

## Accumulated Injuries of Environmental Injustice: Living and Working with Petrochemical Pollution in Nanjing, China

Alice Mah & Xinhong Wang

To cite this article: Alice Mah & Xinhong Wang (2019) Accumulated Injuries of Environmental Injustice: Living and Working with Petrochemical Pollution in Nanjing, China, *Annals of the American Association of Geographers*, 109:6, 1961-1977, DOI: [10.1080/24694452.2019.1574551](https://doi.org/10.1080/24694452.2019.1574551)

To link to this article: <https://doi.org/10.1080/24694452.2019.1574551>



© 2019 The Author(s). Published with license by Taylor & Francis, LLC.



Published online: 07 May 2019.



Submit your article to this journal [↗](#)



Article views: 5955



View related articles [↗](#)



View Crossmark data [↗](#)



Citing articles: 24 View citing articles [↗](#)

# Accumulated Injuries of Environmental Injustice: Living and Working with Petrochemical Pollution in Nanjing, China

Alice Mah and Xinhong Wang

*Department of Sociology, University of Warwick*

This article examines perceptions of living and working with toxic pollution in two periurban petrochemical areas in Nanjing, China, a heavily polluted megacity on the Yangtze River. Despite the concentrated geography of the petrochemical industry in Nanjing, protests over pollution have been small scale and highly localized, paralleling dynamics in many “cancer villages” of rural China. This contrasts with high-profile anti-PX (paraxylene) protests that have happened in Xiamen, Dalian, and other cities in China over the past decade. This article draws on twenty-five semistructured interviews and participant observation with workers and residents in both petrochemical areas. We extend the idea of the “hidden injuries of class” (Sennett and Cobb 1972) to analyze the cumulative effects of social and environmental inequalities in China, contributing to interdisciplinary debates about environmental justice and health, environmental pollution in China, and the lived experiences of toxic geographies. We argue that people living and working with petrochemical pollution in Nanjing, China, experienced accumulated injuries of environmental injustice: multilayered and intersecting effects on health and well-being, which reflect social inequalities between different populations. Accumulated injuries of environmental injustice emerged in interrelated ways: epistemic injustices about toxic exposures; unequal and inadequate compensations for environment harm; and collective frustrations over political powerlessness. The research has wider implications for analyzing the complex social effects of living and working with environmental injustice in different places around the world. **Key Words:** *China, environmental health, environmental justice, petrochemical industry, toxic pollution.*

本文检视中国南京这个座落于长江沿岸饱受严重污染的大都会中的两个市区外围石化工业地区，对于和有毒污染物共同生活与工作的认知。尽管石化工业在南京的集中地理，对于污染的抗议却往往规模小且高度在地化，并与中国农村诸多“癌症村”的动态相似。这与中国过去十年来在厦门、大连以及其他城市中高调反对PX（对二甲苯）的抗议活动形成对比。本文运用在两个石化工业地区中对工人与居民的二十五个半结构访谈和参与式观察。我们延伸“阶级隐而不显的伤害”之概念（Sennett and Cobb 1972），分析中国社会与环境不均的积累效应，并对环境正义与健康、中国的环境污染，以及有毒地理的生活经验之跨领域辩论做出贡献。我们主张，在中国南京受到石化污染的地区生活与工作的人们，经历了环境不正义的累积伤害：对健康与福祉的多层级与相互交织之效应，并反映不同人口之间的社会不均。环境不正义的累积伤害，以相互关联的方式浮现：有关毒物暴露的认识论上的不均；对环境伤害不均且不足的赔偿；以及对政治无权的集体挫败。本研究对于分析在世界各地与环境不正义共同生存与工作的复杂社会效应有着更为广泛的意涵。 **关键词：** *中国，环境健康，环境正义，石化产业，有毒污染。*

Este artículo examina las percepciones sobre vivir y trabajar con polución tóxica en dos áreas petroquímicas periurbanas de Nanjing, China, una megaciudad altamente contaminada situada sobre el Río Yangtze. A pesar de la geografía concentrada de la industria petroquímica de Nanjing, las protestas contra la polución han sido limitadas y altamente localizadas, mostrando la dinámica del paralelismo de muchas “aldeas del cáncer” de la China rural. Esto contrasta con las protestas de alto perfil anti-PX (paraxileno) que han ocurrido en Xiamen, Dalian y otras ciudades chinas durante la pasada década. El artículo se basa en veinticinco entrevistas semiestructuradas y observación participativa con trabajadores y residentes en las dos áreas petroquímicas aludidas. Ampliamos la idea de las “heridas ocultas de clase” (Sennett y Cobb 1972) para analizar los efectos acumulativos de las desigualdades sociales y ambientales de China, contribuyendo a

© 2019 The Author(s). Published with license by Taylor & Francis, LLC.

This is an Open Access article distributed under the terms of the Creative Commons Attribution-NonCommercial-NoDerivatives License (<http://creativecommons.org/licenses/by-nc-nd/4.0/>), which permits non-commercial re-use, distribution, and reproduction in any medium, provided the original work is properly cited, and is not altered, transformed, or built upon in any way.

los debates interdisciplinarios sobre justicia ambiental y salud, la contaminación ambiental en China y las experiencias vividas de las geografías tóxicas. Sostenemos que la gente que vive y trabaja expuesta a la polución petroquímica en Nanjing, China, sufre lesiones acumuladas de injusticia ambiental: efectos multicapa e intersectoriales sobre la salud y el bienestar, que reflejan las desigualdades sociales entre diferentes poblaciones. Las heridas acumuladas de injusticia ambiental emergieron de maneras interrelacionadas: injusticias epistémicas alrededor de exposiciones tóxicas, compensaciones desiguales e inadecuadas por daño ambiental, y frustraciones colectivas sobre impotencia política. La investigación tiene implicaciones más amplias para el análisis de los complejos efectos sociales de vivir y trabajar con injusticia ambiental en diferentes lugares alrededor del mundo. *Palabras clave:* China, industria petroquímica, justicia ambiental, polución tóxica, salud ambiental.

The evening sun sets over the sports field of a state-owned petrochemical factory in Nanjing, where people of various ages are jogging, stretching, and walking. The petrochemical factory is located next to a middle school, apartment buildings, and shops, south of the Yangtze River. Inscribed above the stadium entrance are the words: “Healthy life, happy work.” Similar sayings line the walls of petrochemical factories across Nanjing: “Create real safety, care for employee life”; “Bearing in mind social responsibility, abide by the concept of integrity.” Echoing the corporate social responsibility catchphrases of multinational petrochemical corporations, these slogans also link to propaganda posters around the city promoting “socialist core values” and Xi Jinping’s vision of the “Chinese Dream.” Yet beneath the veneer of “harmonious society,” there is a wide gap between the slogans and everyday life in petrochemical areas in Nanjing.

Much scholarly attention has focused on mass anti-paraxylene (PX) protests against petrochemical companies in China (see Lee and Ho 2014; Gu 2016; Steinhardt and Wu 2016). The first large-scale protest in China against a PX petrochemical project occurred in Xiamen in 2007 and led to the relocation of the project to another city where there was less public resistance.<sup>1</sup> Since then, anti-PX protests have occurred in a number of cities across China, including Dalian, Kunming, Maoming, and Chengdu, among others. Our research shifts attention from large-scale environmental protests to everyday experiences of petrochemical pollution in urban China, focusing on the case of Nanjing. Despite the concentration of the chemical industry in Nanjing, protests over pollution have been relatively small scale, involving local residents in the immediate vicinity of industry seeking compensation for damages. What explains the lack of large-scale opposition to the petrochemical industry in Nanjing?

This article examines narratives about pollution, health, and industry among workers and residents in two periurban petrochemical areas in Nanjing. The research is based on twenty-five semistructured interviews and participant observation with workers and residents in both petrochemical areas. It was conducted as part of a large European Research Council-funded project “Toxic Expertise” on the global petrochemical industry in relation to debates about expertise and environmental justice, with international case studies in the United States, Europe, and China. We argue that people living and working with petrochemical pollution in Nanjing, China, have experienced *accumulated injuries of environmental injustice*: multilayered and intersecting effects on health and well-being, which reflect social inequalities between different populations. These accumulated injuries were embodied both individually and collectively, and they revealed combined traumas of socioeconomic decline, environmental contamination, illnesses, and political resignation. In particular, people experienced anxieties about health risks and deeply ambivalent attitudes about their capacity to change their local environment.

Our analysis extends the idea of the “hidden injuries of class” (Sennett and Cobb 1972) to analyze the cumulative effects of social and environmental inequality in China. In the postwar decades of a rising middle class in the United States, the hidden injuries of class evoked a crisis of self-respect and dignity among blue-collar workers, despite increasing material power: “the feeling of not getting anywhere despite one’s efforts, the feeling of vulnerability in contrasting oneself to others at a higher social level, the buried sense of inadequacy that one resents oneself for feeling” (Sennett and Cobb 1972, 59). With the unprecedented growth of China’s middle class alongside deepening social inequality, internal conflicts have also emerged for many people who are disappointed with “the insufficient improvement in

lives amid rapid economic growth” (Tsinghua sociologist Guo Yuhua, as cited in Osnos 2014, 272). The “Chinese dream” has been promoted by the Chinese Communist Party as a collective national pathway toward prosperity and success, challenging yet mirroring the myth of the American dream (Bakken 2018).

The tremendous gaps between societal expectations and lived experiences in China are particularly evident for people in heavily polluted places, which typically have high levels of socioeconomic deprivation and vulnerable populations (Shapiro 2012; Liu, Liu, and Zhang 2014; Yang 2016). Environmental justice research, including much scholarship within human geography, has shown that low-income, ethnic minority, and marginalized people face the heaviest burdens of toxic pollution (Pellow 2007; Schlosberg 2007; Bullard and Wright 2009; Walker 2012). Although this environmental justice research has thus far been heavily centered on U.S. case studies (Reed and George 2011), China is no exception. Residential areas in close proximity to petrochemical facilities represent just one of many landscapes of environmental injustice in China. Amidst rising public discontent over pollution, in 2013 the Chinese government admitted the existence of hundreds of “cancer villages” in rural China (Gao 2013; Lora-Wainwright 2017).

Environmental justice was the first environmental discourse that was advanced by people of color in the United States, and it brought together tactics and energies from the civil rights, antitoxic, and community and occupational health movements (Bullard and Wright 2009; Taylor 2014). Environmental justice demands a focus not only on distribution but also on recognition and participation, as interlinking areas of concern (Schlosberg 2007). Since the 1990s, the environmental justice movement has expanded beyond its original focus on environmental racism to include other geographies and socioeconomic factors (Agyeman et al. 2016; Pellow 2007). It has also traveled to places beyond the United States, with different reformulations and adaptations. Despite its resonance with environmental problems in China, the concept of environmental justice has not been taken up as a mobilizing discourse within Chinese civil society, although it has been increasingly discussed within academic research in China (see Quan 2002; Ke 2005; Liu, Liu, and Zhang 2014; Mah and Wang 2017).

Although injustice is evoked within debates about environmental justice, we argue that the concept of injustice is more palpable and salient than justice (see Fricker 2007; Barnett 2017), particularly in the absence of environmental justice movements or local environmental justice framings. In this article, we consider everyday forms of environmental injustice, through analyzing accumulated injuries of living and working in polluted petrochemical areas with severe yet normalized toxic exposures. Accumulated injuries relate to the “slow violence” (Nixon 2011; Davies 2018) of environmental devastation that occurs in the everyday lives of poor and marginalized communities, beyond the media spectacle surrounding large disasters and protests. These manifest as unequal, multilayered, social effects of living and working in polluted environments in China, within a periurban industrial context. As Holdaway (2013) argued, some of the greatest health risks from pollution concentrate in periurban areas in China, “where agricultural and industrial activities intermingle, and infrastructure, institutional and governance capacity are weak” (270).

In this article, we first situate our research within the context of petrochemical pollution and environmental protests in China, before elaborating on our case study methodology. Then, we present our research findings, arguing that accumulated injuries of environmental injustice for people who live and work with petrochemical pollution in Nanjing emerged in interrelated ways: epistemic injustices about toxic exposures, unequal and inadequate compensations for environment harm, and collective frustrations over political powerlessness. We conclude by discussing the wider significance of the research for examining the cumulative social effects of working and living in toxic environments.

## **Petrochemical Pollution and Environmental Protests in China**

The health effects of exposure to toxic petrochemicals include cancer, respiratory illnesses, and neurological damage (World Health Organization 2014). The negative social, health, and environmental effects of the petrochemical industry on “fenceline” communities around the world have been widely researched, from the petrochemical corridors of “Cancer Alley” in Louisiana in the United States, to “Cancer Valley” in Sarnia, Ontario, to

urban slums in Argentina (Allen 2003; Auyero and Swistun 2009; Bullard and Wright 2009; Wiebe 2016; Davies 2018). In particular, researchers and activists have focused on the environmental justice and health struggles of black, indigenous, and minority ethnic populations who inhabit these polluted communities. Despite some environmental justice success stories, resulting in relocation or compensation, many petrochemical fenceline communities around the world continue to experience high levels of toxic exposure. Where there have been environmental justice wins, there have also been losses, as toxic hazards move to communities with weaker political voices.

The petrochemical industry has played a crucial role in China's rapid economic growth, but it has also caused repeated environmental conflicts. In the twenty-first century, China emerged as a global leader in the petrochemical industry, driven by its national quest for self-sufficiency. The petrochemical industry is considered one of the state's "pillar industries" and is dominated by three giant state-owned companies: Sinopec Group, China National Petroleum Corporation (CNPC), and China National Offshore Oil Corporation.<sup>2</sup> Despite the Chinese government's repressive policies against mass demonstration, people throughout China have protested against large-scale petrochemical (PX) projects, in the form of "taking a stroll," from Xiamen (2007) and Maoming (2014) in the south, to Dalian (2011) and Longkou (2016) in the north. Much scholarship in China has focused on the dynamics of environmental activism, noting the relative power of urban middle classes in campaigning for change but the lack of power of poor and rural populations (J. Chen 2010; Lee and Ho 2014; Gu 2016; Steinhardt and Wu 2016; Lora-Wainwright 2017).

The petrochemical industry is just one of many polluters in China, and it is not the worst offender, as compared with heavy metals mining, for example. The anti-PX protests, however, have political as well as symbolic significance. After the first mass anti-PX protest in Xiamen in 2007, PX effectively became a byword for toxic industry in China. There have been some notable cases of petrochemical accidents leading to deaths, injuries, and evacuations, including petrochemical plant explosions in Jilin in 2005 and chemical blasts in Tianjin in 2014. Media reports have also drawn attention to petrochemical cancer villages, such as the communities living

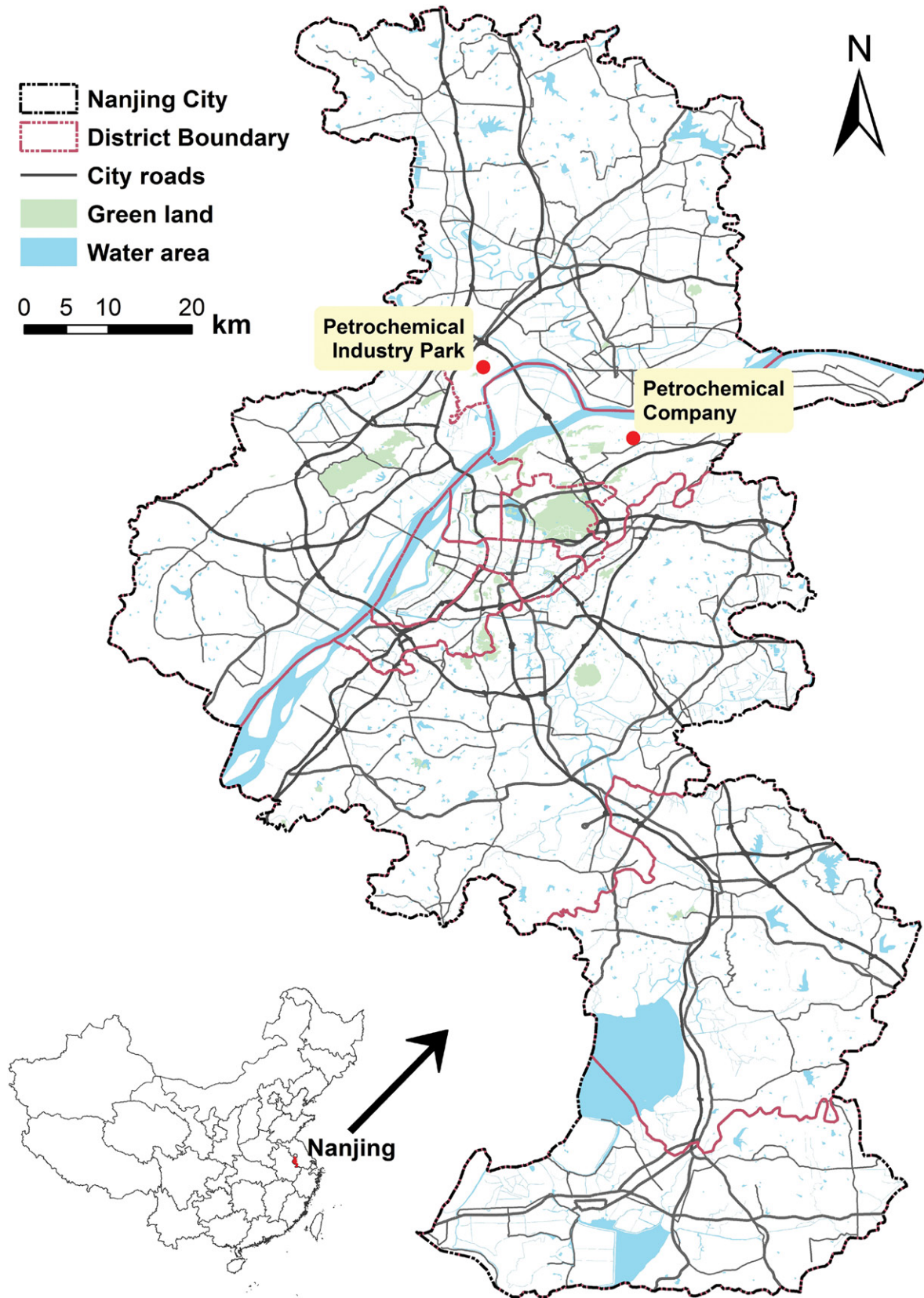
nearby Sinopec Zhenhai Refining and Chemical Company in Ningbo of Zhejiang Province and Jinling Village near Sinopec Qilu Petrochemical Company in Zibo of Shandong Province (Chen 2012; Chai and Chen 2016).

Rather than focusing on protests, disasters, or cancer villages, our research examines the everyday experiences of people who live and work with petrochemical pollution in China. This approach resonates with ethnographic studies that have examined the ambivalence of workers and residents living in polluted petrochemical areas around the world, who are concerned about impacts on environment and health but rely on industry for jobs (López-Navarro, Tortosa-Edo, and Llorens-Monzonís 2015; Neumann 2016; Jovanović 2018). Our research reveals dynamics that challenge universalizing frameworks about industry, pollution, and communities. In China, with a lack of publicly available information on corporate polluting practices, local demographic information, or epidemiological studies, it is difficult to assess the levels of pollution or risk in a given area. Furthermore, concerns about petrochemical hazards are often eclipsed within the context of multiple sources of pollution, including wider concerns about urban air quality, particularly in socioeconomically marginalized communities.

Petrochemical companies operate across multiple territorial and networked scales, in a complex global political ecology of material, socioeconomic, and environmental dynamics (see Swyngedouw and Heynen 2003). The levels of risk within petrochemical fenceline communities vary across and within different regional and national contexts, with different types and sizes of petrochemical facilities, regulatory frameworks, monitoring and polluting practices, corporate players, and proximity to rural or urban populations. In China, the staggering scale of environmental contamination, the powerful legacy of state-owned enterprises, and the constraints on civil society together create a context that is both extreme and typical, where one of the most intense accumulated injuries is to people's sense of agency, evident in the common refrain, "But what can we do?"

### Case Study Methodology: Periurban Petrochemical Areas in Nanjing

The majority of the Chinese petrochemical industry is located in eastern and northwestern China, as



**Figure 1.** Map of Nanjing petrochemical industrial areas. *Source:* Nanjing hundred year time space construction and service (Jiang 2017). Prepared by Yiyun Chen. (Color figure available online.)

well as in coastal areas (Zhang, Dong, and Tian 2009; Wu et al. 2015). Our research focused on the case study of periurban Nanjing, a heavily polluted megacity along the lower reach of the Yangtze River, which is encircled by four heavy chemical industry areas and surrounded by hills in three directions and water in one direction. The city government of Nanjing has recognized the dangerous geographical situation of the city, which traps polluted air and lacks an easy escape route in the event of an uncontrollable pollution incident. Nanjing has a strong historical industrial legacy, dating from its first years at a national hub for the chemical industry in the 1950s, and it remains one of the top national petrochemical bases within China.<sup>3</sup> The oil and petrochemical industry in China underwent significant restructuring in the late 1990s, based on the state's principle of "grab the big, release the small" (Nolan 2001; Lin 2008; Tobin 2008), which aimed to centralize power in large state-owned enterprises, while closing others, to compete in the global economy. Many chemical factories in Nanjing were closed or relocated to a large chemical industry park established in 2001 in the northeast of the city. Although small and medium-sized companies have been closed or relocated, the locked-in political economy of the petrochemical industry has made it difficult for the city government of Nanjing to relocate large-scale state-owned petrochemical enterprises (Shi 2015; Wu et al. 2015).<sup>4</sup> Furthermore, relocating heavy industry is not a straightforward environmental solution; Chinese environmental scientists have argued that moving heavy industry to the chemical park in Nanjing has in fact concentrated risk (Meng et al. 2014; Kang et al. 2017).

We decided to focus on Nanjing as a case study because of its role as a leading traditional base of the petrochemical industry in China, its high levels of pollution and environmental risk related to the concentration of heavy industry, and the lack of widespread protests over pollution in the city.<sup>5</sup> The case study is both illustrative and exemplary (Flyvbjerg 2001; Yin 2009), revealing dynamics within a particular type of petrochemical area, with common yet distinct features. It is also a "nested" case study because there are several petrochemical complexes within the city, concentrated in two main petrochemical areas in Nanjing (Figure 1). The first area is located in Nanjing Chemical Industry Park, which was established in 2001 in northeast Nanjing, as a

major national-level chemical industry park in Jiangsu Province.<sup>6</sup> It is a typical industry cluster that "consists of firms and related economic factors and institutions that draw productive advantage from their mutual proximity and connections" (Pillai 2006, 3). Nanjing Chemical Industry Park includes more than 130 companies, including state-owned, privately owned, and multinational enterprises. The second area is located south of the Yangtze River and includes a small number of large enterprises. Both petrochemical areas host special oil piers for ease of water transportation.

We conducted our research in two fieldwork trips to both petrochemical areas in Nanjing in March 2016 and September and October 2016.<sup>7</sup> The research included twenty-five semistructured interviews and participant observation with employees in petrochemical plants and related industries, retired workers, local taxi drivers, shop owners, migrant workers, residents, government officials, and village leaders in these two petrochemical industrial areas. We also interviewed local nongovernmental organization (NGO) representatives, researchers, and lawyers, to gain a wider understanding of the complex local environmental and political issues.

All research was conducted in accordance with professional sociological ethical guidelines of informed consent and confidentiality. We interviewed men and women, younger and older people, and migrants and traditional urban villagers, but we did not collect precise demographic information for reasons of anonymity and rapport, given the sensitivity of environmental topics in China. Access to participants was very challenging, and all interviews were arranged through gatekeepers and snowball sampling. The names of interviewees given are pseudonyms to protect the identities of research participants. The names of the specific villages and industrial enterprises we researched have also been anonymized.

In China, most petrochemical plants cluster in the periurban places where villages were originally located in the past, prior to urban development. When the petrochemical plants were originally constructed in the 1950s and 1960s, residential buildings for employees were also built nearby. During our research in Nanjing, this historical heritage was still visibly marked by place names such as Oil-petro Road, Petrochemical Road, and Petrochemical Village. For decades, the petrochemical company

employees, workers, and families were the main residents in these petrochemical fence-line communities, alongside the original villagers. The demographics of the petrochemical villages have gradually shifted since the 1980s, however, related to urban expansion and population migration since China's economic reform in the 1980s and the restructuring of state-owned enterprises in the late 1990s.

In the areas near petrochemical plants in Nanjing, the main population consisted of socioeconomically disadvantaged groups, including retired workers, villagers, and migrant workers. Petrochemical employees had started to move out of the petrochemical areas, seeking to escape the pollution, and also looking for better schools for their children. The petrochemical employees either sold or rented their houses to migrant workers, who were attracted by cheaper rents and job opportunities. Villagers also moved away for higher education or work, and the people who stayed were mostly senior citizens. At the time of our research, the majority of residents in these communities were migrant workers.<sup>8</sup> Although migrant workers were able to move to the periurban villages, the dichotomy hukou (house registration) system officially maintained their identities as countryside people.<sup>9</sup> Most migrant workers rented their houses, which meant that unlike urban workers and village farmers with permanent residential status, they were not eligible to receive compensation for damages to housing or land.

The petrochemical industry, in China as well as globally, is spatially integrated with related industries. In practice, it was very difficult to separate different industrial sources of pollution. Alongside petrochemical enterprises, other industries in these areas included transport, coal, fertilizers, logistics, and specialty chemicals, among others. Thus, although focusing on petrochemical industrial areas as a starting point for our investigations, our research also included perceptions of industrial pollution from multiple sources, which added to the accumulated injuries of environmental injustice.

## Accumulated Injuries of Environmental Injustice

We developed the concept of accumulated injuries to capture how people's injuries of health and well-being overlapped and intersected, echoing the "triple jeopardy" of social, environmental, and health

inequalities (Pearce et al. 2010) involving multiple forms of disadvantage. Our idea of accumulated injuries of environmental injustice emerged from ethnographic findings and extends the sociological concept of the "hidden injuries of class" (Sennett and Cobb 1972), which focused on dislocations of social mobility among U.S. blue-collar workers to consider wider, cumulative effects of social and environmental inequality within China across different social groups. These "injuries" include the complex social, psychological, and material effects of environmental injustice and "slow violence" (Nixon 2011) and overt as well as hidden forms of wounding. Accumulated injuries of environmental injustice in periurban Nanjing were experienced unevenly, demonstrating social inequalities across different populations, particularly between permanent and migrant workers and residents. These injuries were both hidden and in plain sight, figurative as well as literal, and psychological as well as material and visceral. This connects with Walkerdine and Jimenez's (2012) research on the psychosocial and affective impacts of deindustrialization for communities in Wales, which emphasizes the anxiety, hurt, and pain of people living with chronic insecurity and industrial blight (see also Mah 2012).

The concept of accumulation of injuries resonates with the epidemiological terms of *cumulative incidence* and *cumulative risk*, used for measuring disease frequency and rates (Brown 1993). The basis for our analysis is qualitative and ethnographic, rather than quantitative. This follows a turn to qualitative approaches in environmental health research, which offer a way to produce community narratives that give voice to individuals and characterize the community (Brown 2011). The notion of accumulation also has an important temporal dimension, which is particularly relevant for studies of toxic geographies. As Murphy (2013, 107) argued, the effects of toxic hazards often accumulate over generations, allowing past pollution to "defer its violence to the present" (see also Davies 2018).

Accumulated injuries of pollution reflect the lived experiences in *hazardscapes*, a concept within the sociological environmental health literature used to describe the cumulative hazards within a geographical area, including not only quantifiable health hazards but also perceptions of risk (Corson 1999; Cutter 2002; Mustafa 2005).

Our research contributes to interdisciplinary debates about lay understandings of environmental



health and justice in “contaminated communities” (Allen 2003; Edelstein 2004; Brown 2011), environmental pollution in China (Tilt 2006; Bullard and Wright 2009; Lora-Wainwright 2017), and lived experiences of toxicity and exposure (Petryna 2002; Allen 2003; Auyero and Swistun 2009; Davies 2018; Jovanović 2018). More specifically, it contributes to debates about the politics of compensation in toxic spaces and the wider question of whether it is ever possible to put a value on human life (Petryna 2002; van Rooij et al. 2012; Barry 2013; Gilbert and Ponder 2014; Davies and Polese 2015). People living and working in petrochemical areas in Nanjing, like in many other parts of China, have limited access to information about health risks related to pollution and few opportunities to seek compensation for damages, mitigation, or accidents.

We argue that accumulated injuries emerged in three interrelated ways, relating to environmental injustices of distribution, recognition, and participation. First, accumulated injuries were based on epistemic injustices, where there was widespread local knowledge about illnesses from environmental exposures, yet these lacked official recognition. Second, accumulated injuries were experienced in the uneven and inadequate financial compensations offered by polluting enterprises for environmental harms. Third, accumulated injuries related to agency, a collective sense of powerlessness and resignation about the possibility of change, accentuated by environmental injustices of toxic exposures.

### **Epistemic Injustices: “It Affects Our Life Span, Apparently”**

The majority of people in petrochemical areas of Nanjing, both workers and residents, observed that there were health effects due to pollution, despite having different socioeconomic statuses and perceptions of risk. The acknowledgment yet relative tolerance of health risks in petrochemical areas of Nanjing represents a form of epistemic injustice. Fricker (2007) identified two main kinds of epistemic injustice: testimonial injustice and hermeneutical injustice: “Testimonial injustice occurs when prejudice causes a hearer to give a deflated level of credibility to a speaker’s word; hermeneutical injustice occurs at a prior stage, when a gap in collective interpretive resources puts someone at an unfair disadvantage when it comes to making sense of their

social experiences” (1). Hermeneutical injustice was particularly pronounced for marginalized petrochemical villagers in Nanjing, where the health risks of pollution were normalized.

The most commonly reported illnesses both in the communities and in the plants were cancer and nasitis. Some local residents said that 70 percent of children in their community near the petrochemical cluster had nasitis. When asked why so many children got sick, but not adults, a petrochemical worker who had nasitis replied: “People pay more attention to their children’s health, and always take the children for checking up whenever there is a small problem. But for adults, sometimes people just ignore it and do not go to hospital as often as sending their children there” (interview, from field notes, March 2016). Other workers and residents said that cancer in particular had increased in the past fifteen years.

People’s reasons for believing that there were health effects ranged from informal sources of information, to knowledge of people who had suffered illnesses, to personal experience of illnesses, to intuition. In other words, health impacts of petrochemical pollution were sensed, observed, considered, or experienced, but these were normalized, alongside a lack of publicly available information about toxic exposures. This echoes the findings of Davies (2018), who highlighted the “slow observations” of communities who bear witness to pollution in Louisiana’s Cancer Alley. As one petrochemical company worker explained, “Of course the chemical plant affects our health, however whether it is really caused by the chemical plant, is difficult to say” (interview, Wu, March 2016).

Our research findings differ from Tilt’s (2006) study of the different risk perceptions of industrial pollution among occupational groups in rural China, where industrial workers perceived fewer health risks than farmers and community and health service workers. If anything, workers in our research reported more health effects than villagers, who were more likely to say, “I do not know, I am not familiar with that,” a typical response to outsiders’ questions in rural China (field notes, September 2016; see also Lora-Wainwright 2017). The general acceptance of health risks on the part of the industrial workers in our study could be accounted for by two factors. First, the petrochemical enterprises implicitly acknowledged occupational health problems related to working in the plants, particularly

the “frontline” toxic jobs, offering medical checkups, rehabilitation retreats, and early retirement to the worst affected. Second, the more privileged petrochemical employees were able to protect themselves, compared with more precarious migrant workers, by moving away from the immediate proximity of industrial plants to less polluted areas and by working in less dangerous jobs.

Many local accounts emphasized the common-sense, self-evident, and widely accepted local knowledge about toxic exposures in the community. For example, petrochemical worker Li thought that there was a connection between health and pollution on an intuitive level: “Over these years, I feel there are more people getting cancer. Not sure if it’s associated with the working environment. ... Somehow I feel there must be some connection” (interview, March 2016). Similarly, petrochemical worker Yang highlighted intuitive knowledge about the links between health and pollution:

There is harm to health. The exhaust from the chemical factories ultimately affects our body. Otherwise, why would we retire at the age of fifty? Especially if you are not feeling well, you can retire in your forties. ... For workers, we retire at fifty. Everyone knows there’s danger and radiation, so it’s best to retire early. (Interview, March 2016)

An elderly female villager described how her forty-two-year-old daughter, who worked as a lab analyst in the petrochemical refinery, was eligible for health compensations due to the toxic exposures involved in her job. Her daughter had a low white blood cell count. Her work was particularly dangerous because it involved taking oil samples and working closely with toxic substances. Each year, the company provided her daughter and other lab employees with the opportunity to rest for one week at a company rehabilitation center (field notes, September 2016). Another petrochemical employee confirmed that for cases like the villager’s daughter, early retirement would be an option:

We have health checking once per year; we have a special department in charge of this. For people who work at positions that are toxic or dangerous, if they work there for eight years, they can retire earlier. For instance, if one works in this company for thirty years, but twenty-two years in the office, and eight years in a toxic and dangerous position, then if the retirement age is fifty-five, he can retire by fifty. (Interview, October 2016)

Although several workers attributed early retirement to occupational risk, early retirement policies might have also related to labor management policies of state-owned enterprises to shed surplus labor, rather than social welfare entitlements. Since 1997, pensions have no longer been directly provided by state-owned enterprises (Smyth, Zhai, and Hu 2001).

Some petrochemical company workers felt that they were at particularly high risk from toxic exposures due to the agglomeration of polluting industries where they worked, including fly ash, coal, and sulfur. For example, Liu, a petrochemical company worker, said that working with coal dust “definitely affects human health and respiratory tract. Specifically, it affects our trachea. As to potential effect, it’s a lot more. For example, it affects your life span, apparently. It goes without saying” (interview, March 2016).

Other workers showed knowledge of occupational diseases in their workplaces but emphasized that they were at a distance from the frontline of exposure. Petrochemical worker Zhang reported that a number of other workers at his plant were diagnosed with cancer during medical checkups, but those who were diagnosed were not from his line of work (interview, September 2016). This theme of differentiation between one line of work and another was echoed in Wong’s narrative.

*Wong:* Since I came to this chemical enterprise, I have always known that chemical enterprises do harm to human health.

*Researcher:* What do you think of the enterprise now, compared to other enterprises, so many years later?

*Wong:* I’m not working on the frontline; therefore, I’m better off. I have no direct contact with those people working on the frontline. (Interview, petrochemical worker, September 2016)

Even the most ambivalent responses among workers about the connections between pollution and health did not go so far as to outright deny them. For example, this was evident in the following exchange with Tian, a petrochemical worker who was reluctant to make any statements about health and pollution:

*Researcher:* Since you work the chemical industry nearby, do you find this affecting your health in a different way from other places?

*Tian:* I guess more or less as we have the chemical industry in the neighborhood.

*Researcher:* You mean there might be some impact on health?

*Tian:* Yeah, possibly. (Interview, March 2016)

Despite the acknowledgment of occupational health risks by many workers, they often felt that the benefits of working in large state-owned petrochemical plants outweighed the possible risks. State-owned enterprises typically had better health and safety procedures than smaller enterprises in China, particularly for regular workers (see M.-S. Chen and Chan 2010; He et al. 2014; Ho 2017). Although many benefits had been eroded, skilled workers had relatively high wages and job stability, and some hoped that their children would work in big state-owned petrochemical factories in the future. According to Warner (2000), the *danwei* (work unit) in Communist China prior to restructuring “provided not only an economic and industrial structural form but also a political and psychological one” (4). The most privileged urban workers, known as *zhuren* (masters), were employed in state-owned enterprises, and they were provided with job security, good working conditions, housing, and welfare facilities.

With restructuring of state-owned enterprises, however, many of these benefits were being eroded. Some workers at petrochemical enterprises in Nanjing expressed frustration at the loss of benefits over the years, combined with problems of pollution and occupational illnesses. “Our enterprise used to be a big commune,” said one petrochemical worker (interview, Wong, September 2016). “The hospital is now gone, and so is the Design Institute.” Another worker echoed this complaint:

In terms of our income, there has been less welfare since Xi took office. The welfare system has been reformed. It is stipulated that everyone be given 500 yuan on occasions of public holidays. We would even get mooncake for the Mid-Autumn Festival, and glutinous rice dumplings for the Dragon Boat Festival before. There weren’t such things last year. (Interview, Zhang, September 2016)

According to a village leader in a street near one petrochemical area, few villagers worked in the petrochemical plant or related sectors because the petrochemical company recruited university graduates with technical knowledge (interview, Zhao, March 2016). In the past, villagers had benefited from the petrochemical plants through working there or making economic income by providing related

services such as transportation or construction. The main complaint of the villagers was the dust from heavy factory truck traffic and poor road conditions:

The road condition in our village is very bad; the factory trucks all pass through here. In 2003, we repaired it by ourselves, but after only one year, it was broken again. There is a lot of dust at night; the trucks go through our village with thundering noise. Our village wants to do something, but money is a big problem; we can only make small repairs. (Interview, Zhao, village leader, September 2016)

The reports of noise and dust pollution, which have been associated with sleep disruption, anxiety, and mental health disorders, echoed findings from other low-income, polluted fenceline communities around the world; for example, in the Port of Long Beach, California (Gottlieb and Ng 2017).

Although health effects from pollution were widely accepted by workers and residents alike, with a wide range of sources for local knowledge, there were no official reports or epidemiological studies to which they could turn. Implicitly, their claims were accepted by state-owned enterprises, through offering financial compensation for polluted land, piping in clean water to communities when water supplies were contaminated, and offering health retreats and early retirement for workers. When we asked petrochemical workers whether the detection of cancer within regular medical checkups was treated by the petrochemical enterprises as an occupational disease, however, the answer was decidedly “no.”

Local people had lay knowledge about the health risks of pollution, but this was uneven and fragmented. Some environmental NGOs have worked to improve problems of industrial pollution in Nanjing, but their activities have been carefully monitored and restricted by the government (field notes, September 2016). This shows the limits of the role of alliances between professional scientists and civil society (Allen 2003; Ottinger and Cohen 2011) in advocating for change, in a case where the risks from toxic exposures are plainly evident, particularly for marginalized migrant workers, yet civil society action is limited.

### **Valuing Life: Unequal and Inadequate Compensations**

Workers and residents in our study reported that farmers and other residents in their communities had

sought financial compensation for damages to land, but these were possible only in cases of acute contamination (evident in dead fish, accidents, or land on the immediate fenceline). Instead of joining petitions for compensation, workers and residents attempted to mitigate their circumstances by closing their windows on days with high pollution, occasionally reporting pollution by phoning the environmental protection hotline, and taking holidays to places with cleaner air. These practices resonate with findings in many other communities exposed to pollution (see Auyero and Swistun 2009; Cousins 2016; Lora-Wainwright 2017; Allen 2018).

In 2005, during the construction of the BASF-YPC joint venture petrochemical site in Nanjing Chemical Park, there were a number of protests and demonstrations by local residents. According to Grabicki (2015), author of the commemorative book about the history of BASF in China, the protests happened because 200 people were still living on the fenceline of the plant first due to a “planning error by the regional authorities” and second because of an ammonia spill following a malfunction (194–95). Grabicki (2015) argued that BASF understood the importance of gaining “trust and support from the local population” (195–96), and he suggested that some of the residents’ claims for compensation were dubious; for example, through purchasing new housing on the fenceline of the plant, inflating costs of compensation for a turtle farm, and exploiting the leverage of petitioning a multinational Western company. These corporate fenceline dynamics have parallels with Barry’s (2013) research findings about disputes over compensation from British Petroleum (BP) for beehives and trees during the construction of the Baku–Tbilisi–Ceyhan oil pipeline.

At the time of our research in 2016, workers and residents recalled protests over compensation, but these were primarily described as periodic or settled, rather than ongoing. Farmers had received compensation for contaminated land and dead or distressed animals. For example, one petrochemical worker said:

People came to the company to protest [“make noise”], rather than to the local government. They came to ask about their houses, demolition, and relocation, or else to protest when the fish in their privately owned fish ponds died. (Interview, Sun, March 2016)

Another petrochemical worker reported a recent incident, where poisonous gas had leaked out of a

pipeline and caused harm to farmers. The farmers were paid compensation by the factory, and this had ended the dispute: “The farmers could be dismissed just by paying them” (interview, Wong, September 2016). This relates to van Rooij et al.’s (2012) argument that seeking compensation represents a “trap” within community-based pollution regulation in China. Furthermore, the uneven and inadequate compensations demonstrate how Chinese citizens have been neglected not only by petrochemical enterprises but also by the state. This resonates with research by Davies and Polese (2015) on the de facto state abandonment of people living in Ukraine’s nuclear exclusion zone.

None of the people whom we interviewed said that they had personally protested or complained about polluted land in order to seek compensation. Rather, protests were reported as the actions of others, mostly people living on the immediate fenceline of industry, and related to acute contamination. Hu, a petrochemical company worker, described the compensation process as nearly complete:

*Hu:* The government has almost finished dealing with most of this. Because there was a huge demolition recently. All of the farms have been taken over. First of all, they put the torch there. Hens won’t lay eggs consequently.

*Researcher:* Hens won’t lay eggs?

*Hu:* That’s right. The sky is always like that, being so bright with the torch nearby. Imagine all the hens looking at the torch. (Interview, Hu, petrochemical worker, March 2016)

For most petrochemical workers and village residents, the main environmental issue that they perceived was air pollution, either as bad smells or as dust. The severity depended on the wind direction and the closest industries, which included a number of industries related to petrochemicals. Some of the workers thought that the air quality and health impacts were worse within the companies than in the communities because they were surrounded by power plants, oil refineries, and other polluting industries (field notes, March 2016).

One of the main possibilities for local residents to take action about pollution was to call the hotline of the government’s Environmental Protection Bureau. This did not offer the possibility of financial compensation for complainants, but it did have the

possibility of imposing fines on companies. Although some people said that they regularly complained to the Environmental Protection Bureau, most people thought that this was ineffective.

Compensations were also described, in some cases, as voluntary. One petrochemical enterprise that had contaminated its water supply installed a water treatment facility to provide each community with clean water. According to Hu:

Most people drink the pure water. ... This shows the idea of humanism is being gradually realized in the concept behind what the government is doing. It's not like we can just discharge water and leave it to the lower course of the river for purification. If there's any risk, we all suffer. (Interview, petrochemical worker, March 2016)

This account shows a sense of trust in the enterprise in terms of social responsibility, despite the problem of contamination. It also reveals a cautious note of optimism for the future, of a gradual realization of the government's plan. Hu explained further that he frequently called the government hotline to complain about night smells, which affected him even in a community 1.5 km away from the industry. He was convinced that the environmental monitoring hotline was improving, with more fines given to polluting enterprises, which had not been the case in the past. Ultimately, Hu believed in an economic development trade-off for living and working with petrochemical pollution: "The development of mankind is supported by the existence of chemical industry, like nuclear power plants. Its existence means some degree of danger" (interview, March 2016). This calculated balance between health and economic development corresponds to findings about workers in other industrial polluted communities (see Mah 2012; Neumann 2016; Jovanović 2018). It also suggests a "hidden injury of class" (Sennett and Cobb 1972) in the conflict of different personal and societal values.

Petrochemical enterprises have offered compensation to those people who are most immediately affected by pollution, either through accidents or through residence at the fenceline. In most cases, compensation is for traditional villagers (i.e., not migrants) who have witnessed direct losses of land and livelihoods from pollution. Workers who live in petrochemical areas, like villagers, have raised complaints about smells through calling the Environmental Protection Bureau and received

alternative water supplies due to contaminated factory water. Companies have offered basic compensations to settle disputes and be able to carry on with their activities, but these forms of compensation have been very limited in terms of eligible recipients. Compensation for health problems associated with pollution was also extremely limited and only available indirectly, through offering health checkups, health retreats, and early retirement to workers in high-risk jobs. This case falls short of offering even the "compensation trap" described by van Rooij et al. (2012), due to low levels of perceived political agency.

### Collective Frustration: "But What Can We Do?"

Our research revealed an overarching narrative of collective frustration at political powerlessness, exemplified in the phrase, "But what can we do?" (field notes, September 2016). Although there were different levels of trust in industrial enterprises among the different populations living and working with petrochemical pollution in Nanjing, there was a common resigned attitude toward the status quo in relation to entrenched pollution and health problems. Very often, people would say, "We cannot do anything about it," or "What can we do?" This finding relates to Lora-Wainwright's (2017) idea of "resigned activism" within rural China but with a deeper bitterness. Like people living in Cancer Alley in Louisiana, people in petrochemical villages in Nanjing expressed their "toxic frustration" (Singer 2011; see also Allen 2003; Huber 2017; Davies 2018). When we asked one migrant worker why people do not file complaints about the pollution, he said, a bit angrily, "To report [the pollution situation]? For what? They are all the Communist Party's factories, so why do we complain to the Communist Party?" (field notes, March 2016).

Residents who were affected the most by the petrochemical industry in Nanjing were mostly socioeconomically disadvantaged groups, including retired workers, villagers, and migrant workers. For different reasons, they generally held a passive attitude toward the industry as a polluter. Compared to the people who have vocally opposed the planned siting of petrochemical projects in their communities in anti-PX protests, petrochemical fenceline communities in Nanjing have voiced little resistance. In addition, the ubiquitous environmental problems in

China, such as the rampant smog, have played the role of diminishing and naturalizing the severe situation of fenceline communities. For example, one migrant worker scoffed: “Environment? Everywhere is the same. Do you think the air is better in Xinjiekou [a central commercial area in Nanjing]? Clean places, only in the mountains” (field notes, September 2016). Because migrant workers continue to face few job opportunities in their hometowns, the benefit of employment clearly prevails over their worries about the environment or health, and this leads to the sacrifice of living amidst toxic pollution.

In one petrochemical village, we spoke with an elderly woman who was resting on a long brick laid bench along a path. She told us that most people who live in this place were nonlocals, including her family. When we discussed the pollution in the village and whether she had concerns about it, she replied: “Oh, so what? What could we do?” (field notes, September 2016). She then explained that because her family were not locals and nobody would really listen, they could not do anything. She was not eligible for free breast cancer and cervical cancer screening that was offered to female residents in the community with Nanjing household registrations (*hukou*). Then she reflected on what they could do, given their constraints as a migrant family: When there were holidays, they would go back to their hometown with their grandchildren, and the air there was good (field notes, September 2016). Several other residents and workers also discussed their practices of taking holidays for clean air, similar to the evacuation retreats organized for children in communities affected by the Chernobyl and Fukushima disasters (see Cousins 2016).

The phrase “used to it” was repeated frequently in the research. Chen, a petrochemical village leader said, laughing with irony: “Is there a strong smell here? You can smell it, but we cannot at all. We are used to it and completely unaware of it. Many things are not visible to our naked eyes.” Li, a petrochemical worker, said, “I am used to this place. It doesn’t matter much that it’s this bad” (interview, March 2016). Yang, another petrochemical worker, said, “We are all used to this situation in the environment. Sometimes they call up to report [to the Environmental Protection Bureau]. I don’t know the phone number, so I don’t know where to call. We simply shut the doors and windows. Nothing more than that” (interview, March 2016). These narratives

echo Stawkowski’s (2016) research findings, where the self-titled “radioactive mutants” in nuclear landscapes of Kazakhstan claimed that they were used to radiation.

Several of our research participants reported that petrochemical enterprises would secretly discharge chemical waste during the evenings when people had gone home, when nobody was on patrol, or when it rained. This was described as common practice, which people responded to by closing their windows. For example, Lin, a petrochemical worker, explained:

This enterprise sometimes would secretly discharge the wastes in the evenings. Now such a practice has been reduced, but not eliminated. Secretly discharging still takes place in the evening sometimes. We keep our windows closed in the evenings. (Interview, March 2016)

The common attitudes of resignation were typical of all of the different social groups, but the sense of frustration was deeper for villagers and migrants. As petrochemical village leader Chen explained, “Pollution? Dust, and as you say, smell, but we can’t see it. But what can we do? It has nothing to do with us, we even cannot enter the chemical plant” (interview, March 2016). Without access to what was happening inside the barred gates of petrochemical complexes, apart from sensing smells, seeing smoke, and experiencing illnesses, villagers had no official information about the impact of petrochemical plants on the environment or people’s health. This toxic frustration links to the problems of epistemic justice and uneven and inadequate compensations, coalescing together as accumulated injuries of environmental injustice.

## Conclusion

Petrochemical villages in Nanjing are marked by environmental injustice, not only in terms of the unequal distribution of environmental hazards in disadvantaged communities but also in the lack of recognition or political participation. Nanjing has a history of dependency on the state-owned petrochemical industry, which remains deeply embedded materially and culturally within the urban and industrial landscape. After decades of economic restructuring, frequent toxic explosions, and mounting pollution, the industrial social contract has started to fray.

The possibilities for political action to address toxic exposures in China are extremely limited, and ultimately people seek pragmatic solutions. Where possible, some people in the petrochemical villages of Nanjing have sought basic financial compensations from industry for acute loss of livelihoods and health, but these compensations have been inadequate and uneven, paralleling the politics of compensation and social welfare in toxic geographies around the world (Petryna 2002; van Rooij et al. 2012; Barry 2013; Gilbert and Ponder 2014; Davies and Polese 2015). Overall, residents and workers highlighted their lack of political power to campaign for justice, cleanup, or meaningful compensation, a stark reflection of the unequal politics of knowledge and science (Fricker 2007; Boudia and Jas 2014; Allen 2018). In the wider Chinese context, these injustices of political voice and power relate to collective attitudes of resignation and pragmatism among ordinary people coping with the immense problems of pollution (Lora-Wainwright 2017). The most common response among local people living next to petrochemical factories was a sense of frustration, reflecting the epistemic injustice (Fricker 2007) of knowing the negative health and environmental effects of petrochemical pollution, yet not having the power to do anything about it. This highlights the importance of examining cases of environmental injustice outside of Western democratic contexts.

Accumulated injuries of environmental injustice are evident in everyday communities throughout China, a country with unprecedented scales of industrial and urban development, considerable constraints on civil society, powerful state-owned enterprises, and multiple sources of pollution and risk. The concept of accumulated injuries demonstrates the cumulative, nested social, environmental, and health effects of living and working with toxic pollution and how these relate to intense inequalities. By focusing explicitly on environmental injustice, rather than the more abstract ideal of justice, we have underscored the relevance of attending to areas marked by the slow violence of environmental devastation. Accumulated injuries of environmental injustice in petrochemical areas in Nanjing were severe and unjust, despite the absence of overt disaster or protest. The concepts of accumulation, injury, and injustice offer scope for making nuanced global comparisons about the complex social, temporal, and spatial effects of toxicity and environmental justice.

## Acknowledgments

We thank our research participants in Nanjing for sharing their time and experiences with us. We are especially grateful to Yuanni Wang for excellent research assistance. Many thanks are due to Professor Nik Heynen and three anonymous reviewers for their useful comments. We thank Loretta Lou and Hannah Jones for valuable feedback on earlier drafts. An early version of this article was presented at the University of Kent Social Policy, Sociology, and Social Research Seminar Series.

## Funding

This project has received funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation program (Grant Agreement No. 639583).

## Notes

1. The plant was relocated to Zhangzhou in Fujian Province, where there have since been major explosions in 2013 and 2015.
2. This trio of national companies was formed in 1949 under the Fuel and Industry Department of China, and they were later transformed into state-owned enterprises in the 1980s. The industry was radically transformed following the "grab the big, release the small" policy adopted by the Communist Party of China in September 1997, which aimed to promote large state-owned enterprises, including joint venture companies (Nolan 2001; Smyth, Zhai, and Hu 2001; Lin 2008).
3. The traditional legacy of the petrochemical industry in Nanjing is exemplified by the failed "Donglian experiment" of the late 1990s. In January 1997, the State Council of the People's Republic of China "formally designated the petrochemical industry as the model industry for others to study in experimenting with the national holding company system" (Nolan 2001, 464). According to Lin (2008), "The most notable case of daring but ill-conceived experimentation" (74) was the Donglian experiment in Nanjing. This was a merger of four competing southern regional refining giants on the southeast coast of the Yangtze River into a single company, Donglian, as the largest enterprise group in China. Similar to many subordinate enterprises of Sinopec, the four merged companies had strong and distinct corporate identities (Nolan 2001; Lin 2008). The Donglian experiment ultimately failed, however, because it was not able to compete on a global level (see Nolan 2001; Smyth, Zhai, and Hu 2001; Lin 2008).
4. In 2014, the city government of Nanjing made a decision to close or relocate all remaining heavy

industries to the chemical park within ten years, although this has stalled in the face of vested interests of state-owned enterprises (Shi 2015). Local governments in China have also faced increased pressure since 2013 to meet environmental responsibility targets for emissions reductions and energy savings set by the central government (Goran 2017). Environmental responsibility targets have officially been in place since 1996, but they have been extended and enforced since 2013.

5. At the time of writing, the most significant public environment protest to have happened in Nanjing was a campaign in 2011 to save urban trees (see Steinhardt and Wu 2015).
6. There are in total twelve national-level industry parks, including four chemical parks in Jiangsu Province: Nanjing Chemical Industry Park, Nanjing Economic Development Zone Fine Chemical Industry Park, Changzhou Binjiang Chemical Industry Park, and Nantong Chemical Industry Park (Jiangsu Investment Net 2015).
7. We developed our case study research methodology as part of a comparative project and both authors undertook a preliminary field trip to China in November 2015. The second author conducted the primary field research in Nanjing, with support from a research assistant, and both authors analyzed the interview transcripts and field notes. The semistructured interviews were conducted in Chinese, recorded, and later transcribed and translated into English. The informal interviews were recorded in field notes as part of the participant observation, with verbal consent from interviewees. Anonymized interview transcripts and field notes are on file with the research project.
8. In one village about a kilometer away from the petrochemical area, there were about 3,000 permanent villager residents and an estimated migrant population of about 8,000 (interview, village official, October 2016). This demographic profile parallels dynamics in other petrochemical villages in China; for example, in Guangzhou, another case study focus of this research project.
9. The Hukou system in China requires all households to register, and it divides people in China into urban and rural residents. People registered as rural residents often face discrimination when they live in cities. They normally take low-paid jobs with no pension or welfare, and their children cannot go to local schools in cities due to their hukou registration.

## References

- Agyeman, J., D. Schlosberg, L. Craven, and C. Matthews. 2016. Trends and directions in environmental justice: From inequity to everyday life, community, and just sustainabilities. *Annual Review of Environment and Resources* 41 (1):321–40. doi: 10.1146/annurev-environ-110615-090052.
- Allen, B. 2003. *Uneasy alchemy: Citizens and experts in Louisiana's chemical corridor disputes*. Cambridge, MA: MIT Press.
- . 2018. Strongly participatory science and knowledge justice in an environmentally contested region. *Science, Technology and Human Values* 41:1–25. doi: 10.1177/0162243918758380.
- Auyero, J., and D. A. Swistun. 2009. *Flammable: Environmental suffering in an Argentine shantytown*. Oxford, UK: Oxford University Press.
- Bakken, B. 2018. *Crime and the Chinese dream*. Hong Kong: Hong Kong University Press.
- Barnett, C. 2017. Geography and the priority of injustice. *Annals of the American Association of Geographers* 26:317–26. doi: 10.1080/24694452.2017.1365581.
- Barry, A. 2013. *Material politics: Disputes along the pipeline*. Hoboken, NJ: Wiley-Blackwell.
- Boudia, S., and N. Jas. 2014. *Powerless science? Science and politics in a toxic world*. New York: Berghahn.
- Brown, P. 1993. When the public knows better: Popular epidemiology challenges the system. *Environment* 35 (8):16–41. doi: 10.1080/00139157.1993.9929114.
- . 2011. Qualitative approaches in environmental health research. In *Contested illnesses: Citizens, science, and health social movements*, ed. P. Brown, R. Morello-Frosch, and S. M. Zavestoski, 33–45. Berkeley: University of California Press.
- Bullard, R., and B. Wright. 2009. *Race, place, and environmental justice after Hurricane Katrina*. Boulder, CO: Westview.
- Chai, G., and J. Y. Chen. 2016. 山东淄博求解“化工围城”困局 [Shandong Zibo seeks to solve “city besieged by petrochemicals”]. 2 August 2016. [http://www.cb.com.cn/difangjingji/2016\\_0822/1167075.html](http://www.cb.com.cn/difangjingji/2016_0822/1167075.html).
- Chen, J. 2010. Transnational environmental movement: Impacts on the green civil society in China. *Journal of Contemporary China* 19 (65):503–23. doi: 10.1080/10670561003666103.
- Chen, M.-S., and A. Chan. 2010. Occupational health and safety in China: The case of state-managed enterprises. *International Journal of Health Services* 40 (1):43–60. doi: 10.2190/HS.40.1.c.
- Chen, X. 2012. 以PX的名义 [Resistance in Ningbo: In the name of PX]. 9 November 2012, 三联生活周刊 [Life Week]. <http://www.lifeweek.com.cn/2012/1109/39118.shtml>.
- Corson, M. W. 1999. Hazardscapes in reunified Germany. *Global Environmental Change Part B: Environmental Hazards* 1 (2):57–68. doi: 10.1016/S1464-2867(99)00009-1.
- Cousins, E. 2016. Temporary refuge from invisible threats: Outdoor evacuation retreats for children from Fukushima, Japan. *Toxic News* 5. Accessed July 15, 2018. <https://toxicnews.org/2016/11/08/temporary-refuge-from-invisible-threats-outdoor-evacuation-retreats-for-children-from-fukushima-japan/>
- Cutter, S. 2002. *American hazardscapes: The regionalization of hazards and disasters*. Washington, DC: Joseph Henry Press.
- Davies, T. 2018. Toxic space and time: Slow violence, necropolitics, and petrochemical pollution. *Annals of the American Association of Geographers* 108 (6):1537–53. doi: 10.1080/24694452.2018.1470924.
- Davies, T., and A. Polese. 2015. Informality and survival in Ukraine's nuclear landscape: Living with the risks



- of Chernobyl. *Journal of Eurasian Studies* 6 (1):34–45. doi: [10.1016/j.euras.2014.09.002](https://doi.org/10.1016/j.euras.2014.09.002).
- Edelstein, M. 2004. *Contaminated communities: Coping with residential toxic exposure*. 2nd ed. Boulder, CO: Westview.
- Flyvbjerg, B. 2001. *Making social science matter: Why social inquiry fails and how it can count again*. New York: Cambridge University Press.
- Fricker, M. 2007. *Epistemic injustice: Power and the ethics of knowing*. Oxford, UK: Oxford University Press.
- Gao, H. 2013. Chinese government admits existence of cancer villages. *The Lancet* 14 (4):284. doi: [10.1016/S1470-2045\(13\)70065-2](https://doi.org/10.1016/S1470-2045(13)70065-2).
- Gilbert, E., and C. Ponder. 2014. Between tragedy and farce: 9/11 compensation and the value of life and death. *Antipode* 46 (2):404–25. doi: [10.1111/anti.12063](https://doi.org/10.1111/anti.12063).
- Goron, C. 2017. Climate revolution or long march? The politics of low-carbon transformation in China (1992–2015). PhD thesis, Université Libre de Bruxelles.
- Gottlieb, R., and S. Ng. 2017. *Global cities: Urban environments in Los Angeles, Hong Kong, and China*. Cambridge, MA: MIT Press.
- Grabicki, M. 2015. *Breaking new ground: The history of BASF in China from 1885 to today*. Hamburg, Germany: Hoffmann und Campe Verlag.
- Gu, H. 2016. NIMBYism in China: Issues and prospects of public participation in facility siting. *Land Use Policy* 52:527–34. doi: [10.1016/j.landusepol.2014.12.015](https://doi.org/10.1016/j.landusepol.2014.12.015).
- He, G., L. Zhang, A. P. J. Mol, T. Wang, and Y. Lu. 2014. Why small and medium chemical companies continue to pose severe environmental risks in rural China. *Environmental Pollution* 185:158–67. doi: [10.1016/j.envpol.2013.10.041](https://doi.org/10.1016/j.envpol.2013.10.041).
- Ho, W.-C. 2017. *Occupational health and social estrangement in China*. Manchester, UK: Manchester University Press.
- Holdaway, J. 2013. Environment and health research in China: The state of the field. *The China Quarterly* 214:255–82. doi: [10.1017/S0305741013000337](https://doi.org/10.1017/S0305741013000337).
- Huber, M. T. 2017. Hidden abodes: Industrializing political ecology. *Annals of the American Association of Geographers* 107 (1):151–66. doi: [10.1080/24694452.2016.1219249](https://doi.org/10.1080/24694452.2016.1219249).
- Jiang, N. 2017. *Nanjing hundred year time space construction and service*. Project for Nanjing Government.
- Jiangsu Investment Net. 2015. 江苏化工园区现状分析 [Analysis of Chemical Parks in Jiangsu Province] 江苏招商网 Jiangsu Investment Net, 30 December 2015. <http://js.zhaoshang.net/2015-12-30/358546.html>.
- Jovanović, D. 2018. Prosperous pollutants: Bargaining with risks and forging hopes in an industrial town in Serbia. *Ethnos: Journal of Anthropology* 83 (3):489–504.
- Kang, F., X. Mao, X. Wang, J. Wang, B. Yang, and Y. Gao. 2017. Sources and health risks of polycyclic aromatic hydrocarbons during haze days in Eastern China: A 1-year case study in Nanjing city. *Ecotoxicology and Environmental Safety* 140:76–83. doi: [10.1016/j.ecoenv.2017.02.022](https://doi.org/10.1016/j.ecoenv.2017.02.022).
- Ke, J. 2005. Environmental justice: Can an American discourse make sense in Chinese environmental law? *Temple Journal of Science Technology & Environmental Law* 24:253–85.
- Lee, K., and M.-S. Ho. 2014. The Maoming anti-PX protest of 2014. *China Perspectives* 3:33–39. Accessed September 12, 2014. <http://chinaperspectives.revues.org/6537>.
- Lin, K.-C. 2008. Macroeconomic disequilibria and enterprise reform: Restructuring the Chinese oil and petrochemical industries in the 1990s. *The China Journal* 60:49–79. doi: [10.1086/tcj.60.20647988](https://doi.org/10.1086/tcj.60.20647988).
- Liu, L., J. Liu, and Z. Zhang. 2014. Environmental justice and sustainability impact assessment: In search of solutions to ethnic conflicts caused by coal mining in Inner Mongolia, China. *Sustainability* 6 (12):8756–74. doi: [10.3390/su6128756](https://doi.org/10.3390/su6128756).
- López-Navarro, M. Á., V. Tortosa-Edo, and J. Llorens-Monzonis. 2015. Environmental management systems and local community perceptions: The case of petrochemical complexes located in ports. *Business Strategy and the Environment* 24 (4): 236–51. doi: [10.1002/bse.1817](https://doi.org/10.1002/bse.1817).
- Lora-Wainwright, A. 2017. *Resigned activism: Living with pollution in rural China*. Cambridge, MA: MIT Press.
- Mah, A. 2012. *Industrial ruin, community, and place: Landscapes and legacies of urban decline*. Toronto: University of Toronto Press.
- Mah, A., and X. Wang. 2017. Research on environmental justice in China: Limitations and possibilities. *Chinese Journal of Environmental Law* 1 (2):263–72.
- Meng, X., Y. Zhang, X. Yu, J. Bai, Y. Chai, and Y. Li. 2014. Regional environmental risk assessment for the Nanjing Chemical Industry Park: An analysis based on information-diffusion theory. *Stochastic Environmental Research and Risk Assessment* 28 (8):2217–33. doi: [10.1007/s00477-014-0886-3](https://doi.org/10.1007/s00477-014-0886-3).
- Murphy, M. 2013. Chemical infrastructures of the St. Clair River. In *Toxicants, health and regulation since 1945*, ed. S. Boudia and N. Jas, 103–15. London and New York: Routledge.
- Mustafa, D. 2005. The production of an urban hazard-scape in Pakistan: Modernity, vulnerability, and the range of choice. *Annals of the Association of American Geographers* 95 (3):566–86. doi: [10.1111/j.1467-8306.2005.00475.x](https://doi.org/10.1111/j.1467-8306.2005.00475.x).
- Neumann, P. 2016. Toxic talk and collective (in) action in a company town: The case of La Oroya, Peru. *Social Problems* 63 (3):431–46. doi: [10.1093/socpro/spw010](https://doi.org/10.1093/socpro/spw010).
- Nixon, R. 2011. *Slow violence and the environmentalism of the poor*. Cambridge, MA: Harvard University Press.
- Nolan, P. 2001. *China and the global business revolution*. Basingstoke, UK: Palgrave Macmillan.
- Osno, E. 2014. *Age of ambition: Chasing fortune, truth, and faith in the new China*. New York: Farrar, Straus and Giroux.
- Ottinger, G., and B. R. Cohen. 2011. *Technoscience and environmental justice: Expert cultures in a grassroots movement*. Cambridge, MA: MIT Press.
- Pearce, J. R., E. A. Richardson, R. J. Mitchell, and N. K. Shortt. 2010. Environmental justice and health: The implications of the socio-spatial distribution of multiple environmental deprivation for health

- inequalities in the United Kingdom. *Transactions of the Institute of British Geographers* 35 (4):522–39. doi: [10.1111/j.1475-5661.2010.00399.x](https://doi.org/10.1111/j.1475-5661.2010.00399.x).
- Pellow, D. N. 2007. *Resisting global toxics: Transnational movements for environmental justice*. Cambridge, MA: MIT Press.
- Petryna, A. 2002. *Life exposed: Biological citizens after Chernobyl*. Princeton, NJ: Princeton University Press.
- Pillai, J. 2006. Importance of clusters in industry development: A case of Singapore's petrochemical industry. *Asian Journal of Technology Innovation* 14 (2):1–27. doi: [10.1080/19761597.2006.9668616](https://doi.org/10.1080/19761597.2006.9668616).
- Quan, R. 2002. Establishing China's EJ study models. *Georgetown International Environmental Law Review* 14:461–87.
- Reed, M. G., and C. George. 2011. Where in the world is environmental justice? *Progress in Human Geography* 35 (6):835–42. doi: [10.1177/0309132510388384](https://doi.org/10.1177/0309132510388384).
- Schlosberg, D. 2007. *Defining environmental justice: Theories, movements, and nature*. New York: Oxford University Press.
- Sennett, R., and J. Cobb. 1972. *The hidden injuries of class*. New York: Norton.
- Shapiro, J. 2012. *China's environmental challenges*. Cambridge, UK: Polity Press.
- Shi, Y. 2015. 大石化搬不动 南京“十年搬迁计划”暂搁浅 [Big petrochemical difficult to move, Nanjing “ten years relocation plan” temporarily suspended]. *China Business Journal*, February 9. Accessed July 15, 2018. <http://news.cb.com.cn/index.php?m=content&c=mobile&a=show&catid=10&id=23791>.
- Singer, M. 2011. Down cancer alley: The lived experience of health and environmental suffering in Louisiana's chemical corridor. *Medical Anthropology Quarterly* 25 (2):141–63. doi: [10.1111/j.1548-1387.2011.01154.x](https://doi.org/10.1111/j.1548-1387.2011.01154.x).
- Smyth, R., Q. Zhai, and W. Hu. 2001. Restructuring China's petrochemical enterprises: A case study of the Fushun Petrochemical Company. *Post-Communist Economies* 13 (2):243–61. doi: [10.1080/14631370124898](https://doi.org/10.1080/14631370124898).
- Stawkowski, M. E. 2016. “I am a radioactive mutant”: Emergent biological subjectivities at Kazakhstan's Semipalatinsk nuclear test site. *American Ethnologist* 43 (1):144–57. doi: [10.1111/amet.12269](https://doi.org/10.1111/amet.12269).
- Steinhardt, H. C., and F. Wu. 2016. In the name of the public: Environmental protest and the changing landscape of popular contention in China. *The China Journal* 75:61–82. doi: [10.1086/684010](https://doi.org/10.1086/684010).
- Swyngedouw, E., and N. C. Heynen. 2003. Urban political ecology, justice, and the politics of scale. *Antipode: A Journal of Radical Geography* 35 (5):898–918. doi: [10.1111/j.1467-8330.2003.00364.x](https://doi.org/10.1111/j.1467-8330.2003.00364.x).
- Taylor, D. 2014. *Toxic communities: Environmental racism, industrial pollution, and residential mobility*. New York: New York University Press.
- Tilt, B. 2006. Perceptions of risk from industrial pollution in China: A comparison of occupational groups. *Human Organization* 65 (2):115–27. doi: [10.17730/humo.65.2.69dufcr1hatnpu5v](https://doi.org/10.17730/humo.65.2.69dufcr1hatnpu5v).
- Tobin, D. 2008. From Maoist self-reliance to international oil consumer: A resource-based appraisal of the challenges facing China's petrochemical sector. *Journal of Chinese Economic and Business Studies* 6 (4):363–83. doi: [10.1080/14765280802431761](https://doi.org/10.1080/14765280802431761).
- Van Rooij, B., A. L. Wainwright, Y. Wu, and Y. Zhang. 2012. The compensation trap: The limits of community-based pollution regulation in China. *Pace Environmental Law Review* 29 (3):701–45. Accessed July 1, 2018. <http://digitalcommons.pace.edu/pelr/vol29/iss3/2>.
- Walker, G. P. 2012. *Environmental justice*. London and New York: Routledge.
- Walkerdine, V., and L. Jimenez. 2012. *Gender, work, and community after de-industrialisation: A psychosocial approach*. London: Palgrave Macmillan.
- Warner, M. 2000. *Changing workplace relations in the Chinese economy*. Basingstoke, UK: Palgrave Macmillan.
- Wiebe, S. M. 2016. *Everyday exposure: Indigenous mobilization and environmental justice in Canada's chemical valley*. Vancouver: UBC Press.
- World Health Organization 2014. *Human health in areas with industrial contamination*. Copenhagen, Denmark: WHO Regional Office for Europe.
- Wu, Q., X. Zhang, H. Li, H. Chen, Z. Li, and Z. Shang. 2015. Pro-growth giant business, lock in, sustainable urban development and effect on local political economy: The case of petrochemical industry at Nanjing. *Journal of Cleaner Production* 107:324–32.
- Yang, L. 2016. At the bottom of the heap: Socioeconomic circumstances and health practices and beliefs among garbage pickers in peri-urban China. *Critical Asian Studies* 48 (1):123–31. doi: [10.1080/14672715.2015.1092389](https://doi.org/10.1080/14672715.2015.1092389).
- Yin, R. K. 2009. *Case study research: Design and methods*. 4th ed. Los Angeles: Sage.
- Zhang, W.-Z., K.-G. Dong, and S.-C. Tian. 2009. Development and evolution of spatial distribution of Chinese petrochemical industry. *Geographical Research* 28 (5):1378–88.

ALICE MAH is a Professor in the Department of Sociology at the University of Warwick, Coventry CV4 7AL, UK. E-mail: [a.a.mah@warwick.ac.uk](mailto:a.a.mah@warwick.ac.uk). Her research interests include global environmental injustice, legacies of industrial ruination, and political and urban ecology.

XINHONG WANG is an Honorary Research Fellow in the Department of Sociology at the University of Warwick, Coventry CV4 7AL, UK. E-mail: [x.wang.39@warwick.ac.uk](mailto:x.wang.39@warwick.ac.uk). Her research interests include open government information, environmental law, environmental justice, and human rights law in China.