining in Peru," in *Resource Booms and Institutional Pathways* (Cham: Palgrave Macmillan, 2017), 97–117. On formalized rules enforced by a third party, see K. Thelen, "How Institutions Evolve: Insights from Comparative Historical Analysis," in *Comparative Historical Analysis in the Social Sciences*, ed. J. Mahoney and D. Rueschemeyer (New York: Cambridge University Press, 2003), 208–40; W. Streeck and K. Thelen, *Beyond Continuity: Institutional Change in Advanced Political Economies* (New York: Oxford University Press, 2005).
[75] G. Edwards, *Implementing Public Policy* (Washington, DC: Congressional Quarterly Press, 1980); A. Etzioni, *The Active Society* (New York: Free Press, 1968); P. Sabatier and D. Mazmanian, "The Conditions of Effective Implementation: A Guide to Accomplishing Policy Objectives," *Policy Analysis* 4 (1979): 481–504; O. R. Young, *Compliance and Public Authority* (Baltimore: Johns Hopkins University Press, 1979).
[76] J. Schwartz, "The Impact of State Capacity on Enforcement of Environmental Policies: The Case of China," *Journal of Environment & Development* 12, no. 1 (2003): 50–81.
[77] T. Skocpol, "Bringing the State Back In: Strategies of Analysis in Current Research," in *Bringing the State Back In*, ed. P. Evans, D. Rueschemeyer, and T. Skocpol (Cambridge: Cambridge University Press, 1985), 3–38.
[78] L. Cingolani, *The State of State Capacity: A Review of Concepts, Evidence and Measures* (United Nations University, 2013).

Moreover, state capacity can be viewed from a dual causal perspective: it is a determinant of development, as noted above, but it is also shaped by factors such as bureaucratic autonomy, human capital, fiscal strength, and responsiveness. These elements align with the classification above, as they define the state's scope of action across domains; strengthening them enhances the state's ability to exert influence beyond legislative functions.

This research focuses on administrative capacity as defined by Cingolani: a professionalized, insulated bureaucracy that ensures impartial policy implementation and is closely linked to good governance.[79] There is no unified definition of administrative capacity, which encompasses attributes such as bureaucratic autonomy and organizational efficiency.[80] More recent work identifies three dimensions of state capacity—extractive, coercive, administrative—that are difficult to distinguish empirically;[81] administrative capacity should therefore be examined in relation to the broader political context in which it operates.

Other scholars define state capacity in terms of policy implementation under adverse conditions: Skocpol emphasizes enforcing policies despite opposition from powerful groups, and Evans[82] stresses an "embedded autonomy" balancing bureaucratic independence with strategic engagement, while Mann[83] frames it as "infrastructural power" to penetrate civil society and implement decisions nationwide. Fukuyama and Knutsen[84] link it, respectively, to officials' educational background and to the efficiency of bureaucratic rule enforcement.

A common denominator among these definitions is the role of bureaucratic autonomy in shaping state capacity. Carpenter offers a refined definition of "bureaucratic autonomy," arguing that it emerges only under three historical conditions:

[79] F. Fukuyama, *State-Building: Governance and World Order in the 21st Century* (Cornell University Press, 2004); F. Fukuyama, "What Is Governance?," Working Paper 314 (Center for Global Development, 2013).
[80] S. Huntington, *Political Order in Changing Societies* (New Haven, 1968).
[81] J. K. Hanson and R. Sigman, "Leviathan's Latent Dimensions: Measuring State Capacity for Comparative Political Research," *The Journal of Politics* 83, no. 4 (2021): 1495–1510, https://doi.org/10.1086/715066.
[82] P. B. Evans, *Embedded Autonomy* (Princeton University Press, 1995).
[83] M. Mann, *The Sources of Social Power: The Rise of Classes and Nation-States, 1760–1914* (Cambridge University Press, 1993).
[84] C. H. Knutsen, "Democracy, State Capacity, and Economic Growth," *World Development* 43 (2013): 1–18.

i. Political differentiation – Actors seeking to control state formation have distinct preferences, interests, and ideologies separate from those of politicians and power organizations.

ii. Unique organizational capabilities – The ability to analyze, create new programs, solve problems, manage policies efficiently, and remain free from corruption.

iii. Political legitimacy or organizational reputation – Bureaucracies must develop independent sources of authority and recognition.

Thus, this research operationalizes state capacity through administrative capacity, particularly bureaucratic autonomy, with two clarifications. First, although Carpenter developed his framework for US federal agencies between 1862 and 1928, the CIMP was created in 1902, within that period, and took its US counterpart, the United States Geological Survey, as a reference model (see "Technical Expertise and International Model"). Second, recent scholarship distinguishes bureaucratic capacity—an agency's potential—from bureaucratic performance, what it actually achieves, which also depends on internal coordination and the pressures of multiple political principals,[85] useful for assessing whether the CIMP's autonomy translated into effective enforcement. The next section presents the methodology, and the Results section applies this approach to the CIMP and La Oroya.

METHODOLOGY

This study employs a historical-institutional approach to the environmental conflict known as *Los Humos de La Oroya*, focusing on the mining institutional framework and the construction of state capacity. Given the scarcity of quantitative data for the early 20th century, the analysis is qualitative, integrating economic theory, economic history, and political science. The period of analysis covers the conflict over smelter emissions (1922–1927), which began shortly after the La Oroya refinery started operating in 1922, as well as the institutional antecedents of the CIMP from its creation in 1902. The main primary sources are the CIMP's bulletins (No. 108, containing the

[85] M. J. Williams, "Beyond State Capacity: Bureaucratic Performance, Policy Implementation and Reform," *Journal of Institutional Economics* 17, no. 2 (2021): 339–57, https://doi.org/10.1017/S1744137420000478.

Bravo Report, and No. 86) and the *Boletín Oficial de Minas y Petróleo* of the Ministry of Development (Nos. 3, 5, and 7), complemented by the mining legislation of the period and the secondary literature on the CIMP and on mining in the central highlands. State capacity is operationalized through Carpenter's three criteria of bureaucratic autonomy–legitimacy, organizational capacity, and political differentiation–used as analytical categories for the evidence on the CIMP.

The analysis is structured into three main dimensions:

1. **The institutional framework prior to the formation of the CIMP and its crisis** (see "The Pre-existing Institutional Framework and Institutional Crisis"). This section relies on historical document analysis of legal texts, administrative records, and contemporary reports to identify the institutional weaknesses that preceded state intervention.
2. **The creation of the CIMP and the construction of state capacity** see "The Role of State Capacity in the Policy-Making Process"). This section examines the legislative and bureaucratic processes that led to the formation of the CIMP, using analysis of decrees, regulations and official communications to assess how the state justified the need for a stronger regulatory body.
3. **The Bravo Report (1926) as evidence of state capacity** see "Institutional Autonomy and the La Oroya Case (1926)". This section employs content analysis of the *Informe Bravo*, evaluating its technical assessments, recommendations, and its role in shaping early environmental policy.

To ensure the reliability of the findings, the research employs three complementary validation strategies: source triangulation, by cross-referencing legal texts, government reports, and periodicals; analysis of official statements, by examining how state actors framed environmental concerns and institutional reforms; and historical contextualization, by situating La Oroya within the broader trajectory of mining regulation and state-building in Peru, as discussed in the Historical Background and the State of the Art. These strategies are complemented by an assessment of the CIMP's bureaucratic autonomy based on its organizational capacity, political differentiation, and political legitimacy. Together, they help examine the relationship

between the CIMP's bureaucratic autonomy and the formulation of what could be considered an early environmental policy in Peru.

RESULTS

THE PRE-EXISTING INSTITUTIONAL FRAMEWORK AND INSTITUTIONAL CRISIS

The institutional framework governing mining activity in Peru began to take shape in the late 19th century with three key institutions: the School of Engineers (1876), the Ministry of Development and Public Works (1896), and the National Mining Society (1898).[86] The School of Engineers trained professionals in mining, geology, and legislative and economic aspects; the Ministry of Development and Public Works (MFOP) emerged in the post-war context to organize and promote economic sectors, including mining; and the National Mining Society, originally an extension of the Society of Agriculture and Mining, bridged private actors and the government, influencing policy and advocating for miners' interests.

Despite these institutions, the mining sector lacked a cohesive structure for enforcement and technical oversight. The failure of the Cuerpo de Ingenieros y Arquitectos del Perú (1872) exemplifies this weakness[87]; the 1877 law allocating mining tax revenues to a specialized mining corps and the 1879 law tasking the School of Engineers' mining professors with assessing the industry's needs proved ineffective[88], and by 1886 oversight passed to professors from the School of Engineers and independent mining engineers[89]—an arrangement that failed due to conflicts of interest, financial mismanagement, and lack of systematic supervision.

The institutional crisis became evident with the collapse of existing oversight and technical-support mechanisms: professors from the School of Engineers, constrained by academic obligations, could not fulfill their duties, while state-appointed mining engineers prioritized personal gain over public service—revealing the

[86] A. M. Ueda, Historia del Cuerpo de Ingenieros de Minas del Perú (1902–1950) (Universidad Nacional de Ingeniería, Proyecto Historia UNI, 2002).
[87] Ueda, Historia del Cuerpo de Ingenieros de Minas del Perú.
[88] R. Aranda, Colección de leyes, decretos, resoluciones y circulares que forman la legislación de minas del Perú, 1786–1890 (Lima: Carlos Prince, 1891), 136–38, 163.
[89] Aranda, Colección de leyes.

absence of state capacity to regulate the sector and the insufficiency of the institutional framework for a sustainable mining administration.

By the end of the 19th century, these institutions' failure to coordinate had created a regulatory vacuum, reflecting broader structural weaknesses in Peru's bureaucratic apparatus, hindering economic development, and exposing the limits of state autonomy over natural resources. This set the stage for the creation of the Cuerpo de Ingenieros de Minas del Perú (CIMP) in the early 20th century to address these deficiencies and build state capacity.

The Role of State Capacity in the Policy-Making Process

The Corps of Mining Engineers of Peru (CIMP) was established on March 21, 1902, by legislative decree as a technical institution under the Ministry of Development.[90] This initiative, stipulated in Article 31 of the Mining Code of 1900, institutionalized specialized professionals in managing the country's mineral wealth and filled a critical institutional vacuum, ensuring that trained experts—rather than foreign enterprises or unregulated actors—would oversee mining studies and administration.

Designed from its inception as a cornerstone of the national mining framework, the CIMP was endorsed at the highest levels—the President, the Ministry of Development, the National Mining Society, and the School of Engineers—and aimed to formalize mining governance through expert analysis and structured technical evaluation, staffed primarily by competent engineers and professionals, reinforcing the centrality of expertise to managing natural resources.

The ideological discourse surrounding the CIMP at the beginning of the 20th century was shaped by two primary narratives. First, the "emancipation" discourse, which underscored the need for territorial study and national control over resources. Second, the "civilizing" discourse, which framed economic progress as dependent on the exploitation and integration of natural resources into the global trade system.[91]

[90] Samamé, *El Perú minero*.
[91] J. López, "Adiós al discurso moderno en el Perú," *Hueso Húmero*, no. 39 (Lima, 2001).

Institutional Autonomy and Tensions with National Policy

Despite its intended role as a technical institution, the CIMP did not always align with national political directives: initially, it promoted foreign investment through geological surveys and publicizing Peru's mineral wealth, in line with the mining-friendly policies of President Eduardo López de Romaña and, later, of Augusto Leguía's second government (1919–1930)—reflecting the civilist approach of the Aristocratic Republic in attracting foreign capital for large-scale extraction.

This stance was evident in the institutional strategy to produce and distribute detailed mining reports to foreign investors. As Valcárcel noted:

"*Mining requires that a state-paid engineer visits, thoroughly inspects, and reports on the extraordinary mineral wealth in these territories so that these findings are known abroad, encouraging large-scale exploitation by powerful capitalists.*"[92]

Over time, however, the CIMP's position occasionally diverged from national policies favoring foreign monopolization. In 1918, it issued a statement warning against the monopolization of the mining sector by foreign companies, arguing that it hindered the development of national mining enterprises:

> "The current system does not contribute to the capitalization and overall economic strength of the nation. This can only be achieved in the future by nationalizing the industry in the many unexploited regions that remain."[93]

Technical Expertise and International Model

The CIMP's institutional credibility was largely built on the technical qualifications of its personnel. Its members were required to have degrees from specialized institutions, either domestically or internationally, and had to demonstrate expertise before being contracted.[94] This emphasis on technical competence was

[92] M. Valcárcel, *Memoria que el Ministerio de Gobierno, Policía y Obras Públicas presenta al Congreso Ordinario en 1891* (Lima: Imprenta de Torres Aguirre, 1891), annex 3F.
[93] C. Jiménez, "Estadísticas mineras del Perú en 1916," *Boletín del Cuerpo de Ingenieros de Minas*, no. 86 (Lima: Imprenta Americana, 1918).
[94] Ueda, *Historia del Cuerpo de Ingenieros*.

critical in establishing organizational legitimacy, particularly given the lack of a coherent mining regulatory framework prior to its formation.

The CIMP's institutional capacity was further strengthened by taking the United States Geological Survey (USGS) as its institutional reference model, as the National Mining Society had urged when supporting its creation.[95] This transnational reference reinforced the CIMP's scientific authority and its credibility in national and international mining circles.

Key Functions and Knowledge Production

The CIMP's mandate was explicitly technical. According to Article 1 of the 1902 Organic Regulations, its primary responsibilities included:

- Cadastral and topographic mapping of active mining sites
- Geological and industrial studies of existing mines
- Exploratory surveys
- Comprehensive mineral studies across the national territory
- Evaluation and improvement of mining and beneficiation methods
- Compilation of mining statistics
- Publication of research findings

The CIMP also played a crucial role in knowledge production, publishing 131 technical bulletins classified into five main categories:

- Mining, geological, and paleontological explorations
- Hydrological studies and irrigation projects
- Mining statistics
- Cadastral reports

[95] Ueda, *Historia del Cuerpo de Ingenieros*.

- Other specialized studies

A notable example of its data-driven approach was its extensive research on Junín Province, where it conducted ten major studies.

Institutional Legitimacy and Government Support

The CIMP's legitimacy was reinforced by its triple institutional backing—from the Ministry of Development, the School of Engineers, and the National Mining Society. This support solidified its authority and ensured its permanence as a key actor in the mining sector.

Its establishment also received wide public endorsement in leading Peruvian newspapers, including:[96]

- El Comercio (March 31, 1902)
- El Tiempo (May 15, 1902)
- La Opinión Nacional (August 1, 1902)

These publications highlighted the necessity of a state-backed scientific body for mining exploration and governance, further reinforcing the CIMP's institutional standing.

Confidentiality and Ethical Standards

To maintain objectivity and prevent conflicts of interest, the CIMP's 1902 internal regulations prohibited its members from:

- Providing private consulting services
- Holding shares or ownership in mining enterprises
- Acquiring mining properties within their assigned jurisdictions

[96] J. Balta, *Primera memoria que presenta el director del Cuerpo de Ingenieros de Minas del Perú al ministro de Fomento* (Lima: Imprenta de la Escuela de Ingenieros, 1903).

- Disclosing research findings without official authorization

This emphasis on confidentiality and ethical governance distinguished the CIMP from other state agencies and reinforced its role as a neutral, technical body dedicated to national mining policy.

Institutional Autonomy and the La Oroya Case (1926)

The La Oroya smelter pollution case, which gave rise to the Bravo Report, represented one of the first recorded instances of a mining-related environmental conflict in Peru.

The Earlier Report by Fernández (1923)

Before the main report, the Mining Delegate of the Yauli District, Engineer Arturo Fernández, conducted a study published in the *Boletín Oficial de Minas y Petróleo* No. 3 in April 1923,[97] under the Ministry of Development's Directorate of Mines, informing the Director of Mines of the damage caused by the La Oroya smelter to the Huari community—affecting livestock and crops such as potatoes, ollucos, mashuas, fava beans, wheat, ocas, barley, and quinoa, some completely destroyed. As a solution, Fernández proposed financial compensation from the CPC.

Fernández also highlighted CPC's significant investment in constructing the metallurgical plant and its contribution to national and local development, arguing that additional costs beyond the company's control should not be imposed on it: "*It would not be rational or fair to burden this industry.*"[98] The report also considered expropriating land if the damage caused by emissions persisted over time, underscored the smelter's modern technology, and emphasized the need for the state to play a regulatory role to maintain collective benefit.

[97] A. Fernández, *Boletín oficial de minas y petróleo*, no. 3 (Lima: Ministerio de Fomento – Dirección de Minas, 1923).
[98] Ibid.

The Study by the Corps of Mining Engineers of Peru

Despite Fernández's study, in September 1923, the government commissioned the CIMP to prepare a new technical report on the environmental issues caused by the La Oroya refinery. The study was led by Engineer José Julián Bravo, appointed by President Leguía through a supreme resolution of September 14, 1923 (see Figure 2).[99] The report, titled *Report on La Oroya's Emissions*, was presented on March 31, 1925, and published in 1926 in the *Boletín del Cuerpo de Ingenieros de Minas del Perú* No. 108.[100]

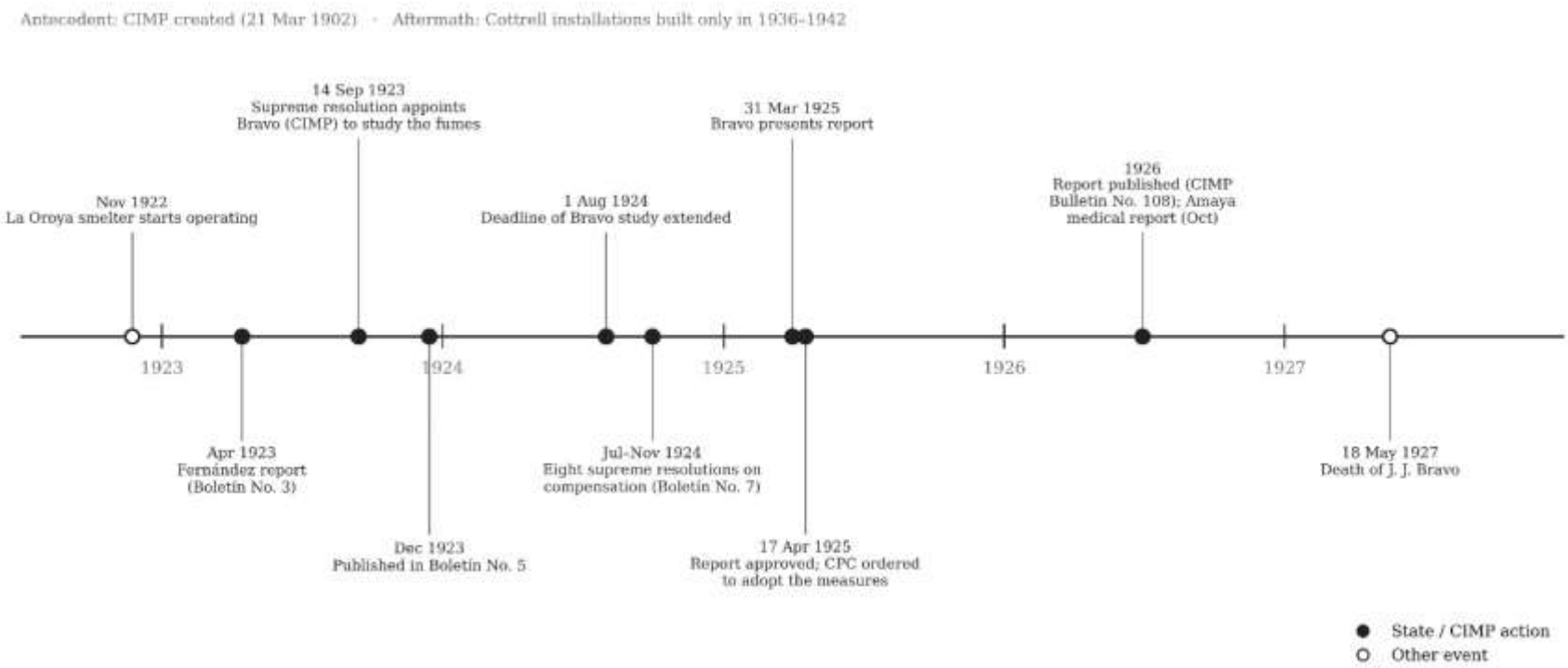
This report adopted a technical and multidisciplinary approach, involving engineers, doctors, chemists, agronomists, and veterinarians. The Ministry of Development's request to the CIMP was based on its academic credibility and the impartiality of the School of Engineers. The La Oroya refinery, inaugurated in 1922, almost immediately generated negative externalities such as the disappearance of natural pastures, livestock diseases, and air and water degradation.[101]

As part of the investigation, Bravo inspected the smelter's production processes and traveled through the Mantaro Basin, collecting evidence and testimonies on the impact of emissions on the ecosystem. The report followed the six-chapter structure described in the subsection "Technical Studies."

[99] Ministerio de Fomento, Boletín oficial de minas y petróleo, año II, no. 5 (Lima: Ministerio de Fomento – Dirección de Minas, diciembre de 1923); Samamé, "La minería en la década del 20," 75, 78–79.
[100] Bravo, Informe sobre los humos.
[101] N. Long and B. R. Roberts, *Mineros, campesinos y empresarios en la sierra central del Perú* (Instituto de Estudios Peruanos, 2001), 89; Bravo Alarcón, "El problema ambiental de La Oroya," 37.

1

Figure 2: Timeline of the State Response to the La Oroya Smelter Emissions (1922–1927)



Source: Author's elaboration based on Ministerio de Fomento, Boletín oficial de minas y petróleo, nos. 3, 5, and 7; Samamé, "La minería en la década del 20"; Bravo, Informe sobre los humos; and Tácunan Bonifacio, "Contaminación ambiental en el valle del Mantaro."

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MEASURES AND CONSEQUENCES

Parallel to Bravo's report, the *Boletín Oficial de Minas y Petróleo* No. 7[102] published eight supreme resolutions issued between July and November 1924. These resolutions established compensation for the affected communities: La Oroya Antigua, Suitucancha, Saco, Canchayllo, Huaynacancha, Chacapalpa, Huay Huay, and Yauli. Additionally, on August 1, 1924, the deadline for Bravo's studies was extended, as the initial period of only two months was deemed insufficient.

Bravo's report confirmed the presence of pollution caused by sulfur dioxide and indicated that the CPC lacked the necessary technology to prevent it. Consequently, after the report was approved in April 1925, the company was ordered to implement pollution controls by constructing chimneys with anti-pollution filters.[103] However, these filters, known as *Cottrell Installations*, were not installed until between 1936 and 1942.[104] Initially, Bravo had proposed a six-month deadline for implementing these measures.

In addition to the filters, *rod curtains* were implemented to neutralize the negative effects. Farmers and ranchers were compensated, and lands in the affected area were purchased, representing an additional expenditure of approximately $3.4 million.[105] According to Bernard Colley, the CPC's chief engineer, the company spent more than $9 million on mitigation measures and land purchases.[106]

DISCUSSION: REFLECTIONS ON THE ROLE OF THE CIMP

The early decades of the CIMP culminated in a significant test of its institutional autonomy: the La Oroya smelter pollution case, which shows how its technical expertise was mobilized in a socio-environmental dispute and raises the question of whether the CIMP had the power to enforce state-led environmental policies and to shape mining regulation in practice.

[102] Ministerio de Fomento, Boletín oficial de minas y petróleo, año III, no. 7 (Lima: Ministerio de Fomento – Dirección de Minas, diciembre de 1924).
[103] Samamé, "La minería en la década del 20," 75, 79.
[104] Vega Centeno, "El ocaso de un modelo"; Kruijt and Vellinga, *Estado, clase obrera y empresa transnacional*, 54–55.
[105] S. Aldana, *Historia de la minería en el Perú* (Lima: Compañía Minera MILPO, 1999), 335.
[106] Samamé, *El Perú minero*.

The case of La Oroya reveals the complex relationship between economic development and environmental regulation in early 20th-century Peru. Despite the Peruvian government's close ties with foreign investment,[107] a state technical institution was allowed to produce an independent technical report, contrasting with Fernández's earlier study, which emphasized CPC's economic benefits and promoted a conciliatory solution.

However, the CIMP also faced limitations: although it identified the problem and proposed technical solutions, it lacked the authority to enforce them. In terms of the distinction between capacity and performance,[108] its technical capacity did not translate into regulatory performance—CPC complied only partially and kept polluting, finding it more convenient to buy land cheaply than to bear the cost of abatement.[109] As a result, CPC ultimately acquired much of the Mantaro Valley's agricultural and livestock lands.

The CIMP's 1918 statement quoted in Section 6.2.1 marked a shift in its stance, reflecting an internal political differentiation that recognized the risks of over-reliance on foreign corporate control over national resources.

From a bureaucratic autonomy perspective, following Carpenter's framework, the CIMP demonstrated organizational capacity and generated specialized knowledge in its first decades, but its influence was constrained: its recommendations did not significantly alter the power dynamics between the affected communities and the foreign corporation. This case is among the earliest documented conflicts in Peru over the environmental impact of mining and the tension between economic development and community well-being.

CONCLUSIONS

This research aimed to determine whether the Peruvian state's resolution of the La Oroya emissions conflict demonstrated state capacity. This required understanding

[107] F. E. Mallon, *The Defense of Community in Peru's Central Highlands: Peasant Struggle and Capitalist Transition, 1860–1940* (Princeton: Princeton University Press, 1983), 230, cited in Bravo Alarcón, "El problema ambiental de La Oroya," 76.
[108] Williams, "Beyond State Capacity."
[109] Kruijt and Vellinga, *Estado, clase obrera y empresa transnacional*, 54; A. De Wind, "De campesinos a mineros: el trasfondo de las huelgas en las minas del Perú," *Allpanchis*, no. 26 (1985): 259.

the dispute as an environmental conflict—a confrontation between two parties over a shared resource that, for one of them, was a means of subsistence—and assessing the state's intervention in terms of its environmental considerations, particularly pollution. State capacity was thus examined through the implementation, or lack thereof, of the policies adopted.

To this end, the study analyzed the role of the CIMP, the institution responsible for mineral resources, reviewing its duties and competencies over its first decades, based on Carpenter's concept of bureaucratic autonomy—(a) legitimacy, (b) capacity and organization, and (c) political differentiation—using CIMP bulletins, institutional reports, and records from the Ministry of Development and Public Works.

The CIMP was established in Peru in 1902 to manage the country's mineral resources in the post-war reconstruction after the conflict with Chile, backed by the central government, mining-related institutions, and the media. It was meant to generate technical and scientific knowledge while promoting Peru's mineral wealth abroad to attract foreign investment, and was staffed by highly trained engineers capable of driving national development with a strategic, country-benefiting vision.

However, despite the CIMP's political support and legitimacy within governmental and media spheres, the resolution issued in response to the La Oroya emissions conflict reveals that its bureaucratic autonomy was constrained precisely on the criterion of political differentiation, which proved decisive in shaping the measures taken. This dynamic hindered the articulation of an environmental policy that could have prioritized the well-being of affected communities. Instead, the resolution favored the company—an early example of the pattern seen in later environmental conflicts in the country.

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Capacidad Estatal y Regulación ambiental: El caso de la Contaminación del Aire en La Oroya, Perú (1922–1927)

Resumen

Este estudio evalúa la resolución del Estado peruano del conflicto por emisiones en La Oroya (1922–1927), analizando si demostró capacidad estatal al incorporar consideraciones ambientales e implementar efectivamente las medidas adoptadas. Mediante un enfoque histórico-institucional basado en el análisis cualitativo de fuentes históricas –boletines e informes del Cuerpo de Ingenieros de Minas del Perú (CIMP), establecido en 1902 para gestionar recursos minerales, boletines oficiales del Ministerio de Fomento y literatura secundaria–, el análisis aplica el concepto de autonomía burocrática de Carpenter (legitimidad, capacidad organizativa y diferenciación política) para examinar el rol del CIMP durante sus primeras décadas. Los resultados muestran que, a pesar de su apoyo político, legitimidad y capacidad técnica, la autonomía burocrática del CIMP se vio limitada en el criterio de la diferenciación política. Su *Informe sobre los humos de La Oroya* (1926) identificó el problema y propuso soluciones técnicas, pero el CIMP carecía de autoridad para hacerlas cumplir: la Cerro de Pasco Copper Corporation acató las medidas solo parcialmente, instaló filtros recién entre 1936 y 1942 y adquirió a bajo precio gran parte de las tierras afectadas. En La Oroya, la resolución favoreció los intereses corporativos sobre los ambientales y comunitarios, reflejando una tendencia en Perú de priorizar el crecimiento económico sobre la protección ambiental. Los hallazgos revelan limitaciones en la capacidad estatal para aplicar políticas ambientales. Aunque el CIMP mostró autonomía burocrática, sus acciones estuvieron condicionadas por intereses políticos y económicos. El caso de La Oroya subraya los desafíos persistentes en la gobernanza ambiental peruana, ilustrando la tensión entre desarrollo económico y sostenibilidad, y constituye un antecedente histórico para comprender conflictos contemporáneos sobre recursos.

Palabras clave: conflicto ambiental; capacidad estatal; políticas ambientales; Perú.

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