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Working Paper
October 2020

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Mining extractivism and urban risk in Copiapó, northern Chile

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Design and layout: Ottavia Pasta

The production of risk: Mining extractivism and urban risk in Copiapó, northern Chile

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2nd September 2019 /
reviewed for DPU working paper
12th October 2020

Abstract

Mining is the main economic activity in Northern Chile. The development of Chilean northern cities such as Copiapó can be largely explained by the key role they play within global circuits of natural resources. While extractive activities respond to global requirements and international forces, their negative environmental outcomes tend to be rooted at a local level, becoming 'everyday disasters' for rural and urban communities.

This paper is focused on one of these outcomes, mining tailing deposits. These deposits consist of large accumulations of discarded rock and toxic substances used to concentrate and purify metals, which are many times located near cities. There are more than seven hundred tailings deposits in Chile, and have become one of the main environmental crisis in the country. This paper aims at exploring the ways in which Chilean extractivism, adopted on a regional scale and linked with global circuits of natural resources, produces urban risk on a local scale. Particularly, it explores the socio-spatial expression of mining tailing deposits in the city Copiapó, in the Atacama region. The conceptual framework of the paper is built around two main concepts: 'risk', understood as socially produced; and 'extractivism', from a political ecology perspective, addressing the specificities of the Chilean case.

The paper examines national, regional, and local policies, maps, and news reports, drawing on an analytical model built upon the 'pressure and release' disaster risk framework, with a special focus on those features that increase the overall vulnerability of the population of Copiapó. Three main issues emerge: uncoordinated policies, poor urban management, and issues regarding access to information, risk perception and communication between actors.

Through the analysis it is observed that a generalised scenario of dependency and negotiation, where different actors throughout spatial scales are positively or negatively affected by extractive operations, in cyclic stages of boom and recession. While the region is 'commodified', tailing deposits become 'outsides' of capital, depleted of all value, and located on the physical edges of the city.

Content

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01. Introduction

Mining is the main economic activity in Northern Chile. The development of regions such as Atacama can be largely explained by the key role they play within global circuits of natural resources, which typically move from global South to global North in an ever-increasing pace, especially since the copper demand 'boom' at the beginning of the 21st century driven by China's unprecedented economic growth.

Copiapó is the capital city of the Atacama region and, despite the fact that its historical growth is strongly linked with its role in supporting mining – by supplying services, housing and infrastructure– its future development and environmental conditions are being paradoxically undermined by mining extractive operations.

While extractive activities respond to global requirements and international forces, their effects – particularly the negative environmental outcomes they produce – tend to be rooted at a local level and in a tangible way; they affect not only the areas where the operations are located, but the associated urban centres and their population. This aspect is scarcely discussed in the relevant literature.

There are numerous negative environmental outcomes in the Atacama region due to mining such as overconsumption of fresh water (which leaves little or no fresh water for human use or agriculture), air and soil pollution, widespread environmental degradation and displacement or disruption of indigenous communities, among others. However, in order to explore and exemplify the ways extractive activities interact with cities, this paper is focused on one of these outcomes: mining tailing deposits. Tailing deposits consist of a large accumulation of discarded rock and toxic substances used to concentrate and purify metals, and are many times located around urban areas. Seven hundred and forty four of these deposits are distributed throughout the national territory. They are currently one of the main drivers of risk for many inhabited areas such as Copiapó. Notably, they entail risks for human health, dwelling and livelihood. Furthermore, extensive flash floods in recent years – unprecedented in a semi-arid territory but likely to increase their occurrence due to climate change – have spread the tailings' toxic components across the city.

1.1 Research question and structure

This research seeks to answer the following question:

In which ways does Chilean extractivism, adopted on a regional scale and linked with global circuits of natural resources, produce urban risk on a local scale? How is this manifested in the case of mining tailing deposits in Copiapó, in the Atacama region?

Based on this question, the main argument of this research is that, firstly, the specific way in which extractivism was implemented in Chile – imposed under a dictatorship and linked with parallel processes of regionalisation and commoditisation of the national territory – led to strengthening the position of the Atacama region as a productive spatial unit at the expense of (or overlooking) the development of urban centres that support these productive activities, such as Copiapó. Secondly, there is a structural imbalance between the region and the city: the region focuses on intense extraction operations linked with global commodity markets, while the city becomes a local recipient of negative outcomes from such operations. This is manifested on three main dimensions: uncoordinated policies, poor urban management, and issues regarding access to information, perception of risk and communication between actors. Finally, these dimensions lead to an increase of vulnerability of the city's inhabitants, which results in an increased disaster risk.

In order to answer the question and ponder the argument, this paper has been divided in five chapters. The second chapter (after this introduction) is a literature review structured around two main concepts: 'risk' — understood as socially produced — and the way it accumulates in urban contexts, and 'extractivism', from a political ecology perspective, addressing the specificities of the Chilean case. The third chapter is a conceptual and analytical framework which details this research's explanatory model and categories, based on the 'pressure and release' risk framework, but adapted to the case study. The fourth chapter unfolds the methodology; it defines the main information sources (policies, plans and news reports) and addresses the research's limitations. The fifth chapter starts with a contextualisation of the case study including the relevance of mining in Chile; a characterisation of the city of Copiapó and the state of tailing deposits and their major risks. The chapter then continues with the main findings from the analysed sources. Finally, the sixth chapter discusses the findings in relation to the original research question and argument in order to re-evaluate them and define some future paths of research.

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02. Literature review

As mentioned, risk and extractivism are the two main concepts I review in this chapter. Risk is relevant as it allows for a more specific and local entry point to the case study, providing tools to assess and frame its multiple aspects. Extractivism, on the other hand, is relevant to understand structural issues regarding development strategies on the regional, national, and global level. Both approaches are further connected and operationalised in chapter three.

2.1 Risk is produced

It is widely acknowledged in disaster risk literature that risk is socially constructed, and is therefore deeply affected by the spatial, economic and cultural context in which it occurs (Oliver-Smith, Alcántara-Ayala, Burton and Lavell, 2017; Lavell and Maskrey 2014; Pelling 2003; Wisner, Davis, Cannon and Blaikie, 2004). 'Natural disasters' are not natural anymore: around 1990, a more integrated human-nature approach started to be favoured, along with a shift from the traditional understanding of 'hazard' as something purely natural, to phenomena comprising "human-ecological interaction that can generate disaster" (Mitchell 2001, p. 87).

Despite the above, several studies have shown that even in those countries where measures tackling disaster risk reduction (DRR) have been taken, the figures of losses in lives and livelihood have not stopped increasing (Lavell and Maskrey 2014; Oliver-Smith, Alcántara-Ayala, Burton and Lavell, 2017). These and other authors (Castree and Braun, 2001) argue that the problem comes from the way risk is conceptualised: risk is not only socially affected by the context; more importantly, it is largely caused by the specific modes of development implemented by each country. The first attempts to understand risk as human-nature relations can be traced back to the work of Burton, Kates and Snead (1969), who adopted a human ecology perspective (the origins of political ecology) – further developed by Hewitt (1983) – characterised by emphasising the role of macro-economic and political systems in the way risk is produced.

Oliver-Smith, Alcántara-Ayala, Burton and Lavell (2017) refine the argument by stating that models of development that prioritise economic growth over social or environmental dimensions of development tend to fail in reducing disaster risk. Thus, disaster risk can be seen as a concrete manifestation of failed, incomplete or one-dimensional development which, for Pelling (2003), is strongly linked with capitalist-based economies. The occurrence of disasters are signals of the structural inequalities of the capitalist model, showing "unsound and manifestably (sic) unsustainable human-environment relations" (ibid. p. 6). Finally, Lavell and Maskrey (2014) propose that current development trajectories must change to effectively reduce risk. Otherwise, they warn, DRR might paradoxically reproduce the status quo, or even increase the vulnerability of the population.

The latest Framework for Disaster Risk Reduction by the United Nations Office for Disaster Risk Reduction (UNDRR, formerly UNISDR) has mainstreamed the connection between development and disaster (United Nations, 2015). This constitutes a major improvement over the previous framework, the 2005-2015 Hyogo Framework for Action (UNISDR, 2005). One of the 2015 framework's guidelines states that "relevant policies, plans, practices and mechanisms need to aim at coherence, as appropriate, across sustainable development and growth"; and that "disaster risk reduction is essential to achieve sustainable development" (United Nations, 2015, p. 13). Nevertheless, it can be argued that such acknowledgment is not enough: the first statement calls for stronger coordination between development strategies and disaster management but not necessarily structural changes, while the second underlines the relevance of reducing risk to support development, without mentioning its counterpart: that failed development can lead to disasters.

Despite all this, what remains highly problematic is the fact that disasters are still perceived as natural by most of the population, and consequently risk is still considered as something largely unforeseeable. As long as this perception remains, politicians, policy makers (and even researchers) have little incentive to change their approach, from the current focus on preparedness and post-disaster recovery – as in the case of Chile (for example, see Sandoval and Voss, 2016; Cartes, 2018) – to more structural changes regarding development (Oliver-Smith, Alcántara-Ayala, Burton and Lavell, 2017). Furthermore, in many countries, including Chile, as exposed in the case study analysis, DRR maintains the notion of disaster as events coming from outside – similar to Cannon's (2008) notion of 'innocent disaster' – an understanding which has two consequences: firstly, recovery processes aim at returning as soon as possible to a 'business as usual' scenario; secondly, policy largely focuses on 'high impact, low probability' (HILP) disasters, such as earthquakes, large floods and tornadoes, disregarding the everyday, low impact, largely invisible phenomena (Lavell and Maskrey, 2014).

2.2 Urban risk: accumulation and co-evolution

As suggested by Norgaard (1994), urban risk can be defined as a series of continuous feedback loops between urban processes and natural factors in a process that he defined as 'co-evolutionary'. These loops constantly grow, change and adjust themselves while producing uncertainty about the sustainability of cities. On the other hand, urban development policies are often still based on a much more linear understanding of sustainability, referred to as 'weak sustainability' by Pelling (2003, p. 10), whose main objective is to maintain the existing trajectories of growth, despite seemingly unpredictable events such as disasters[1].

NOTE 01

Since 1990, this vision of linear, 'business as usual' sustainability has been challenged from the academia by authors such as Hardoy et al. (1992) and Girardet (1999).

A second idea for conceptualising urban risk is introduced by Bull-Kamanga, Diagne, Lavell, Leon et al. (2003) through their notion of 'accumulation of risk': instead of thinking and managing separately two categories of disasters (on the one hand 'HILP' disasters, on the other every day or extensive disasters), the authors propose a continuum between both ends in order to tackle them comprehensively. In relation to this, the accumulation cycle of small events in densely populated areas such as cities is strongly linked with the impact of large disasters, as exemplified in Copiapó's tailing deposits which led to increased damage during the 2015 floods. This is worsened by the fact that, in many cases, daily exposure to incremental low intensity risk reduces people's preparedness, as risk is normalised as part of their lives (Wisner, Davis, Cannon and Blaikie, 2004; Kasperson, J. X., Kasperson, R. E. and Turner, B. L., 1995). This might also be the case in Copiapó, as their inhabitants accept risks and health hazards as part of living within mining areas.

2.3 Modelling risk from vulnerability

As a consequence of the increasing understanding of the human-environment interactions leading to risk there is increasing interest in understanding human vulnerability when facing disasters (Pelling 2003; White, Kates and Burton, 2001). Within the multiple models developed to understand risk, this paper focuses on those that take human vulnerability as their entry point, as this

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concept seems more suitable to make bridges between communities' living conditions and more structural issues.

The 'progression of vulnerability' (or 'pressure and release') model (Wisner, Davis, Cannon and Blaikie, 2004), which comes from a human ecology perspective, conceptualises risk as the manifestation of 'pressures' coming from natural hazards on one side, and from increasing vulnerability on the other. Vulnerability is organised in three levels, from the local to the structural, covering a wide range of temporal and spatial dimensions. Nevertheless, the model does not develop in detail the relation between nature and human actions, as explicitly found in models coming from sustainability science such as the one proposed by Turner, Kasperson, Matson, McCarthy et al. (2003). This model shows a less linear link between factors, including feedback loops and a specific scalar approach (Adger, 2006; Wisner, 2016). However, as mentioned by Cardona and Carreño (2013, cited in Wisner, 2016), this model unfortunately uses unclear categories which makes it difficult to implement.

Finally, the 'forensic' approach, recently developed by researchers from the Interna¬tional Council for Science and based on the previously discussed idea of social construction of risk, focuses on four sets of dynamic processes that might lead to increasing risk: population growth and distribution; urban and rural land use patterns and processes; environmental degradation and ecosystem service depletion; and poverty and income distribution (Oliver-Smith, Alcántara-Ayala, Burton and Lavell, 2017). Despite offering an engaging narrative and framework, the type of detailed analysis this model demands requires more time and resources than it is usually available for risk assessment reports, as suggested by Fraser, Patterson and Pelling (2014).

Extractivism, on the other hand, is relevant to understand structural issues regarding development strategies on the regional, national, and global level.

2.4 Global circuits of extractivism: the Latin-American context

Pelling (2003) suggests that the need for cities (or regions in the Chilean case, as it is explained later on this chapter) to compete in the global market can lead to increased vulnerability: by capitalising as much as possible their competitive advantages, local governments tend to overlook poor corporate practices, negative environmental effects, and uneven social development.

Chile, as most of Latin America, has largely relied on a single way to join and compete in the global markets: implementing 'extractivism' as the main economic and productive model. This mode of operation is defined by Acosta (2011, p. 84, my translation) as "those productive activities that remove large volumes of unprocessed (or minimally processed) natural resources, in order to be exported" Having its roots in historic colonial trade, this 'mode of accumulation' (ibid. p. 84), characterised by moving resources from extractive to manufacturing centres, has typically had two main defining features: the key role of transnational corporations and investments; and the role of the state as a facilitator, fostering and preserving suitable conditions that allow the model to work (Burchardt and Dietz, 2014).

Literature on extractivism seems to follow three different approaches: development and post development theory (Acosta, 2011; Burchardt and Dietz 2014; Kirshner and Power 2015, etc.), environmental justice (Tschakert, 2010; Urkidi, 2010; Urkidi and Walter, 2011, etc.), and political ecology (Bebbington, 2015; Arboleda, 2016; Bustos-Gallardo and Prieto, 2019, etc.). This academic production has been complemented by extensive literature examining 'neo-extractivism', a developmental paradigm implemented by Latin-Ameri-

can left-wing governments in the past decade aiming at balancing resource extraction with a more distributed socioeconomic development. Nevertheless, Chile was not part of this continental 'shift to the left' – partially explained by a strong right wing and a constitutional rigidity to open parliamentary representation to new sectors – and therefore this chapter does not deal with such literature. In general terms, this Working Paper is focused on the political ecology approach to extractivism, as it allows bridging multiple gaps between disaster risk, located at the local level, and structural conditions on a regional, national, and global scale.

Gago and Mezzadra (2015), drawing on Marx and, to a certain extent, countering some ideas from Harvey, expand the notion of 'extraction' to make it compatible with current trends of global capital, which is particularly useful to understand how value is created (or extracted) and how accumulation works, beyond the traditional industrial contexts and the Marxist theorisation. As a starting point, they show how extraction implies a 'territorial advance' which requires not only a complex compound of technology, legal instruments, concessions and knowledge appropriation, but also specific ways of violence on the land to make it 'available'. This availability is a condition that is not natural at all (ibid. p. 41), in a similar way that disasters are not natural.

There are three main aspects of this expanded conceptualisation of extraction as developed by Gago and Mezzadra (Ibid.). First, it is not only about raw materials being transformed into commodities, but it also includes the immaterial (financial) dimension. This dimension can be exemplified in the highly abstract and volatile metal pricing defined by international metal trades. Second, extraction assumes a certain 'exteriority', in the sense that capitalist actors do not produce or organise what they are exploiting. In this way, the boundary defining what is 'inside' or 'outside' (or multiple outsides) the scope of capital becomes a contested limit, defined by Nancy Fraser as 'boundary struggle' (2014, cited in Mezzadra and Neilson, 2019). Finally, extraction cannot limit itself to the rural areas (ibid. p. 43), as extractive strategies on the (formal or informal) financial spheres of urban economies are increasingly identified.

Finally, Mezzadra and Nelson's concept of 'capital operations' (2019) seems theoretically productive as it can be connected with the mining operations of the case study explored in this work and their local effects. Beyond the straightforward, positivist, cause-effect implications of the word 'operation', or a metabolic 'input-output' simplification, in reality such operations unfold in a much more complex manner, being in many cases "a drama of frictions and tensions in which the efficacy of the operation appears far more fragile and elusive than might otherwise be assumed" (ibid. p. 67). Within an idealised temporal continuum of accumulation, 'capital operations' are the moments when capital 'hits the ground', producing multiple connections and interactions (positive and negative) with specific forms of life and matter, and particular social fabrics (ibid. p. 70).

2.5 'Commodity regions': the specificity of the Chilean case

The Chilean extractivist context can be better explained by using the concept of 'commodity region' introduced by Chilean researcher Antonio Daher (2003), and further developed by Bustos-Gallardo and Prieto (2019). Coming from a political ecology perspective, these authors describe how the regionalisation of the country - a territorial subdivision implemented during the military regime of Augusto Pinochet (1973-1989) - was a fundamental step towards the neo-liberalisation of the economy. Due to both processes (regionalisation and neo-liberalisation), Chile became deeply involved in (and highly sensitive to) global markets, while becoming highly attractive to foreign investment (Rehner, Baeza and Barton, 2014). Bosier (2000, cited in Bustos-Gallardo and Prieto, 2019) claims that this process of regionalisation was intended to define each region as a 'brand', with a highly specialized set of raw materials to put into global markets. More than the resources, the author argues, the regions are themselves commodified.

Paradoxically, this process has not necessarily produced local development, for at least two reasons. Firstly, while the country's capital city absorbs most of the profits from extractive activities through taxes, the local areas concentrate the negative environmental effects, either at the extraction stage or through

Due to regionalisation and neo-liberalisation, Chile became deeply involved in (and highly sensitive to) global markets, while becoming highly attractive to foreign investment.

the generation of waste (Giljum, 2004). Secondly, mining operation sites act as highly specialised 'enclaves' with little positive links (such as knowledge transfer) with their supporting cities (Arias, Atienza and Cademartori, 2014, p. 79). As suggested by Bustos-Gallardo and Prieto (2019), the regionalisation process did not include any strategy or show any particular interest in strengthening the local urban centres, which might explain the lack of robust planning policies and intense environmental damage observed in cities such as Copiapó.

2.6 Mining tailing deposits: sweeping under the carpet

Most of the literature on mining tailing deposits comes from scientific disciplines such as geology and chemistry, or from technical engineering reports; there is scarce academic production regarding urban studies or including a political ecology perspective[2]. On the other hand, there is a rich production of reports in Chile, carried out by both governmental and independent institutions, where the situation of such deposits throughout the territory is described in detail (Cámara de Diputados de Chile 2011; INDH 2016 and 2019; Medvinsky-Roa, Caroca and Vallejo, 2015). These documents take an environmental justice approach, usually conceptualising the access to a clean and safe environment as a 'human right' and defining tailing deposits as 'hazards'. This recent documentation and the creation of ad-hoc NGOs (such as TERRAM and Fundación Relaves) give an account of the relevance of the issue, demonstrating an increasing awareness in society.

NOTE 02

Except for a brief mention by Arboleda, who connects it with the idea of 'planetary urbanisation' (2016).

Two of the most relevant reports were elaborated by the National Institute of Human Rights (INDH, for its acronym in Spanish) both focused on Copiapó and its surroundings: the first one in 2015, just after the rainfalls that flooded a large extent of the region; and the second one in 2018, which assessed the fulfilment of human rights. Both documents conclude that there have been serious human right violations, concerning health, livelihood, just and safe dwelling, and a pollution-free environment, among other human rights (INDH 2016 and 2019).

In the next chapter, the concepts of 'risk' and 'extractivism' are organised and connected to produce a conceptual and analytical framework suitable for the case study. The definition of this framework is arguably relevant and original. Some recent literature on 'political ecology of risk' (Perreault, 2016) – which could be seen as a 'shortcut' for the intended analysis – has mainly focused on public health issues, while providing few analytical tools to unfold relationships between modes of development, urban environment, and disaster risk.

The conceptual framework draws on two concepts. In the case of 'risk', the focus is put on those aspects producing 'vulnerability' on the city-level [...]. In the case of 'extractivism', despite being apparently linked only with national or global processes [...], it can be locally grounded and linked with risk by using the extended notion of 'extraction' and the idea of 'operations of capital' by Mezzadra and Nelson.

03. Conceptual and analytical framework

Some general definitions by Pelling (2003, p. 5) are introduced here as an entry point for the proposed framework. These definitions are broad enough to allow for further conceptual development throughout the chapter:

'*Risk*: To be threatened by harm.'

'*Vulnerability*: Denotes exposure to risk and an inability to avoid or absorb potential harm. [It can be] physical (…), in the built environment; [or/and] social (…), experienced by people and their social, economic and political systems.'

'*Hazard*: The potential to harm individuals or human systems. [It might include] natural, physical, or environmental elements. It can be everyday (e.g. scarcity of clean drinking water) or episodic (e.g. volcanic eruption).'

'*Disaster*: The outcome of hazard and vulnerability coinciding. Disaster is a state of disruption to systemic functions. Systems operate at a variety of scales, from individuals' biological and psychological constitutions or local socio-economies to urban infrastructure networks and the global political economy.'

No further discussion on the specific wording of these definitions will be conducted for the moment, as this chapter is focused on organising ideas to understand the 'how' of these events, this is, the enabling conditions found on the case. Despite this, the definition of each of these concepts is an open discussion in the literature (for example, see Mitchell, 2001), something that requires a permanent revision.

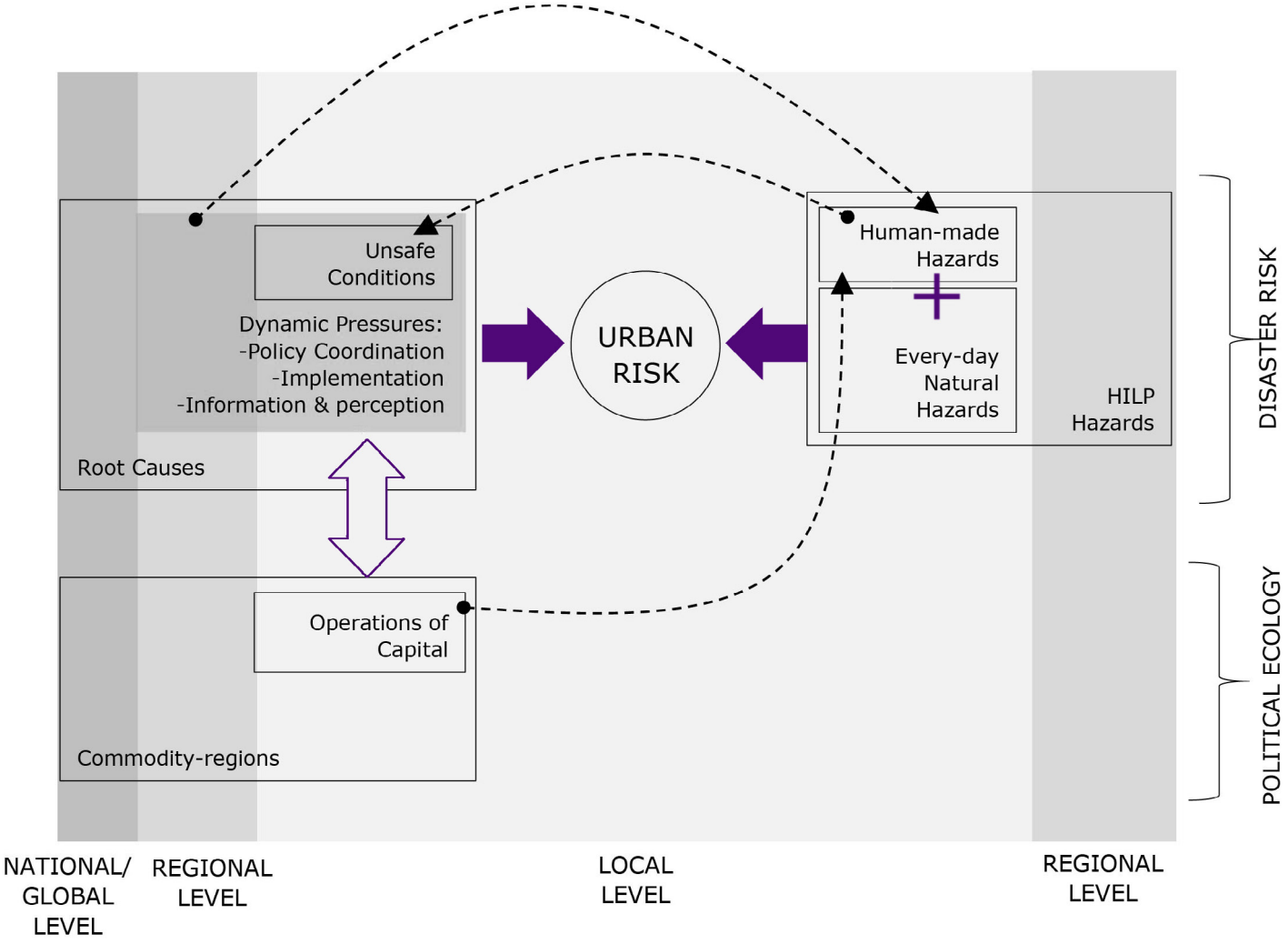


FIGURE 3.1

Conceptual framework diagram.
Source: own elaboration

As mentioned before, the proposed conceptual framework draws on two main concepts, or, more precisely, two groups of concepts. In the case of 'risk', the focus is put on those aspects producing 'vulnerability' on the city-level, covering a wide range of dimensions and scales. Models developed by previously discussed authors from disaster risk literature are taken and combined: the 'pressure and release' model by Wisner, Davis, Cannon and Blaikie (2004) and the framework developed by Turner, Kasperson, Matson, McCarthy et al. (2003). In the case of 'extractivism', despite being apparently linked only with national or global processes such as the 'regionalisation' and 'neo-liberalisation' of the economy, it can be locally grounded and linked with risk by using the extended notion of 'extraction' and the idea of 'operations of capital' by Mezzadra and Nelson (2019). A diagram shows the summary of my conceptualisation (Figure 3.1).

Wisner, Davis, Cannon and Blaikie's (2004) model is based on the idea of 'progression of vulnerability' which establishes a certain level of causality for increased vulnerability as one of the 'pressures' leading to disasters. My framework preserves their original three categories of vulnerability: 'unsafe conditions', 'dynamic pressures', and 'root causes', ranging from local and current conditions, to global and historical ones. On the other hand, hazards act as the second 'pressure' or risk driver, thus only when vulnerability and hazard meet, disaster can occur.

Based on the model by Turner, Kasperson, Matson, McCarthy et al. (2003), this framework incorporates three elements: different spatial scales (local, regional, national/global), a differentiation on the origin of the hazards (natural or human-made), and feedback loops between categories. Regarding the spatial scales, I locate 'unsafe conditions', 'human-made' and 'everyday natural hazards' at the local level. Then, I locate 'dynamic pressures' and 'large episodic hazards' such as Copiapó's 2015 floods at the regional level. Lastly, I link 'root causes' with national and global scales. Regarding the origin of the hazard, my conceptualisation is modified to suit the case study, where the main human-made hazards are tailing deposits. The model prioritises natural hazards that interact with tailings (rain, floods, earthquakes, wind). Finally, I also draw on the model by Turner, Kasperson, Matson, McCarthy et al. (2003) which provides a less linear, more cyclical conceptualisation of the way different

components of the model interact. In the model I present, the main identified interactions are between human-made hazards (tailing deposits) and unsafe conditions, which are both spatially local and incremental in time, incorporating the discussed idea of 'accumulation of risk'. A second interaction is identified at the structural level, where both dynamic pressures and operations of capital produce not only vulnerability but human-made hazards.

At the same time, building on the conceptualisation of 'extractivism' as developed in the literature review, I introduce two further categories into the model: 'commodity region' (linked with the notion of 'root causes') to conceptualise the specific historical processes and institutional settings leading the region to become a mining zone, with strong links with global flows, and 'operations of capital' (linked with 'dynamic pressures'), meaning the specific ways in which capital 'hits the ground' performing tangible and often contestable actions to extend its boundaries. Despite that these two categories are not directly used to analyse the secondary sources, they are extremely useful in the discussion section of this paper, as they provide the theoretical ground necessary to contextualise most of the findings.

Now that the general model is outlined, it bears returning to the categories of vulnerability to explain them in detail.

3.1 Unsafe conditions

This category describes the way vulnerability is manifested in time and space, with a focus on the communities' dwelling and livelihood conditions given their resources, possibilities and knowledge. To simplify the analysis, only one condition is included: 'People living next to mining tailing deposits', summarising the object of study and the scope of this paper. What it is relevant here is not the presence of tailing deposits in the area, but the fact that these are located *next, around, or underneath people's dwellings* in an urban – and therefore, potentially planned – environment.

3.2 Dynamic pressures

The factors included in this category 'translate' root causes into unsafe conditions, which are likely much closer in space and time to the disaster if compared with root aspects. The proposed three dynamic pressures have been defined based on preliminary research on the case, purposely open enough to accommodate a wide range of information from multiple sources:

- Uncoordinated policies
- Poor urban management
- Issues regarding access to information, perception of risk and communication between actors

The above aspects can be roughly called – correspondingly – 'institutional', 'physical', and 'social' dynamic pressures, although a certain degree of flexibility on the categorisation is needed at this level of analysis.

3.3 Root causes

Root causes are the most distant set of factors. These are processes deeply grounded in society and its modes of organisation; they relate to issues such as power distribution, modes of production, and political or economic models, thus are linked in the Chilean case to extractivism, regionalisation and neo-liberalisation of economy.

The conditions of vulnerability should be understood through the three mentioned scales. However, the focus of my analysis is put on the second category, 'dynamic pressures' as it constitutes the middle ground between both ends, combining elements from the other two categories. It can be argued that this is an appropriate scale for this research, considering its scope and objectives: it is not completely abstract as the root causes, which would require a deep understanding of politics and economics, while it does not merely address the unsafe condition of living next to tailing deposits. Instead, it potentially allows for a proper amount of speculation and comprehensiveness of the physical, institutional, and social aspects that configure the case. In this way, a potential 'room for manoeuvre' or paths for complementary research can be identified, while accommodating the overlapping theoretical areas between risk literature and the political ecology approach provided by the notion of 'operations of capital'.

Copiapó was chosen as the case study of this research because it concentrates the largest amount of mining operations and mining waste close to inhabited urban zones in Chile.

04. Methodology

This research is based on a case study (Copiapó, in northern Chile), using mostly qualitative and spatial analysis of secondary data, and developing a specific conceptual and analytical framework for the case study, drawing on the review of relevant literature. The selected case is productive despite not being the most important mining area in the country, nor the one with the largest number of tailing deposits; Copiapó was chosen because it concentrates the largest amount of mining operations and mining waste close to inhabited urban zones in Chile.

The chosen information sources expose different aspects in which root causes or structural conditions are manifested in the city, by producing 'dynamic pressures' of vulnerability. Nevertheless, the analysis does not pretend to be comprehensive or exhaustive; it aims instead to offer a synopsis or snapshot of the current situation, drawing on pieces of visual and textual information collected from institutions, communities and academia.

The main sources of secondary data are the following:

4.1 Policies

Policies as concrete manifestations of the current Chilean model and political 'mindset' are a key source of information for this paper. I analyse them to show how the case study is informed by a series of documents stemming from different public agencies, and the extent to which these documents are linked or aim at common goals. I also use them to appraise the different institutional discourses around the chosen case and topic. The three studied policies are:

- Atacama Regional Policy for Spatial Planning (Gobierno Regional De Atacama, 2013)
- Atacama Regional Plan for Disaster Risk Management (Oficina Nacional de Emergencia, or ONEMI for its acronym in Spanish, 2018)
- Law Regulating the closure of mining works and facilities (Ley 20.551, 2011)

They will be analysed through keyword searching and appraisal of the context in which they are mentioned.

4.2 Plans and maps

I use plans and maps to analyse the spatial dimensions of the case, in order to collate adjacencies, historical growth, spatial patterns and arrangement of different urban features. The key sources are aerial photos, geo-referenced information provided by the Chilean Government, the Copiapó city plan, and reports from national agencies and organisations, complemented by other sources such as scientific papers.

4.3 Local news

I use local news to explore some of the social aspects related with access to information, communication between actors, and communities' perception of vulnerability. The main sources are local newspapers, online news portals, and reports from the National Institute of Human Rights (INDH). The analysis method is keyword searching and appraisal of the context in which they are mentioned, similar to the policies' appraisal method.

Other secondary sources of information are used to contextualise the case, such as scientific papers, economic reports, and informal academic inter-changes with people coming from Engineering and Earth Studies, Landscape Studies, and Geography.

4.4 Limitations

Firstly, it is important to acknowledge the limitations of the implicit cause/effect structure that my proposed framework suggests. As the authors of the 'Pressure and Release' model acknowledge, there is a lack of certainty of causal connections between different levels of vulnerability, especially if going further up in the model, closer to the root causes. This must not be a reason not to attempt to understand the interaction of apparently disconnected aspects that might lead to the production of risk; it is in fact a reason to go further and as deeper as possible in this kind of research. However, this observation signposts a warning on avoiding a positivist or simplistic vision of the studied case. In agreement to this, the conclusions of this Working Paper are in any case tentative and preliminary.

There is a lack of certainty of causal connections between different levels of vulnerability, especially if going further up in the model, closer to the root causes.

Secondly, while included in some conceptual models of risk as a counterpart to vulnerability, 'resilience' is left aside on the present analysis as it opens an extensive new area of literature; it brings its own conceptual corpus as exemplified in the concepts of 'human agency' and 'negotiation of risk', or draws on notions of environmental justice. Further research will greatly benefit from including this category to enrich the analysis and its potential practical applications.

Finally, there is an obvious limitation in the lack of access to primary data as I did not undertake fieldwork data collection in Chile, usually used in academic reports assessing risk. Further collection of this kind of data would complement and cross-check the presented analysis.

The civil-military dictatorship implemented a series of structural changes in the country. All of them have defined, to this day, the way we use (and understand) the land and its resources.

05. Case study

5.1 Neo-liberalisation and regionalisation in Chile

From 1973 to 1989, the civil-military dictatorship implemented a series of structural changes in the country. All of them have defined, to this day, the way we use (and understand) the land and its resources. These changes included fostering foreign investment, delivering natural resource exploitation rights to the private sector and strengthening private ownership, and the 'regionalisation' of the national territory (Bustos-Gallardo and Prieto, 2019).

The regionalisation consisted in a new division of the national territory, implemented from 1974 onwards (through the decrees 573 and 575), originally aiming at decentralising the country and its population, while achieving 'an effective participation of the population in the definition of their own destiny, contributing and committing, in addition, to the superior objectives of their region and the country' (DL-573 1974, Considerando 2b, my translation). Some of the stated requirements for a territory to be established as a region are having enough natural resources to produce economic growth, sufficient population to sustain such growth, and an urban/rural structure able to offer supporting services. In this regard, regions are not understood as entities holding a specific history, culture, or political agency. Instead, they are regarded as self-contained economic units (Boisier, 2000, cited in Bustos-Gallardo and Prieto, 2019). At the same time, the military regime assigned two functions to the regions: to attract foreign investment, and to place products or commodities on the global markets (Boisier 2006, cited in ibid.). Following this process of regionalisation, the Mining Code of 1983 established unprecedented public-private relationships by facilitating the delivery of exploitation rights, prioritising extraction efficiency over social equity, and facilitating processes of dispossession in the local population (figure 5.1).

What it is interesting about the Chilean case is that, despite the official intentions declared in the law, the process of regionalisation was incomplete: while private companies acquired new tools to commoditise the territory, the new public institutions that were created to manage the regions were not conferred with the powers or resources to get effective control over the territory or the private sector, nor the political autonomy to define an independent territorial project (Bustos-Gallardo and Prieto, 2019). In this way, the historical hierarchy of the capital city over the rest of the country remained largely untouched, in line with the fact that this model was implemented during a highly hierarchical, anti-democratic regime[3].

NOTE 03

Despite some updates on the institutional framework, the situation described here is still valid. The regional budget and the way it is distributed largely depend on the 'National Budget', centrally defined and enforced every year by law. Refer to Decreto con Fuerza de Ley 1-19175. Source: Biblioteca Congreso Nacional de Chile

5.2 Role of mining at the national level

Despite the fact that Chile produces and exports multiple metallic and non-metallic minerals, this section is focused on copper as it represents the most important mineral for the country (constituting roughly a 50% of the total exports), while most of the mining operations next to Copiapó extract it (Servicio Nacional de Geología y Minería, or SERNAGEOMIN for its acronym in Spanish, 2019).

Chile is currently the first producer of copper in the world, with around 5.8 million tons or 28% of the global production in 2019, while 40% of the known world stock is on Chilean land. Its main destination is, by far, China, with 53% of the total exported volume, followed by Japan (11.7%) and South Korea (8.1%) (COCHILCO, 2020). A couple of contrasting figures: while it is the largest export sector (55% in 2018), it does not represent a large share of the national GDP (8.9% for the same year). Furthermore, its contribution to the national budget

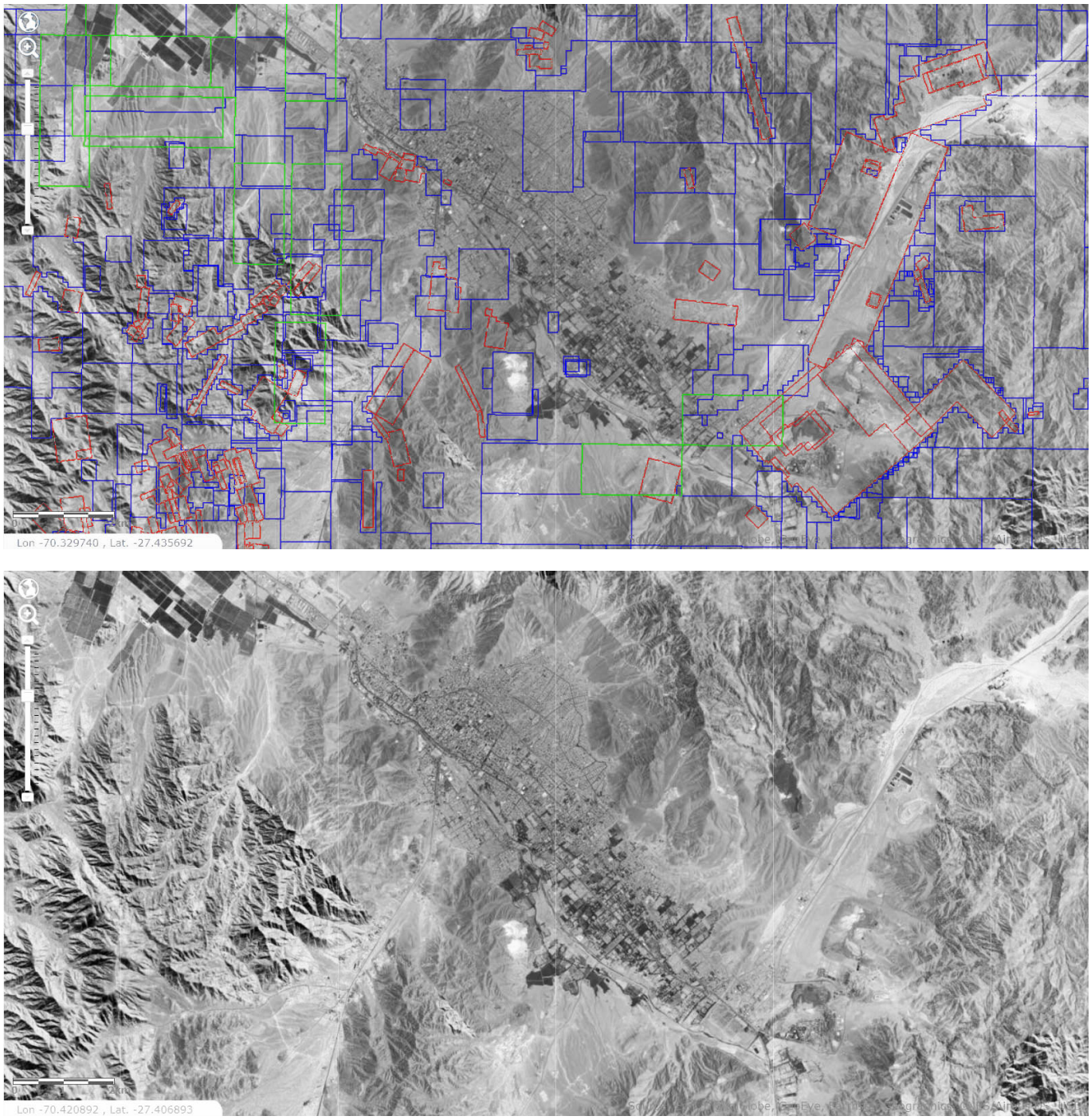


FIGURE 5.1

(Above) Overlapping of exploitation rights issued to different private stakeholders.
(Below) Aerial photo of Copiapó. Source: Geoportal de Chile (Accessed 12 October 2020)

via taxes has consistently decreased: at the beginning of the 1990's, copper represented 20.7% of fiscal revenue, while in 2017 it was only 4.6%.

Copper extraction rates have increased due to a sustained decrease in ore grade, which means that more waste per ton of metal is produced every year. As a reference, only one mining project, 'Mina Candelaria' – one of the largest operations in Atacama, with capital from a Canadian-Japanese joint venture – extracts 270,000 tons per day (TPD), but only 43,700 TPD are sent to a processing plant (ratio of 6:1), out of which only 410 tons of copper can be obtained (ratio of 657:1).

This poor ratio of value extraction from nature is in fact very efficient in terms of revenue extraction. As stated by the Chilean economist Gabriel Palma 'Chile does not have a proper royalty[4], which has allowed foreign investment, mainly mining, to take out of the country for 7 consecutive years (...) an average of 19 billion dollars (…) equivalent to more than half of the total tax revenue of the state' (Huerta, 2013, my translation) while the total contribution of private mining companies to the Chilean state in 2016 'was close to zero' (Fuentes, 2018, my translation).

NOTE 04

'Regular payments, usually based on the volume or price of minerals extracted, made by mining enterprises to national states or other owners of mineral resources as consideration for the right to exploit particular mineral resources.' Source: USLegal (Accessed 12 October 2020).

5.3 Copiapó

The city of Copiapó is near to one of the driest places in the world, the Atacama Desert (NASA 2002, cited in Carkovic, Calcagni, Vega, Coquery et al., 2016) with an annual rainfall of 18mm (Figures 5.2 and 5.3). Representing now 50.8% of the people living in the Atacama region, its population has grown almost 60% from 1992 (101,000 people) to 2012 (158,000 people) precisely during the 'boom' of private mining activities (Biblioteca del Congreso Nacional de Chile, 2019), in parallel to an outstanding increase in real estate investment and job positions in the building sector. Nevertheless, the city remains highly sensitive to international changes in copper price, and to any potential foreign capital operation in the area (and whether those projects are cancelled or approved, among other factors). This has led to events such as the sudden increase of unemployment rates from 3% to 9% in less than a year, from August 2015 to April 2016 (Rehner and Rodríguez, 2018).

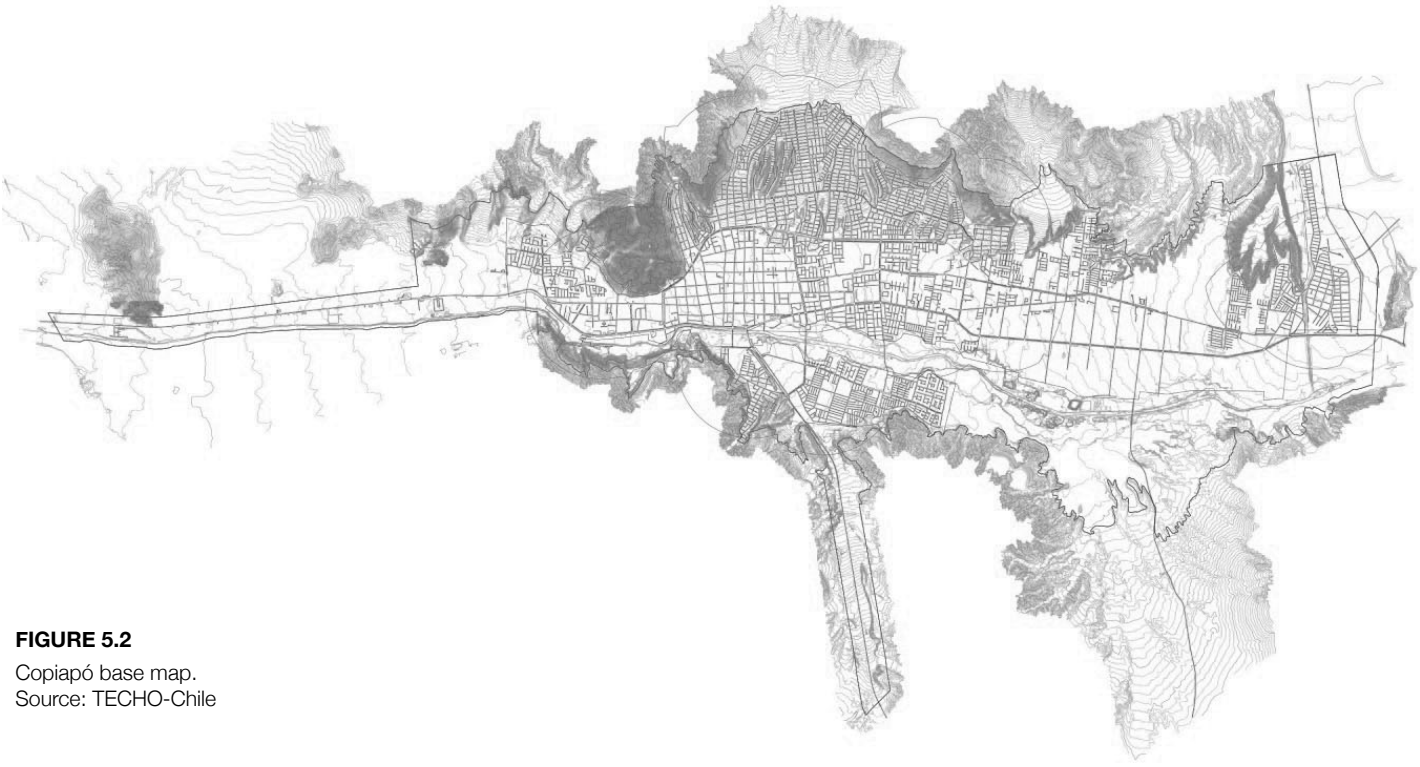


FIGURE 5.2

Copiapó base map.
Source: TECHO-Chile

FIGURE 5.3
Aerial photo of Copiapó.
Source: Google Earth

The highly volatile economy of Copiapó, along with national processes of liberalisation of urban development has resulted in an unplanned growth of residential areas.

Copiapó, as many other cities in the north of Chile, lives in a continuous cycle of economic crisis and booms (ibid.). Its highly volatile economy, along with national processes of liberalisation of urban development (usually led by the private sector) has resulted in an unplanned growth of residential areas. In recent years, due to an increasing shortage of urban land, these new areas and a series of informal settlements have been located on the ravines and hills surrounding the city (Carrasco, 2010, cited in Pizarro, 2017), closer to tailing deposits. This uneven development can be seen in some figures: while the 'objective' poverty rate, based on people's income, is considerably lower than the rest of the country´s (4.6% versus a national average of 10.4%), the 'multidimensional' poverty, including access to education, health, work, social security, housing and general livelihood, is significantly higher (27.8% versus an average of 16.6%) (Biblioteca del Congreso Nacional de Chile, 2019). Additionally, regarding social mobility and equality, Copiapó has a negative evaluation, being ranked 25 out of 27 Chilean cities in one of the most relevant national indexes on the topic (Belmar, Escobar, L'Huillier and Marshall, 2017). As stated by the National Institute of Human Rights, "the wealth of the region in terms on natural resources, is not transferred as livelihood and well-being to their inhabitants" (INDH, 2019, p. 69, my translation).

5.4 But what is a tailing deposit?

A tailing deposit is the accumulation of discarded ground rock, minerals, water, heavy metals and toxic chemicals such as cyanide, arsenic, lead, cadmium, zinc, and mercury, which are obtained as a result of mineral concentration processes. These materials are piled in layered 'cakes' or reservoirs, where the solid material is decanted at the bottom of an artificial lagoon (Medvinsky-Roa et al., 2015).

In Chile there are officially 744 tailing deposits of which 102 are active, 471 inactive and 173 have been abandoned. Historically, Chilean mining operations have produced 24,000 million tons (MT) of waste, while 530 MT are added every year (SERNAGEOMIN, 2019). Eighty five of Atacama's 160 deposits are located in Copiapó[5], mostly distributed within or around the urban perimeter, or up-river next to the Copiapó basin. This last location is chosen by mining companies as fresh water is required to keep the deposits moisturised, in order to reduce the transport of fine particles through the air (figure 5.5). Tailing deposits have been declared as 'environmental liabilities' by the Chilean mining agency (SERNAGEOMIN 2015, cited in Carkovic, Calcagni, Vega, Coquery et al., 2016, p. 1002), nevertheless most of them have been abandoned or do not have a known owner (Figure 5.4).

NOTE 05

Source: SERNAGEOMIN (Accessed 12 October 2020).

5.5 Tailing deposits as hazards: every day and episodic events

Every tailing deposit can potentially increase risk, yet this is especially true for those which have not gone through a rigorous closing process, as they interact with the environment and become a source of toxic metals (Bes, Pardo, Bernal and Clemente, 2014; Varrica, Tamburo, Milia, Vallascas et al., 2014; Nkosi, Wichmann and Voyi, 2015; Sobrino-Figueroa, Becerra-Rueda, Magallanes-Ordóñez, Sanchez-Gonzalez et al., 2015). The effects of tailings are difficult to detect

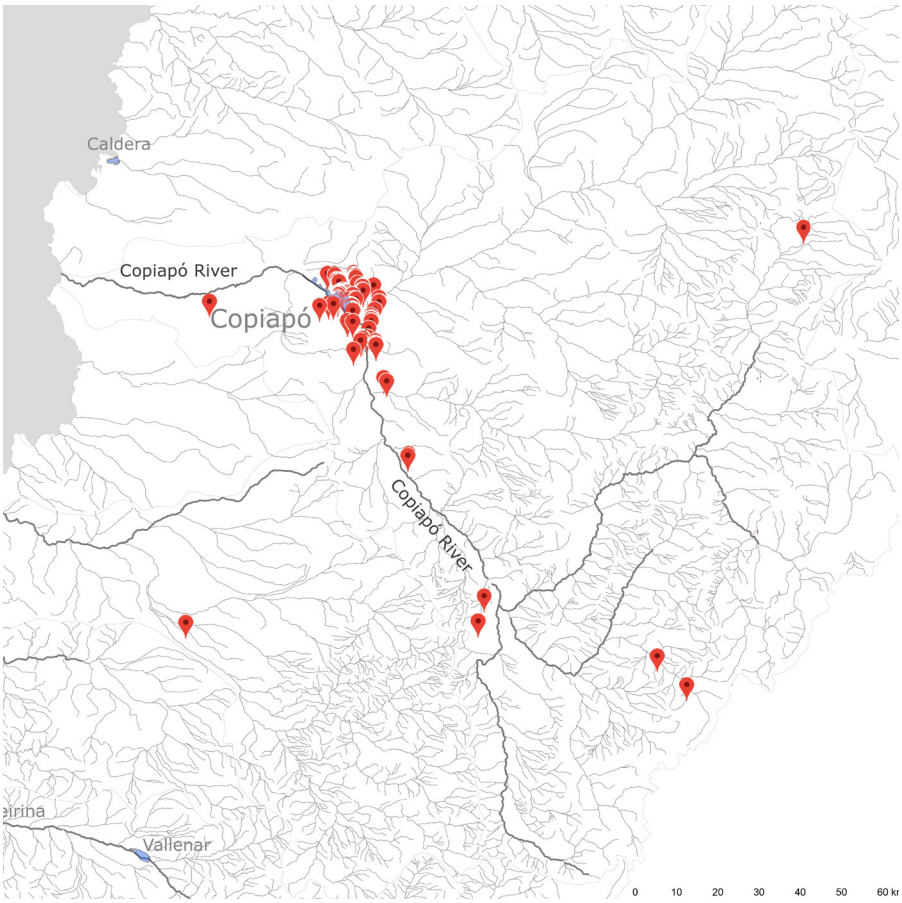
FIGURE 5.4

From top to bottom: Abandoned deposits next to 'El Palomar' Village, Copiapó; abandoned deposits after the 2015 floods, Copiapó; deposits washed away by the 2015 floods. Source: Medvinsky-Roa, Caroca and Vallejo, 2015

FIGURE 5.5

Left: Atacama region in grey and Copiapó river basin in red. Right: Copiapó river and location of tailing deposits (red pins). Source: Own elaboration based on data by National Geology and Mining Service (SERNAGEOMIN) (accessed 12 October 2020)

given that their substances are slowly transported through infiltration to the liquefiers, feeding rivers and wells used for human consumption, or are distributed through wind to distant areas. Given that most of Chilean tailing deposits are located in arid regions, the only obstacle to the wind-travelling dust are cities, where it is slowly accumulated (Medvinsky-Roa, Caroca and Vallejo, 2015).



The human body absorbs these particles via inhalation, ingestion, and absorption. This is particularly critical when different land uses are juxtaposed, as in the case of Copiapó's inner agricultural plots. The air pollution is currently above the national threshold of PM10 particles, as stated by INDH (2019). INDH reports document many cases of people affected by air pollution-related breathing diseases and allergies, as well as links between mental conditions – such as attention deficit in children – with the presence of metals in the blood (ibid.) in Copiapó and surrounding towns.

The 2015 floods brought into attention the risks of mining tailing deposits, when intense rainfalls swept along tons of material from mining operations from the mountains to the cities (Medvinsky-Roa, Caroca and Vallejo, 2015). Many of these toxic substances are still located in urban areas, as shown by the study conducted by the NGO TERRAM and the National Board of Physicians, who by 2015 detected arsenic concentrations a thousand times above the maximum allowed, lead concentrations five times above the norm, and an unhealthy presence of copper, cadmium and iron in some sources of fresh water (ibid. p. 19). Concurrently, Carkovic, Calcagni, Vega, Coquery et al.'s (2016) paper on distribution of metal concentration in the soil of Copiapó (figure 5.6) arrived at consistent findings. What is arguably more critical in relation to these studies' findings is that, despite that these pollutants were found in 2012 as a result of a previous research (CENMA 2012, cited in Medvinsky-Roa, Caroca and Vallejo, 2015), no measure was taken by the authorities.

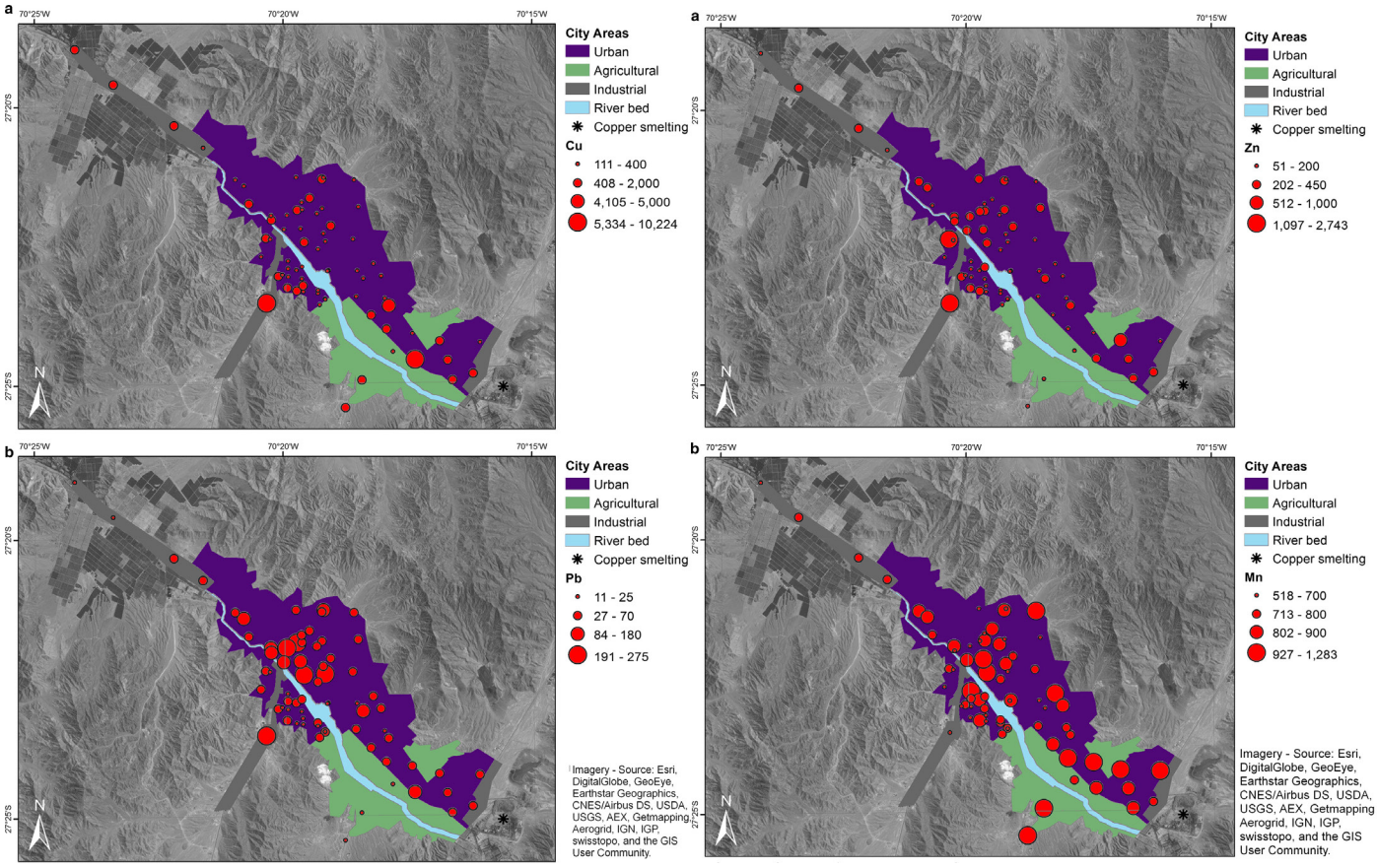


FIGURE 5.6

Distribution of metal concentration in Copiapó´s soil. Source: Carkovic, Calcagni, Vega, Coquery et al., 2016

5.6 Analysis

I conducted the analysis of secondary sources following the three 'dynamic pressures' as defined in the conceptual/analytical framework. Even though more than one type of source is used in each case: the first dynamic pressure 'uncoordinated policies' is initially studied through policies; 'poor urban management' is analysed through mapping and spatial analysis; and 'issues regarding access to information, perception of risk and communication between actors' are studied through the analysis of news and reports. Information cross-checking and triangulation is further developed on the discussion section to enrich the findings and evaluate the conceptual framework.

Uncoordinated policies

NOTE 06

The updated city plan, including a risk assessment done after the 2015 floods by the Ministry of Housing is reported as finished but not yet published.

NOTE 07

A promising new national policy has been announced but apparently not yet developed. Source: Ministerio de Minería Chile (Accessed 12 October 2020).

NOTE 08

Source: GORE Atacama & Ministerio de Mineria Chile (Accessed 12 October 2020) and Evaluación Ambiental Estratégica (EAE) (Accessed 12 October 2020).

This 'dynamic pressure' is analysed through the documents highlighted in colour in table 1. The rationale to choose these documents was to make it 'as local as possible'. Given that city-level policies were not found – as the only local policy, the 2002 Copiapó city plan, is just a land-use map which does not include any further description[6] – regional-level policies are used for both spatial planning and risk management, while there is only a national-level law for tailing management[7]. It is important to keep in mind that from the three chosen documents, only the tailing deposit law is binding, whilst the plan and policy only provide guidelines to be enforced through subsequent instruments such as laws, decrees or municipal city plans.

The regional spatial planning policy (from now on called 'planning policy') constitutes a special case: despite being approved by the regional authorities in 2014, it has been since then under environmental assessment and therefore not yet in force[8]. Nevertheless, this policy has been included in the analysis given that is the most comprehensive assessment and development project carried out by the public sector so far, including environmental considerations, urban and rural contexts and risk evaluation. In order to assess the degree of coordination between policies, four key concepts are pondered throughout the documents:

- *Tailings* ('relave' in Spanish)
- *Mining* ('minería')
- *Disaster and/or risk* ('desastre y/o riesgo')
- *Copiapó and/or Urban* ('Copiapó y/o Urbano').

TABLE 5.1
Summary of relevant Chilean policies. Source: own elaboration Copiapó base map. Source: TECHO-Chile

Topic	Level	Name	Year	Status
Planning	National	National spatial planning policy	-	Not yet approved
	Regional	Regional spatial planning policy	2014	Approved, currently on environmental assessment
	Local (city)	Current city plan	2002	Not a policy, just a land-use map
	Local (city)	Updated city plan	-	Not yet published
Risk	National	National disaster risk management policy	2014	Approved
	National	National strategic plan for disaster risk management 2015-2018	2016	Approved
	Regional	Regional plan for disaster risk management	2018	In force
Tailings	National	Law 20.551 regulating the closure of mining works and facilities	2011	In force
	National	National tailing deposits policy	-	Announced in 2018

Tailings

In the planning policy, 'tailings' are mentioned in four contexts. Firstly, as part of the 'business-as-usual' scenario for Atacama. Tailings are defined as a 'negative effect of mining activity', in acknowledgement of their presence within and around regional urban centres, and their continuous increase due to lack of proper management or strict regulations (Gobierno Regional de Atacama, 2013, p. 69). Secondly, tailing deposits are seen as part of 'desired scenarios', old tailing reprocessing and recycling is mentioned as an opportunity for local innovation and development, while reducing cities' negative environmental features (ibid. p. 79). Thirdly, tailings are described as being part of the fourth development strategy: 'Sustainable Development

and Environment'. This strategy highlights the need to regulate the allowed economic activities based on their impact and, particularly for mining solid and liquid waste, and to assess its influence area and compatibility with other productive activities and inhabited areas. Lastly, the planning policy proposes to develop an 'environmental vulnerability zoning' and to establish tailing deposits closing protocols (ibid. p. 94).

Surprisingly, the Regional Plan for Disaster Risk Management (from now on called 'risk policy') does not explicitly mention tailing deposits. Risk related to hazardous materials is nevertheless included within the human-made hazards category, where is mentioned that 'most of the current industrial processes require the use, transport, handling and storage of hazardous substances or materials', but only with a focus on transportation issues (ONEMI, 2018, p. 14). The only further reference that can be linked with tailings (if only indirectly) can be found in one of the Monitoring and Evaluation parameters by the end of the document, which states the need to 'develop, revise and update multi-hazard maps in order to ensure an appropriate and efficient performance during emergencies and disasters' (ibid. p. 28). There is no mention whatsoever of the way this should be done, the actors involved, or the required institutional framework.

Mining

The planning policy states that the regional economy is based on three activities: mining, construction, and services. Nevertheless, it acknowledges that it is 'fundamentally a mining area' dependant on the global market's fluctuations (Gobierno Regional de Atacama, 2013, p. 50). On the other hand, the risk policy does not directly link any risk with mining activities (ONEMI, 2018).

Disaster and/or risk

The planning policy includes as one of its objectives to analyse risks associated with natural hazards fluctuations (Gobierno Regional de Atacama, 2013, p. 8); one of its strategies is to reduce risks associated with social, economic, and environmental vulnerabilities. Noteworthy, it acknowledges the risk produced by mining deposits 'especially within inhabited areas' (ibid. p. 89). On a negative note, throughout the document risk is conceptualised as 'natural'.

Regarding the risk policy, it is remarkable that its definition of disaster does not consider extensive or everyday events – which is relevant when assessing tailings – nor includes any reference to its origin (natural or anthropic). More promisingly, its definition of 'hazard' includes the idea that it can be produced by human action (ONEMI, 2018).

The law 20.551 'Regulating the closure of mining works and facilities' (from now on the 'tailings law') does not mention the word 'disaster' at all. 'Risk', on the contrary, is highlighted as relevant but only in its economic sense; it is stated that mining operations require insurances, guarantees and a series of financial instruments to back up their closure procedures. Regarding the description of the closure plan, the law only mentions the risk for the people 'immediately related' with mining operations, and therefore it does not include within the plan the nearby (or remote) inhabitants that can potentially be affected.

Copiapó/urban

The planning policy conceptualises the city of Copiapó under two categories: first, as a 'hierarchical urban node', which attracts population on a regional level (Gobierno Regional de Atacama, 2013, pp. 15, 35); and secondly, as a 'system' that structures a series of smaller towns (ibid. p. 48). Later on, in the zoning proposed by this policy, Copiapó is reconceptualised as a 'new territorial unit' defined by its river basin. This reconceptualization does not provide details about productive activities, extractive enclaves, or environmental aspects (ibid. p. 107).

Both the risk policy and the tailing law do not explicitly refer to urban issues.

TABLE 5.2
Summary of analysed maps and plans. Source: own elaboration

Poor urban management

The category 'dynamic pressure' in my model looks at the physical and spatial features leading to urban risk. This category includes the city´s spatial organisation, and the extent to which its current configuration provides a suitable framework for future development. I present the interactions between urban features and socioeconomic aspects, similarly to the way in which I described interactions and alignments between different policies in the previous section. I carried out this section of the analysis by overlapping the following maps over a city base map.

Name	Source	Date
Google Earth aerial photos	Google	1985 to 2016
Chile's Tailings Atlas	National Agency for Mining and Geology (SERNAGEOMIN for its acronym in Spanish).	Updated 25.11.2015
National Geospatial Data Infrastructure	Ministry of National Assets	Update date as per layer
Informal Settlements Monitor	TECHO – Chile	2019
Spatial Welfare Index	Spatial Intelligence Centre, Adolfo Ibanez University	Update date as per layer
City Plan of Copiapó	Municipality of Copiapó	2002

Current situation

Figure 5.7 shows the current location of the tailing deposits in Copiapó, and their status (active, inactive, or abandoned), volume and ownership if available. Abandoned tailings tend to be riskier, as they are unlikely to be appropriately closed and thus interact with the surrounding environment through air, water, and soil. Most of such deposits are in the creeks around the city, while some of them are inside the riverbed and have been dry for many years except for occasional flows.

Historic growth

Figure 5.8 shows the evolution in time from 1985 to 2016 of both the city of Copiapó and the deposits around it. The historical city centre is shown in red while the urban area is shown in grey. At the beginning of the period, tailing deposits were located in rural areas, arguably at a safe distance from the (still small and compact) urban area. From the 1990's onward, the accelerated city' sprawl – especially southeast towards the copper smelting plant of Paipote – and the larger volume and number of deposits have produced an increasing juxtaposition of both processes, with some overlapping observed on the last stages.

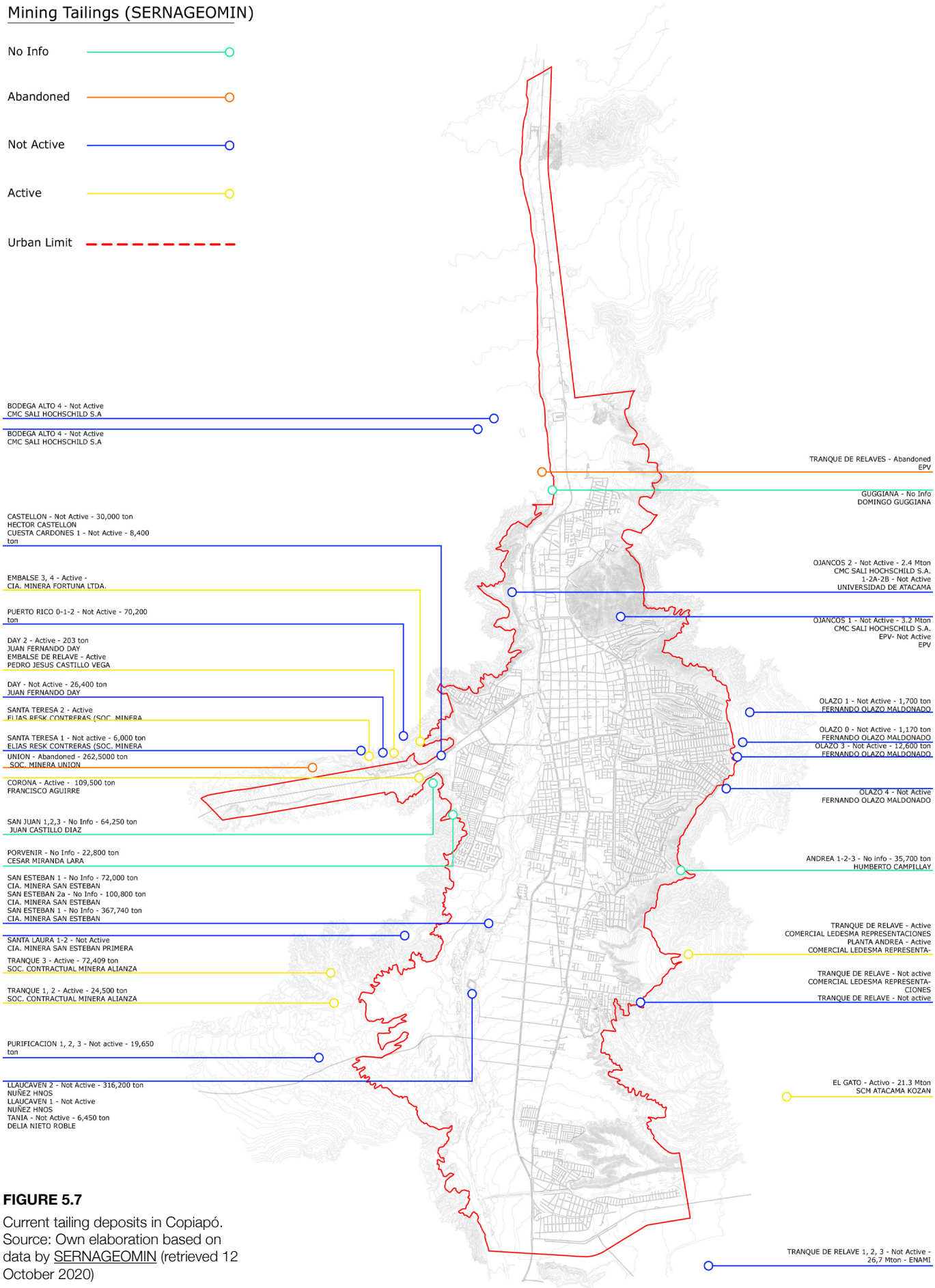


FIGURE 5.7

Current tailing deposits in Copiapó. Source: Own elaboration based on data by SERNAGEOMIN (retrieved 12 October 2020)

FIGURE 5.8

Historic growth of Copiapó and mining tailing deposits, years 1985, 2000, 2005 & 2016. Source: own elaboration based on Google Earth (retrieved 12 October 2020)

Tailing deposits, informality, and socioeconomic segregation

NOTE 09

For this NGO, 'informal settlements' are those meeting the following criteria: a) At least eight families. b) Housing contiguity c) Irregular land tenure d) Irregular access to electricity, drinking water and sanitary services

Figure 5.9 shows the proximity between mining tailing deposits and informal settlements based on the survey conducted by NGO TECHO (2016)[9]. Both tend to concentrate on the proximity of the municipal urban perimeter (settlements are typically slightly inside the polygon, while the deposits are slightly outside), constituting a sort of 'ring of vulnerability'. Figure 5.10 enriches the previous map by specifying the location of deposits and socioeconomic distribution of population, showing a less obvious spatial pattern across the territory, with some deposits next to wealthy neighbourhoods.

FIGURE 5.9

Informal settlements and tailing deposits. Source: own elaboration based on TECHO (2016) (retrieved 12 October 2020)

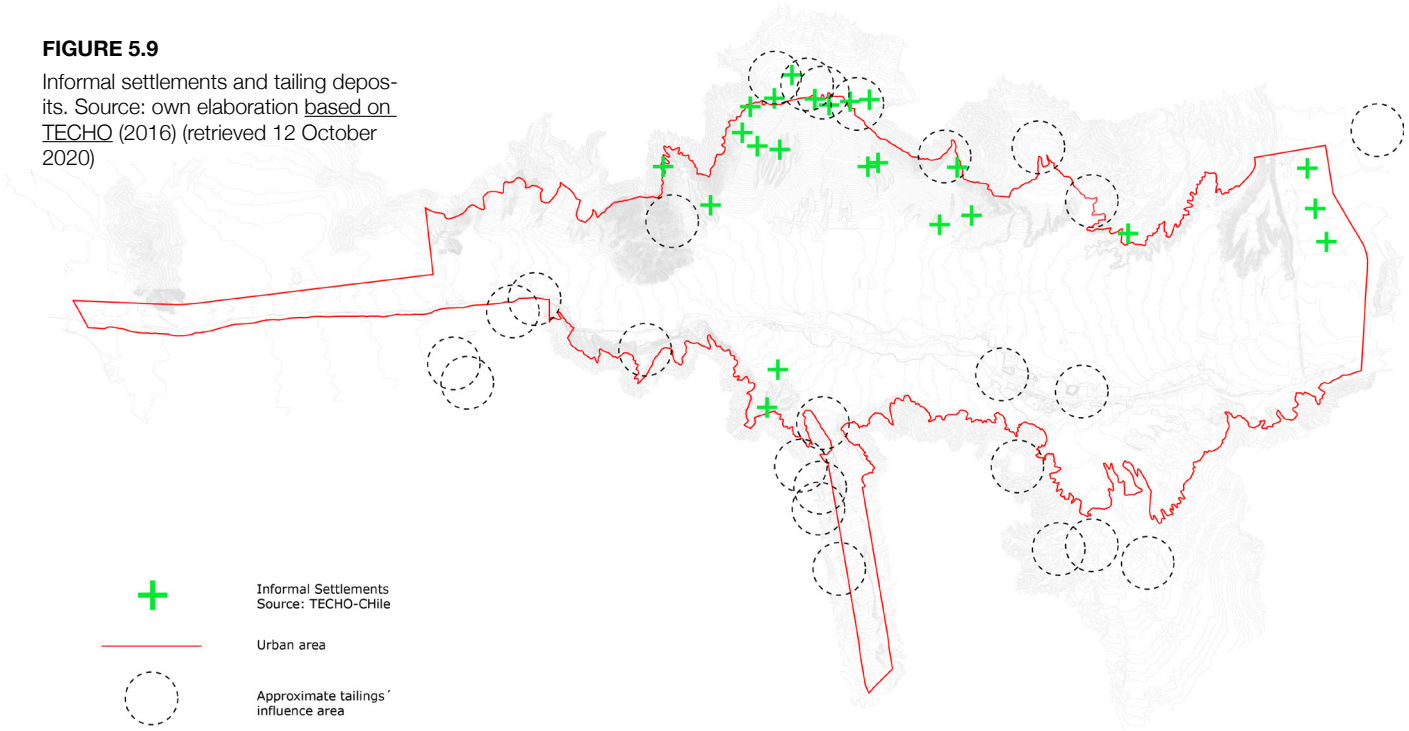


FIGURE 5.10

Socio-economic distribution and tailing deposits. Source: own elaboration based on Bienestar Territorial (2019) (retrieved 12 October 2020)

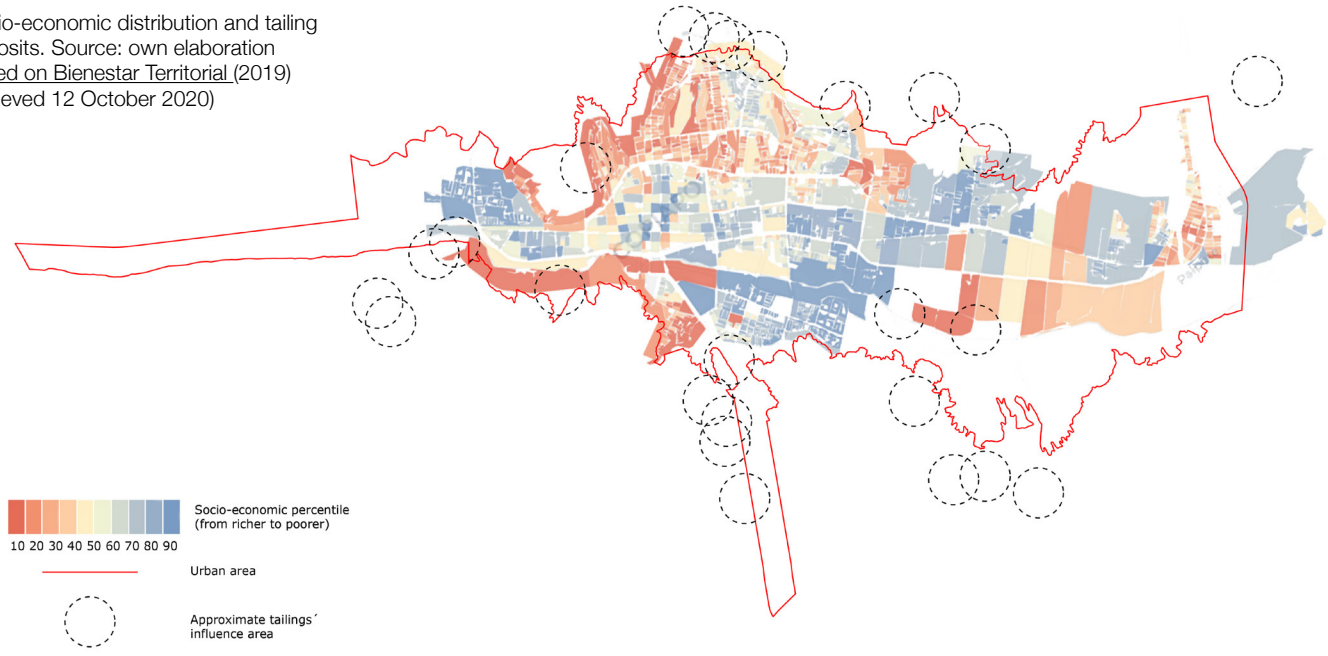
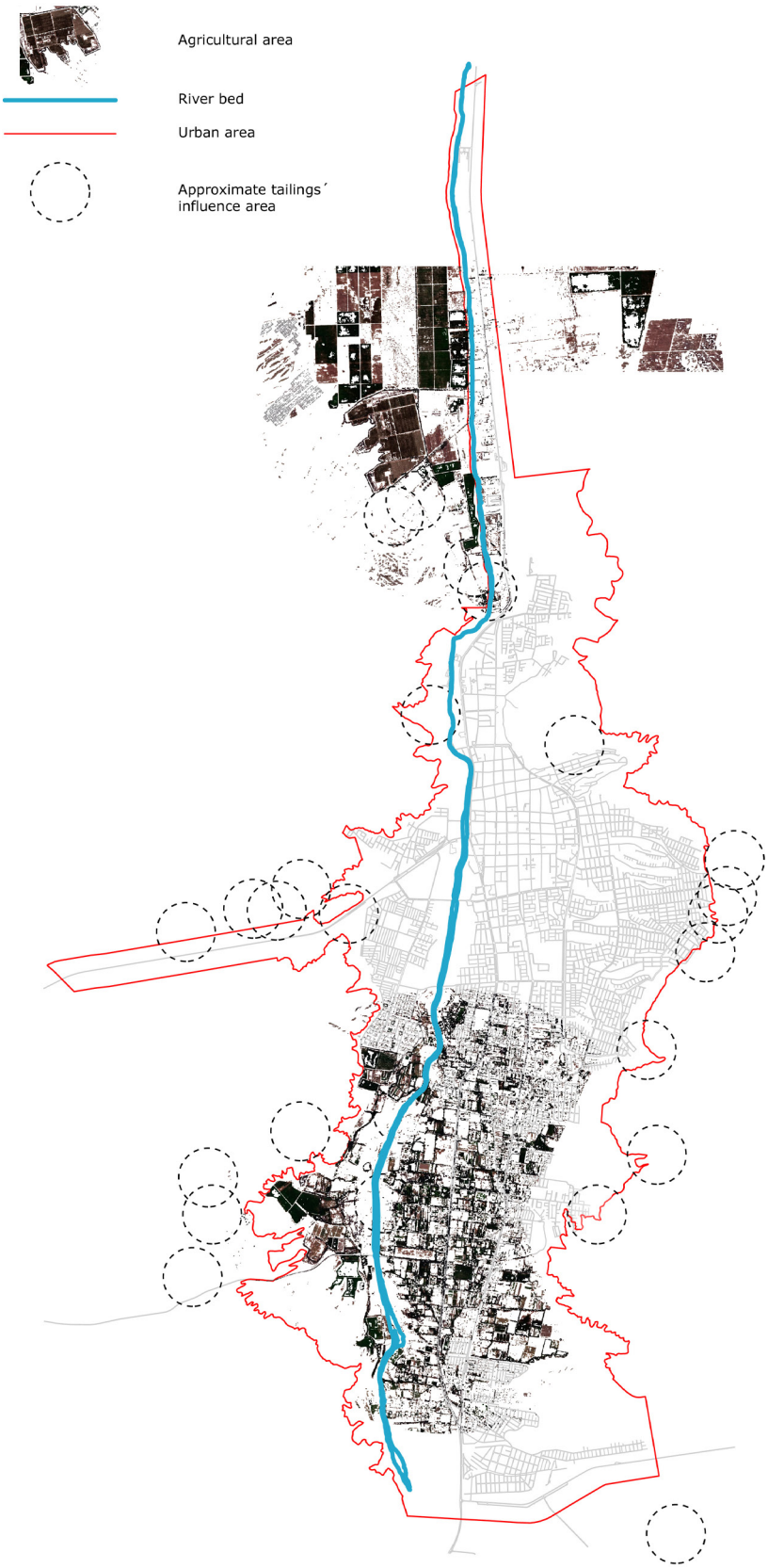


FIGURE 5.11

Overlapping of productive activities. Source: own elaboration based on Google Earth (retrieved 12 October 2020)

Overlapping of productive activities

Figure 5.11 shows the proximity or overlapping between tailing desposit areas and areas dedicated to the second most important productive activity in the region: agriculture (dark coloured areas), which may produce a health hazard for the inhabitants of the city. The feedback loop between mining and agriculture has a second aspect: the mining operations currently possess most of the water rights (which have also been privatised), which has dried the urban segment of the Copiapó river, and reduced the possibility to continue undertaking the inner city small-scale agriculture that has been historically developed in Copiapó.



Issues regarding information, perception of risk and communication between actors

The sources used for the analysis of this aspect were:

- Google News
- Diario Atacama (local newspaper)
- Diario Chañarcillo (local newspaper)
- El Quehaydecierto (local newspaper)
- SoyChile (online news)
- Radio Maray (online news)

The searched keywords were 'Copiapó + Relave' (tailing) in all the cases, plus one of the following words: Habitante (dweller); Vecino (neighbour); Comunidad (community); Testimonio (account); Población (population/settlement); and Poblador (settler).

In spite of the scarce amount of information found in the media, some general findings can be declared. Little interaction between settlers and politicians or authorities is identified, and no strong social movements have risen in the city. This contrasts with other towns within the region, where NGO's and local authorities seem more concerned with these conflicts. A certain 'innovative' approach can be observed in the community, as exemplified in a published project to transform mining waste into paving blocks. Regarding the future, there seems to be a certain distrust on the recently announced new tailing deposit management policy, largely due to its derisive name: 'Adopt a tailing deposit'. Finally, some media seem biased towards mining companies, as they consistently produce articles to 'clean' the image of their projects, while highlighting the positive outcomes and cooperation between them and the communities.

I used the 2018 INDH report (2019) to complement the above information. In general, inhabitants expressed a perception of abandonment from the government, specifically regarding its protective role and the lack of decentralisation in the way resources are managed. People seem to have naturalised the idea of environmental degradation, exclusion and abandonment, as part of the 'mining culture', thus there is not much questioning in relation to this. Given this state of things, only large events like the 2015 and 2017 floods have raised a certain degree of awareness among citizens.

From the perspective of inhabitants, the right to have a safe dwelling does not seem to be respected by the authorities. A neighbour mentions that 'the people live in fear of a new environmental disaster (such as the 2015 floods), since [they live in] an area surrounded by tailing deposits, not properly managed by the authorities or companies' (ibid. p. 65).

Regarding access to information, INDH states that there is a lack of data about the risks associated with productive activities (particularly, a lack of understandable data), which produces speculation, anxiety, and uncertainty in the population (ibid. p. 69). Moreover, members of the community declare they have not been invited to participate in decision-making regarding safety (Medvinsky-Roa, Caroca and Vallejo, 2015, p. 22).

Mining companies declare that they operate under the Chilean regulations and comply with relevant environmental impact assessments (EIA). Nevertheless, all the projects that started before 1994 (year in which the enforcement of the national environmental law began) are not subject to this kind of evaluation, while mining companies currently self-supervise their operations. On the other hand, authorities declare that inspecting mining operations 'is not within their powers' or that they do not have the resources to do it, especially considering the abandoned, older dumps, which currently fall outside any regulation (ibid. p. 30).

It can be argued that in Chile's case, mining tailings are one of these 'outsides' of capital; vast material accumulation from which all value has been extracted [...] located on the physical edges of the city. Here, due to urban growth, mining deposits have recently met informal settlements, other liminal production of space, in doing so producing a feedback loop of socio-spatial vulnerability and risk.

06. Conclusion

It bears now returning to the research question: 'In which ways does the Chilean extractivism, adopted on a regional scale and linked with global circuits of natural resources, produce urban risk on a local scale? How is this manifested in the case of mining tailing deposits in Copiapó, in the Atacama region?'

First of all, this question assumes that there is a 'Chilean Extractivism', different from other 'extractivisms' as found throughout Latin America and in many countries of the 'Global South'. Historically, most of the north of Chile – including the region of Atacama – has been devoted to extractive mining activities. What the civil-military dictatorship introduced as a new dimension was an unprecedented process of 'commoditisation' of the region and a neo-liberalisation of the economy, which defined a radically different way of managing the territory and its resources. At the same time, the dictatorship retained a highly centralised institutional framework and budgetary decision-making, which gave little autonomy to the newly created regions. These opposite forces of extreme opening to global markets and reduced capacity for decision-making produced a particularly fragile territory, highly dependent on centralised national power, international trade markets and logistic chains, unpredictable variations in prices, among other aspects. Furthermore, in contrast with many Latin-American countries, in Chile there have been little attempts to socially re-distribute the extraction of value generated by mining operations, by shifting to what is known as 'neo-extractivism', which would help controlling or reducing the high levels of dependency on centralised power (whilst not necessarily helping to solve structural issues such as inequality, unsustainable development, displaced communities, etc).

Based on this, and enriching the argument stated in the introduction, it seems simplistic to say that there has been a strengthening of the region at the expense of cites, or vice versa (even though the city has captured some of the surpluses generated by the cycles of commodity boom). It would be more precise to say that there is a generalised scenario of dependency and negotiation, where different actors throughout spatial scales get positively or negatively affected by extractive operations, in cyclic stages of boom and recession. Because of that, despite the use of the binary city/region was a highly productive entry point for this research, further investigation and policy-making taking other territorial units as their object of study, such as the river basin system suggested in the regional planning policy, would be highly valuable.

In regard to the research question's notion of 'production of urban risk', and complementing what is discussed in the literature review, it is necessary to return to Mezzadra's (and multiple co-authors) notion of 'multiple outsides' of capital, understood as "privileged sites for the investigation of the operations of capital and their contestation" (Mezzadra and Neilson, 2019, p. 66). The need for capital to produce its own 'outsides' to reproduce and expand itself, leads to a constant redefinition of the boundary separating what is commodified from what is not. As the authors suggest, this limit is precisely where contestation and mobilisation occur, unfolding the 'friction' between the ideal of a continuum value extraction, and the specific features and complexities of each territory and social fabric. It can be argued that in Chile's case, mining tailings are one of these 'outsides' of capital; vast material accumulation from which all value has been extracted – being therefore the exact opposite of commodity – located on the physical edges of the city. Here, due to urban growth, mining deposits have recently met informal settlements, other liminal production of space, in doing so producing a feedback loop of socio-spatial vulnerability and risk.

The use of Nancy Fraser's concept of 'boundary struggle' (2014) could be deemed too literal if it was not for the fact that risk is distributed throughout the city much more democratically than it appears to be, due to multiple interaction of tailings' toxic substances with air, soil and water. The Copiapó floods of 2015, for example, affected middle income neighbourhoods rather than city' slums. Thus, it can be argued that the whole city is located at the boundaries of mining capital operations, being the 'boundary struggle' far from literal or obvious.

A second idea regarding production of risk is that it goes hand in hand with the production of uncertainty. For communities, risk is maximised due to the lack of accessible, understandable, reliable information regarding health hazards and environmental pollution (among other aspects), which fosters in them an increasing anxiety and distrust in relation to their authorities and their own future. In this case, uncertainty and access to information are also about boundaries, but those related with how responsibilities and liaisons are outlined and distributed among different actors, This was shown in the third part of the analysis and can be seen, more generally, in the boundaries and overlapping between policies and regulatory frameworks.

About the specific ways in which risk is produced, the three preliminary categories of dynamic pressures leading to increasing vulnerability and subsequent risk (uncoordinated policies; poor urban management; and issues regarding access to information, perception of risk and communication between actors) were highly productive entry points to the case as they provided a general view of the current situation. Further complementary research on the historical processes leading to these three dynamic pressures, specifically about the history of the city and region prior to the regionalisation stage would greatly help to develop a more comprehensive and thorough understanding of the case. It seems especially relevant to further investigate the notion of 'mining culture' – which can be linked with a potential 'culture of resilience' among the city inhabitants – and the possibility to build agency and social mobilisation from there, all of which was left outside due to this paper´s scope.

A further potential avenue for future research that would complement the understanding of how risk is produced by extractivism concerns climate change and the occurrence of flash floods that may interact with tailing deposits on semi-arid areas such as Copiapó, and the extent to which mining operations are contributing, on different scales, to these phenomena.

Finally, there is an opportunity, taking this Working Paper as a starting point, to develop more speculative research on how the idea of region is being increasingly problematised, due to at least two trends: the creation of binational extractive 'special zones' across the Chile/Argentina border in the Andes; and the tendency of new mining projects to 'move south', due to water or mineral depletion in the north of Chile. This 'moving factories' of environmental degradation and risk production open multiple questions to the national development, especially regarding the compatibility of mining with other relevant activities located in the south, particularly agriculture. They also open the opportunity to re-evaluate the sustainability of mining operations in the long term in a 'business as usual' scenario, and the extent to which copper extraction is still relevant for our economy in the terms we know.

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