Global Environmental Change 73 (2022) 102474

Contents lists available at ScienceDirect

Global Environmental Change

journal homepage: www.elsevier.com/locate/gloenvcha

The role of working-class communities and the slow violence of toxic pollution in environmental health conflicts: A global perspective

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ARTICLE INFO

Keywords:
Environmental health conflicts (EHCs)
Working-class environmentalism
Slow violence
Statistical political ecology
EJAtlas

ABSTRACT

Analysing a sample of 3,033 environmental conflicts around the globe, we compared conflicts reporting no human health impacts to those reporting health impacts linked to toxic pollution. Our study suggests four main findings. First, health impacts are a key concern for working-class communities. Second, the long-term effects of toxic pollution undermine communities' ability to act preventively. Third, industrial activities, waste management and nuclear energy conflicts are more likely to report health impacts than other economic activities. Last, mobilising groups are reluctant to consider the closure of a polluting project a successful outcome because of the persistence of toxic pollution across time. Our results contribute to a better understanding of the dynamics of what we have termed 'environmental health conflicts' (EHCs).

1. Introduction

Toxic pollution –any form of environmental pollution that causes harm to living beings– is a major global health threat which does not affect all equally (Boudia and Jas, 2019; Landrigan et al., 2018). Environmental hazards and health risks disproportionately affect the most vulnerable, low-income, and racialised communities worldwide (Bullard, 1990; Brulle and Pellow, 2006; Ferdinand, 2019; Mah and Wang, 2019). In response, affected communities organise and protest the establishment of socially and ecologically harmful facilities that threaten them (Novotny, 2000). As a result, environmental conflicts arise (Martínez-Alier and O'Connor, 1996).

Exposure to toxic pollution is complex and can take many forms (i.e., skin contact, inhalation, ingestion, and even prenatal exposure). Toxic pollution can be imperceptible, its effects surpassing temporal and spatial scales (Agard-Jones, 2013; Barbour and Guthman, 2018; Carson, 1962; Nash, 2004). For instance, some synthetic pesticides used in agriculture move beyond their target location into the soil, water and air, affecting the health of communities living miles away (Harrison, 2011). Likewise, toxins can be inherited (i.e., in utero exposure or through breastfeeding), increasing intergenerational effects (Smith, 1999; Langston, 2010). These complexities mean that environmental conflicts that report health impacts follow a different pattern than those that do not. This paper describes these differences from a global perspective and proposes new lines of research in this regard.

People engaging in social protest to safeguard their health and environment from pollution is not new (Bullard, 1990; Brulle and Pellow, 2006; Falcone et al., 2020; Pellow, 2002; Sze, 2004). Research on this topic has focused on ethnographic approaches studying one form of pollution (i.e., air pollution), a particular health impact (i.e., asthma) or a single environmental-health movement (i.e., breast cancer movement) (Brown et al., 2003; Sze, 2004; Ley, 2009; Brown et al., 2012; Houston and Ruming, 2014). More extensive nationwide statistical analyses on the incidence of pollution in low-income and racialised communities has been conducted in the US (Mohai et al., 2009; Mohai and Saha, 2015). Fewer research efforts have addressed international perspectives (Pellow, 2007). A global, quantitative, and comparative perspective, as presented in this study, has not been done at all.

We present a large-n analysis of 3,033 environmental conflict cases recorded on the Environmental Justice Atlas platform (see www.ejatlas.org). The EJAtlas documents and catalogues environmental conflicts at different stages of the commodity chain: extraction of energy and materials, transport, production, and waste disposal (Martínez-Alier et al., 2016; Temper et al., 2015). The EJAtlas frames conflicts as 'ecological distribution conflicts' (or EDCs) to emphasise the unfair distribution of environmental costs and economic benefits that economic activities generate (Martínez-Alier and O'Connor, 1996). We analysed this dataset to understand how and why conflicts reporting health impacts differ

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https://doi.org/10.1016/j.gloenvcha.2022.102474
Received 4 February 2021; Received in revised form 23 December 2021; Accepted 14 January 2022
Available online 24 January 2022
0959-3780/

from the rest of the conflicts in the database. We also sought to understand the differences in mobilisation among these conflicts, and how delayed health impacts from toxic pollution affect the timeline of mobilisation of local communities. In sum, we explore if environmental conflicts reporting health impacts linked to toxic pollution – or 'environmental health conflicts (EHCs) – differ from those conflicts that do not (non-EHCs hereafter).

We use descriptive statistics, Pearson's Chi-square test of independence, and a binomial test for our comparison. Our main findings show that EHCs differ from non-EHCs in four key aspects. First, EHCs appear more frequently in struggles involving working class actors. Second, the delayed health effects of toxic pollution can affect local communities' ability to act preventively, making environmental justice harder to achieve. Third, EHCs are predominantly linked to industrial activities, waste management and nuclear projects. Lastly, people involved in EHCs are reluctant to consider the closure of a polluting project a success because of the persistence of toxic pollution across temporal and spatial scales.

As follows, section 2 presents the conceptual background. Section 3 explains the methodology for selecting our samples and the statistical analyses performed. Section 4 presents the main findings and identifies the variables that form the patterns exhibited by EHCs. Section 5 concludes and offers future research directions to address conflicts over environmental health and toxic pollution.

2. Theoretical background

2.1. The role of working-class communities in the study of environmental conflicts

While scholars studying environmental conflicts have acknowledged the role of workers in shaping transitions toward sustainability, workers' struggles are often seen as separate from environmentalists' struggles (Temper et al., 2015; Temper et al., 2018). This separation echoes the 'jobs versus environment' dilemma, founded on the assumption that enacting environmental regulations will increase costs and, consequently, job losses (Bell, 2020). As White (1996) notes in the essay "Are You an Environmentalist or Do You Work for a Living', workers and environmentalists have sometimes failed to support each other in the past.

According to Montrie (2018), environmental justice scholars predominantly focus on social, civic, and racial agencies as drivers of environmental injustices (see Bullard, 1990; 1993), even though working-class communities have historically been active in struggles against environmental health hazards (Räthzel et al., 2021). Looking back at the US and the UK origins of environmentalism, Montrie (2018) and Bell (2020), respectively, show that workers have engaged in environmental struggles "many years before environmental organisations came into existence" (Bell, 2020, p. 139). Industrial and farm workers' have succeeded in improving occupational health conditions while also advocating for enhancing environmental protection and risk reduction in their working environments and communities (Satheesh, 2020; Barca, 2012b; Keil, 1994, London, 2003; Shaw, 2010).

Within this context, 'working-class environmentalism' (WCE) emerged as a theoretical lens to connect workers' and environmentalists' struggles, values, and interests (Barca, 2012b; Bell, 2020). WCE is led by trade unions and other formal and informal groups and communities who identify as 'working-class'. We define the working-class as people whose physical waged work is their only source of income and who occupy the bottom of the labour hierarchy (Barca, 2012b; Barca and Leonardi, 2018). They are often paid lower wages and placed in high-risk conditions. WCE differs from the 'environmentalism of the poor' (Martínez-Alier, 2002), which refers to the environmentalism of grassroots organisations with predominant participation of Indigenous and peasant, black and rural communities, that mobilise to protect their livelihoods and ecosystems (Guha and Martínez-Alier, 1997).

WCE scholars argue that environmentalists, grassroots organisations and workers have a common adversary: profit-making and capital accumulation based on the production of toxic environments in tandem with the destruction of nature and societies. In Bell's words, "'the jobs versus environment' dilemma deliberately distracts attention from the fact that capitalist accumulation destroys both" (Bell, 2020, p. 175). Barca and Leonardi (2018) analysed a steel plant in Taranto (Italy), where as soon as the plant started, it started to pollute the town progressively. While the plant created industrial jobs—risking the workers' health—it also destroyed local traditional economic activities (i.e., agriculture, fisheries, etc.). In this way, the impacts of toxic pollution are also a form of slow violence, which we describe in the following section.

2.2. The slow violence of toxic pollution

Scholars analysing environmental conflicts often focus on direct and physical violence against mobilising actors for environmental justice (Butt et al., 2019; Le Billon and Lujala, 2020; Scheidel et al., 2020; Tran et al., 2020). Nonetheless, other forms of violence appear in such conflicts and require attention (Navas et al., 2018). There are, for instance, cases of environmental (in)justice in which violence is expressed in 'fast and direct' as well as 'slow' forms (Davies, 2018; Kojola and Pellow, 2021). As witnessed in Bhopal (EJAtlas, 2019a), Chernobyl (EJAtlas, 2019b) or the Samarco tailings disaster in Brazil (EJAtlas, 2019c), environmental injustices can happen as accidents or explosions (visible, direct, and fast). The violence also expands as the toxic contaminants slowly diffuse into the environment and live organisms. After the Bhopal explosion in 1984, immediate deaths were estimated by authorities to number anywhere from 3,800 to 15,000. Twenty years later, the legacy of the explosion in Bhopal continued through high levels of dioxins and other toxic chemicals at the site, affecting many thousands more people with chronic diseases (Zavestoski, 2009).

Slow violence refers to "a violence that occurs gradually and out of sight, a violence of delayed destruction that is dispersed across time and space" (Nixon, 2011, p. 2). Disasters can also occur gradually, neither spectacularly nor instantaneously (Ahmann, 2018). For instance, industrial towns in which the steady stream and accumulation of toxic substances reveal their effects on the local population's health only years later. In non-industrial landscapes such as the Arctic, these disasters can also occur. For decades, persistent organic pollutants (POPs), carried on water currents, have accumulated in the marine mammals and in the bodies of local people, who have traditionally consumed those mammals. As a result, Indigenous women in the Arctic have been found to have high levels of chemicals in their breast milk, risking their newborns' health (Cone, 2007; Bruce, 2002; Hanaček et al., 2021). In industrial towns and in the Arctic, violence is not only slow in its manifestation but confused in its origin, complicating local communities' efforts to establish a cause-and-effect link between the source of pollution and ailments experienced, thereby restricting their ability to engage in judicial struggles and claim reparations for damages occurred (Brown, 2007).

Moreover, the long-term effects of toxic pollution are often used as a strategy of 'accumulation by contamination' (Demaria and D'Alisa, 2013). By perpetuating pollution and health ailments that affect the most vulnerable, slow violence is consciously used—and even encouraged—to accumulate wealth (Chertkovskaya and Paulsson, 2021). To run pollutive projects, enterprises have used the lapse of toxic pollution and its long-term health effects as a successful cost-shifting practice (Arcuri and Hendlin, 2019; Litvintseva, 2019). The report "Late lessons from early warnings" shows how, despite early knowledge of possible harm, many years pass from the toxic pollution's occurrence to the passage of regulations and acknowledgement of harms and eventual compensation to victims (Lambert, 2001; Gee and Greenberg, 2001; Bingham and Monforton, 2013). Notably, in the cases mentioned by the report, workers were on the frontline for challenging capital interests and advancing environmental (and occupational health) agendas. Their bodies were the first to be exposed to the hazardous substances at their workplaces.

3. Methodology

3.1. The environmental justice atlas

The EJAtlas is the most extensive archive of environmental conflicts to date. It is presented in an open-access online platform. The unit of analysis is a state or corporate-driven economic project around which different actors mobilise to claim protection or reparations for impacts these projects generate (Martinez-Alier, 2021).

Each conflict is accompanied by a data sheet containing a general description of the case (500–1000 words) and a list of quantitative and qualitative variables: the individuals and organisations that mobilise (mobilising actors), when mobilisation occurs (reaction phase), the commodities involved (i.e., minerals, land, oil), whether the project is planned, in operation or stopped (the status of the project), as well as the environmental, socioeconomic and health impacts the project produces. Conflicts are divided into ten mutually exclusive categories (e.g., industrial, mining, etc.) and 51 non-mutually exclusive sub-subcategories (e.g., land acquisition conflict). For example, a conflict arising from an open-pit iron mining project generating local demands over land or water use is categorised as a 'mining' conflict and sub-categorised as a 'land acquisition' and 'water access and entitlements' conflict.

The analysis of a large number of cases from the EJAtlas has been framed as 'statistical political ecology' (see Del Bene et al., 2018; Martinez-Alier, 2021; Scheidel et al., 2020; Temper et al., 2020). A "method for analysing the global and interlinked aspects of localized environmental struggles, that allows going beyond dynamics at local scales to understand crucial processes and relations generating environmental inequalities at broader regional, national, and global scales" (Temper, 2014: 180). This paper advances knowledge in this regard, analysing patterns of environmental health conflicts globally.

3.2. Data collection

The analysed database consists of a total of 3,033 cases. This is the total number of conflicts recorded on the platform as of January 14th, 2020. To select cases of environmental health conflicts (EHCs), we first selected cases where at least one of the following health impacts were recorded as actually taking place: 'exposure to unknown or uncertain risks', 'malnutrition', 'occupational disease and accidents', 'infectious diseases', 'deaths', 'other environmental related diseases', and 'other health impacts'. In this process, we excluded cases reporting only health impacts such as 'increasing rates of homicides/gender violence' and 'problems related to alcoholism/prostitution'. Even though these are global health challenges, they give few details about the link between toxic pollution and health impacts. Finally, we counted 1,157 EHCs (38% of 3,033). Next, we compared EHCs with the remaining cases (1,876 cases or 62% of 3,033, non-EHCs).

3.3. Statistical analysis

We used Pearson's Chi-square tests of independence to determine whether the presence of EHCs is related to the following variables: 'category of conflict', 'project status', 'reaction phase', and 'success rate'. These are categorical variables with mutually exclusive values, for example a 'project status' can be 'stopped' or 'planned', but not both simultaneously.

Because Pearson's Chi-square test of independence can only be performed with variables having mutually exclusive answers, for 'mobilising actors'—a variable having non-mutually exclusive answers (i.e., more than one actor can mobilise in each conflict, e.g., industrial workers and farmers)—we developed a binomial test. We did so by comparing the percentage of EHCs for each category of mobilising actors to the overall percentage of EHCs observed in the dataset (38%). Then, we test if there is any significant difference between them. In other words, if the percentage of EHCs for each category of mobilising actors is higher than 38%, the mobilising actor has a higher propensity to engage in environmental conflicts when health impacts are reported. To account for the number of hypotheses tested in this exercise, we adjusted the type I error rate (false rejection of null hypothesis) with the Bonferroni approximation ($\alpha_{BONFERRONI} = \alpha_{TOT}/n_c$). Tables' and figures' captions provide the results of the statistical test exercises.

4. General comparison of EHCs vs non-EHCs

4.1. Categories and subcategories of conflicts

As noted in Fig. 1B, mining (20%), fossil fuels (17%), and land use conflicts (15%) are the most common categories of conflicts recorded in the EJAtlas. However, when comparing EHCs vs non-EHCs within each category, there is a higher proportion of EHCs in industrial (65%), waste management (64%), and nuclear conflicts (52%), and a lower proportion in tourism (6%) and infrastructure (22%) conflicts [Fig. 2 'Category of conflict'].

Regarding mining-related conflicts, even though Fig. 2 shows that people mobilise for health issues proportionally less in mining conflicts (than in industrial activities, waste management and nuclear conflicts), this does not mean that mining projects are less harmful to human health. Instead, these conflicts are likely triggered by other social claims such as access to and distribution of natural resources (i.e., land, water). For instance, some mining conflicts in Guatemala, have been trigged principally by land rights (EJatlas, 2020d).

Fig. 3 [Subcategories of conflicts] confirms that EHCs emerge against industrial waste disposal and material processing activities more often than other activities. E-waste, shipbreaking, agro-toxics, toxic waste, metal refineries and chemical industries present higher rates of EHCs than non-EHCs. The production and use of chemical substances such as agro-toxics and intensive food production, more common in rural settings, is also relevant. A lower proportion of EHCs are linked to windmills, solar power plants and tourism facilities.

4.2. Commodities involved

Regarding commodities involved in EHCs (Table 1), we note that asbestos, recycled metals, and pesticides are prevalent. Asbestos is a group of silicate minerals used for industry building materials and as a heat and electric insulator (Litvintseva, 2019). Asbestos is also known for its lethal impacts on exposed populations (Trimbur, 2020). Unsurprisingly, more than 90% of cases involving asbestos are EHCs.

In Catalonia (Spain), the 'Association of victims affected by asbestos' (AVAAC) is a local organisation demanding reparations for asbestos-induced illnesses (EJAtlas, 2020b). From 1907 to 1997, three companies—Roviralta, Eternit, and Uralita—produced fibre-cement and asbestos-based materials. For decades, workers and residents inhaled microscopic fibres resulting years later in lung cancer and *mesothelioma* (a type of cancer affecting the tissues covering internal organs). At least 300 people have died. As the latency period of asbestos-related effects can be up to 40 years from exposure to onset of the disease, many people live in fear of being diagnosed in the future (Muñoz, 2018).

Notably, toxic pollution and hazards –such as asbestos– have been relocated from richer to poorer countries (Arcuri and Hendlin, 2019; Pellow, 2007). When asbestos was banned in Spain in 2002, Eternit continued producing asbestos-based building materials in Colombia until 2019 (EJAtlas, 2015a, Ossa Giraldo et al., 2014). Today, despite knowledge of asbestos' health-related impacts, many entrepreneurs keep producing and using it in countries where it is not yet banned or where there are less strict regulations (Bahk et al., 2013; Litvintseva, 2019).

A similar pattern occurs with pesticides. As stated by Weir and

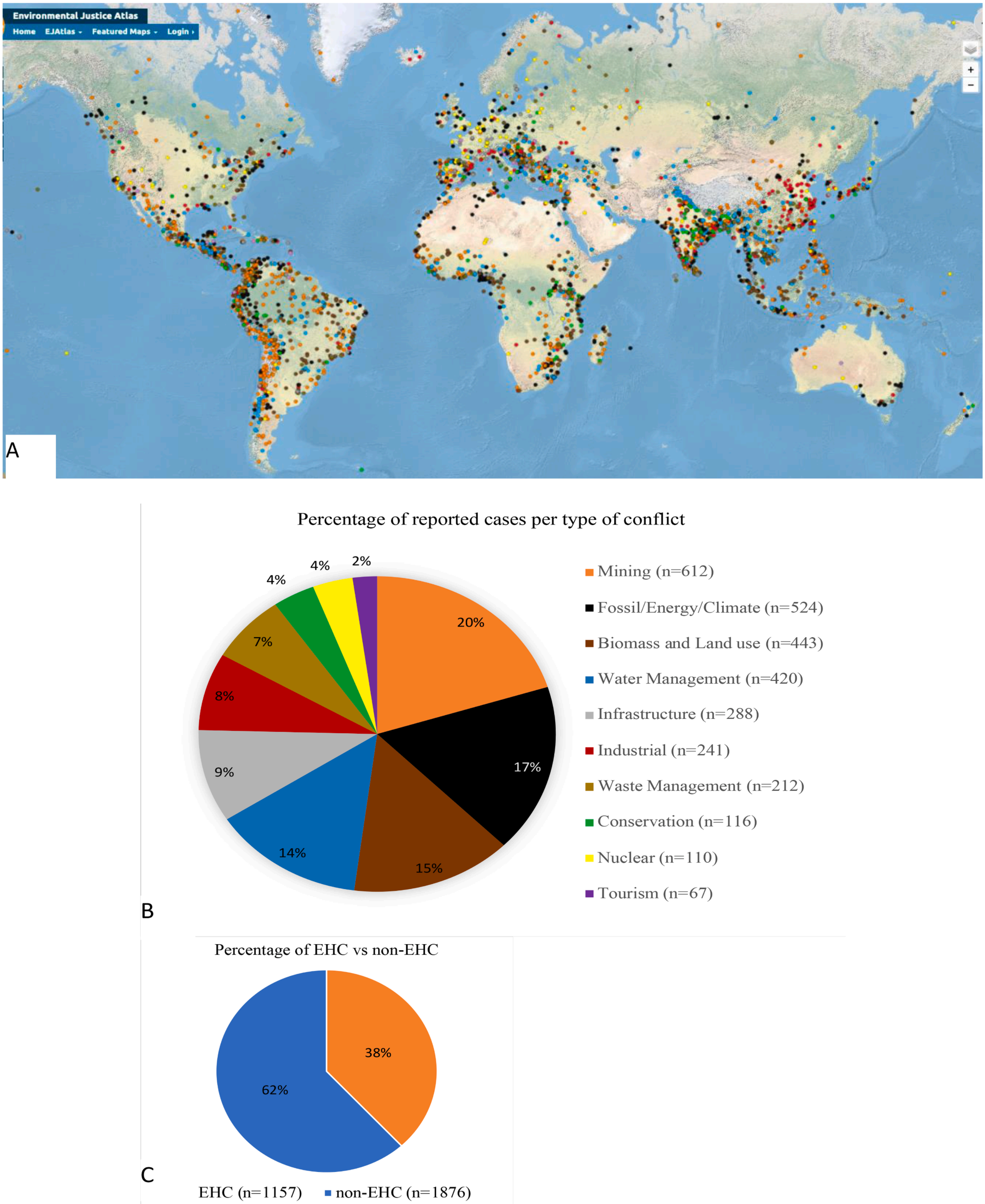

Fig. 1. Environmental conflicts registered in the EJAtlas (n = 3030). A: Geographical coverage of environmental conflicts (each dot represents one case and each colour a category of conflict). B: Category of conflicts and coverage (pie colours correspond to the colour of the cases shown in the map). C: Percentage of EHC cases and non-EHC cases. This figure follows a similar representation as in Scheidel et al., 2020.

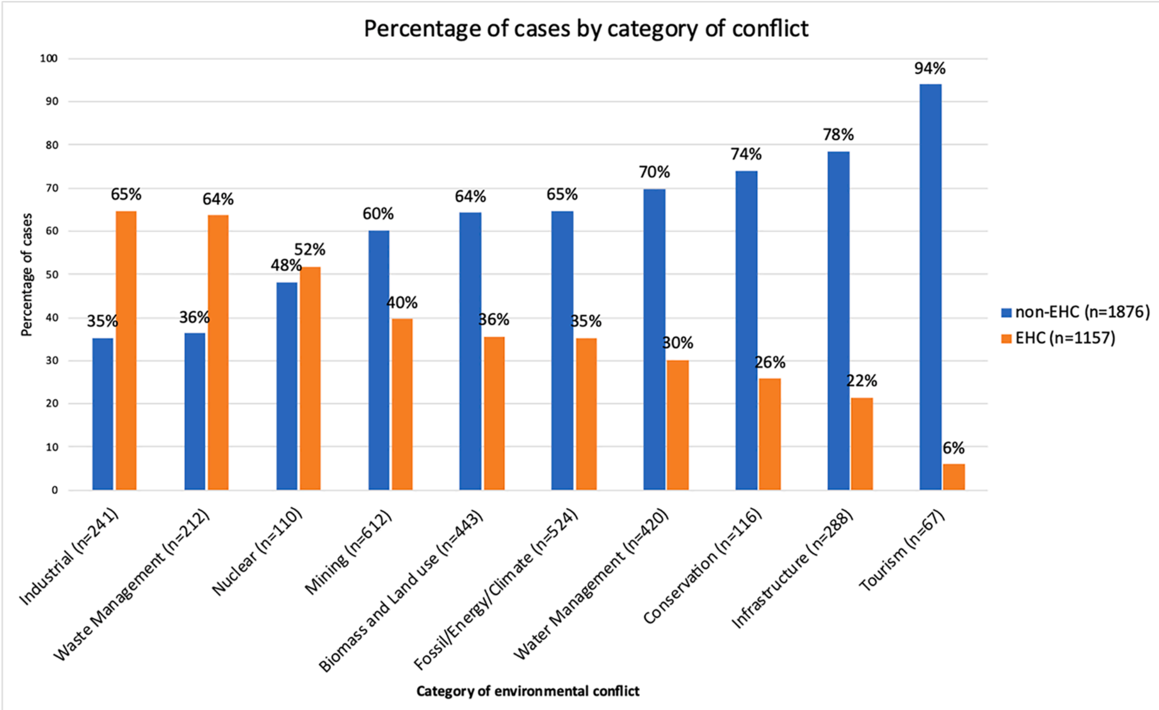

Fig. 2. Percentage of EHCs and non-EHCs by category of conflict. The total number of cases reported is n = 3033. Note that one case can be only classified in one category of conflict. Pearson's Chi-squared test results: Chiˆ2 = 226.3783; $p < 0.001$.

Shapiro since the early 1980s: "companies can play as they move their poisons from one country to the next, trying to maximise sales before their pesticides are banned again" (Weir and Schapiro, 1981, p. 22). For instance, DBCP (a synthetic pesticide) was banned in 1979 in the US because of its proven effects of infertility in exposed workers. Yet, it continued to be exported and used abroad until the 1990s (EJAtlas, 2016a; EJAtlas, 2016e). A systematic process is occurring in which companies accumulate wealth while costs are shifted to people and nature (Kapp, 1971 [1950]).

4.3. Project status

The EJAtlas registers the different stages of the conflictive project: proposed, planned, under construction, in operation or stopped. As noted in Fig. 4 [Project status], EHCs appear in a higher proportion when the project is 'in operation' (54%) and lower proportion when it is 'under construction' (19%), 'proposed' (14%), or 'planned' (12%).

EHCs are generally associated with operative projects, where pollutants can disperse into the community, causing negative health impacts in the local population. There are, however, some exceptions. Conflicts that report health impacts in a project's early phases (12%) can include the expansion of an ongoing project. An example would be the case of the Indigenous Wayuu communities mobilising to revoke a license granted by Colombia's government to enlarge the Cerrejón mining project (EJAtlas, 2019d). Since 1975, pollution and land dispossession have gradually impoverished these indigenous communities (EJAtlas, 2017a; Avilés, 2019). In 2011, the mine planned to increase coal extraction and alter the course of one of the remaining water sources (EJAtlas, 2019d). The Wayuu people organised in response to this initiative. Their demands bolstered mining workers' previous complaints about poor working conditions and toxic exposure in quantities far above legal standards (EJAtlas, 2017a). Although workers and indigenous groups have distinct claims, they converge on denouncing the unhealthy and socioeconomic consequences of the coal mining project (Avilés, 2019).

However, stopping a project does not guarantee non-toxic landscapes or the absence of health impacts in the local population. In Polynesia, for over 30 years, the French government conducted nuclear tests, and the high levels of radiation fallout led to radiation-induced diseases affecting local dwellers (EJAtlas, 2019e). Although the tests concluded, the conflict continues, as the impact of contamination occurred years after radiation diffused in the environment (Ruff, 2015). For years, people in Polynesia vacated polluted islands to escape radioactive exposure by ingesting contaminated seafood. These are not direct evictions as often happen in land acquisition conflicts (Dell'Angelo et al., 2020), but rather slow, violent displacements. The damage to natural resources because of pollution forces people to leave their territories (Li and Pan, 2021).

Toxics can accumulate in the environment and people's bodies, and vulnerabilities can be inherited across generations. Examples include the cases of DDT and DES transmission through breastfeeding (Smith, 1999; Langston, 2010) or lead exposure in placenta (Rees and Fuller, 2020). Cases recorded in the EJAtlas show how actors mobilise to protest specific impacts on new-borns and children. In China, villagers protested lead-battery plants because children's health had been severely affected. Children in these villages had blood lead levels of 89,7 μg/dL, causing acute lead poisoning and damage in their nervous systems (EJAtlas, 2019g; EJAtlas, 2020c; EJAtlas, 2018b). Lead levels above 5 μg/dL can affect the nervous system, behaviour, and intellectual development (Rees and Fuller, 2020).

5. Actors mobilising

Actors and groups participating in environmental conflicts reported in the EJAtlas are diverse and exhibit different scales of action (i.e., local, regional or global). They range from local collective organisations with a specific goal (e.g., a grassroots movement wanting to stop a mining project in their town) to transnational social movements to transform broader structural power dynamics (e.g., an international NGO aiming to stop nuclear power plants worldwide).

Table 2 shows that EHCs appear more frequently in working class actors' struggles. As it shows, from the total number of cases in which

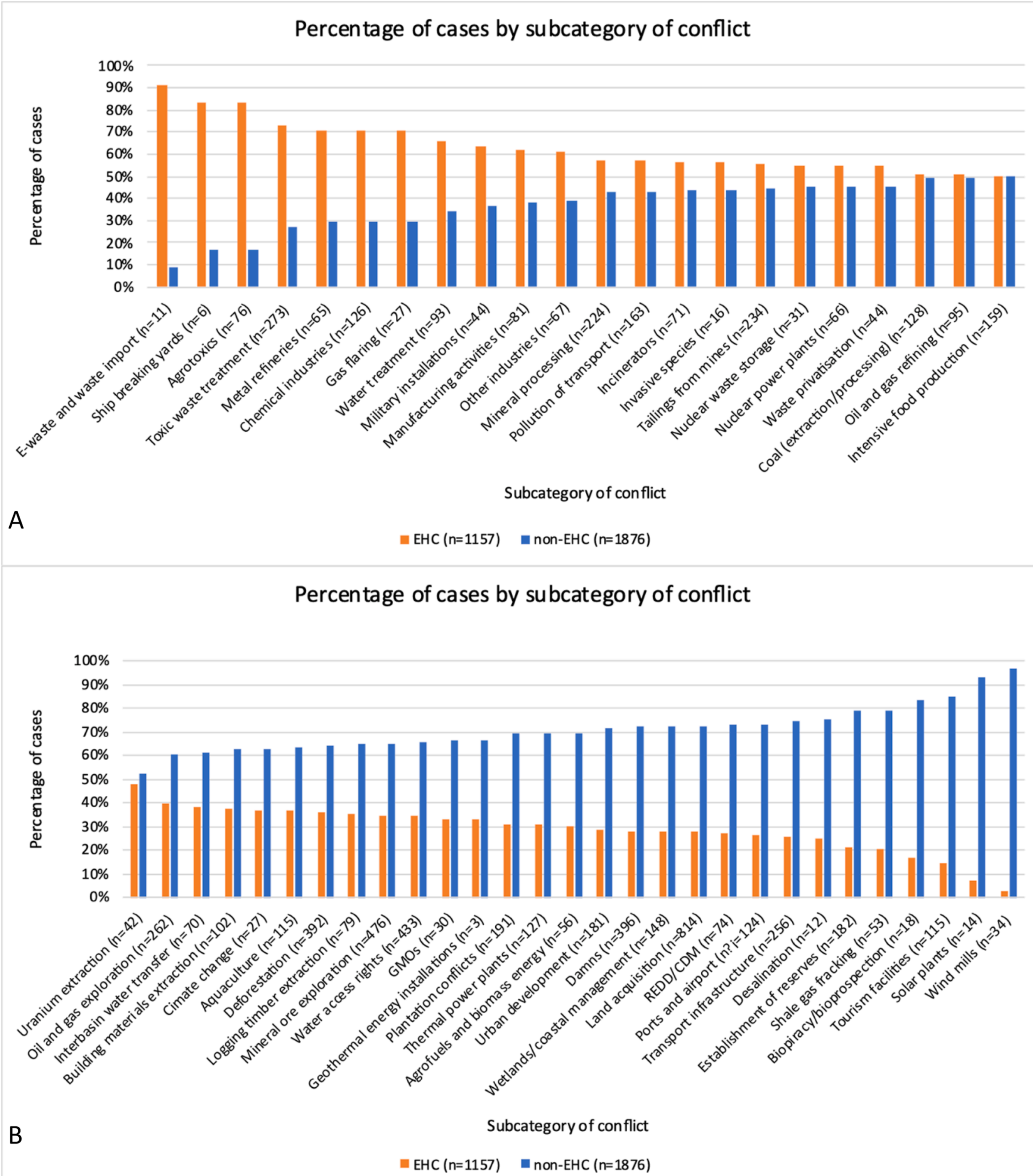

Fig. 3. Percentage of EHCs and non-EHCs by subcategory of conflict. A: Percentage of EHCs reported up to 100%. B: Percentage of EHCs reported up to 50%. The total number of cases reported is n = 3033. Note that one case can be classified in more than one category of conflict.

'industrial workers' mobilise, 71% are EHCs, for 'waste pickers' 68%, for 'informal workers' 58%, for 'artisanal miners' 56% and for 'trade unions' 55%. Moreover, for 'discriminated groups', 49% are EHCs and for 'women collectives' 46% are EHCs. When the actors previously mentioned mobilise, there is a statistically significant positive prevalence of EHCs compared to the average of the EHCs in the entire sample (38%); therefore, negative health consequences determine their participation in environmental conflicts. This result goes in line with previous studies highlighting the role that working-class communities have played in fighting against toxic pollution and an unhealthy environment (Barca and Leonardi, 2018, Montrie, 2018). In Catalonia and similar asbestos exposure cases in Italy (EJAtlas, 2015b) or Brazil (EJAtlas, 2017c), the conflict emerged as an occupational health concern. Still, it was then extended to local dwellers, creating key cases

Table 1
Percentage of EHCs per type of commodity. Column 'Commodities involved in EHCs' refers to the commodities as reported in the EJAtlas (separated by ';'). Column 'Percentage of EHCs per type of commodity' displays, for each commodity, the percentage of cases that are EHCs. Note that more than one commodity can be involved in one conflict.

Commodities involved in EHCs	Percentage of EHCs per type of commodity
Asbestos	90%–100%
Recycled metals; Pesticides	80%–89%
Diamonds; Industrial waste; Chemical products	70%–79%
Lead; E-waste; Steel; Manufactured products	60%–69%
Domestic waste; Cotton; Sugar; Flowers; Rare metals; Shrimps; Uranium, Zinc	50%–59%
Rice; Soybeans; Cement; Iron ore; Crude oil; Fish; Aluminium/bauxite; Fruits /Vegetables; Titanium ores; Coal	40%–49%
Eucalyptus; Corn; Pine; Gold; Cellulose; Ethanol; Wheat; Palm oil; Rubber; Water; Silver; Live animals; Timber; Copper; Natural gas; Sand gravel; Land	30%–39%
Ecosystem services; Electricity; Carbon offsets; Meat; Biological resources; Tourism services; Charcoal	20%–29%
Lithium; Asphalt	below 20%

of working-class environmentalism.

On the contrary, when 'pastoralists' and 'recreational users' mobilise, the percentage of EHCs is 26% and 22% respectively, meaning that negative health consequences do not determine their participation in environmental conflicts. Land-use, aesthetic, and entertainment could be a stronger driver of mobilisation. For the rest of the actors listed in Table 2 there is no statistically significant difference from the whole dataset's average.

Furthermore, from the total of cases in which women collectives participate, 46% are EHCs. As some scholars have shown, women do not only mobilise because they are exposed in their working environments but because they are often responsible for caring for men and children affected by toxic pollution (Bolados and Sánchez, 2017; Martínez-Sánchez, 2019). Concerned about the healthy future of their communities, they often organise in specific collectives such as 'Women of the Zones of Sacrifice in Resistance' in Chile (EJAtlas, 2020a) or 'Mothers of Ituizangó' in Argentina (EJAtlas, 2016f).

Surprisingly, for conflicts involving 'scientists and other professional groups' (i.e., epidemiologists, doctors, lawyers) 41% are EHCs. Therefore, health impacts do not determine their involvement in environmental conflict. However, they play a key role in supporting local communities' claims when involved. Medical scientists have been essential in producing evidence linking toxic exposure and health impacts in several cases. Often, these scientists rely on data previously recorded by the community through community- based research (Brown, 1992). This is the case of 'Mothers of Ituizangó', who used cartography to link the number of ill children's houses and the nearness of fumigated plantations with glyphosate (Arancibia and Motta, 2019). In this case, alliances with health scientists were crucial to back up communities' findings and initiate legal action to claim reparations and secure the banning of glyphosate (EJAtlas, 2016f). Scientists are sometimes preventively involved in many other kinds of conflicts, e.g., as hydrogeologists advising communities confronting open cast mining (Conde, 2014).

6. Reaction phase and success rate

Mobilising actors can either claim reparations once impacts are felt or act preventively before damages occur. As Fig. 5 [Reaction phase] shows, EHCs predominate in cases when social responses organise around reparations (69%) and are less prevalent in preventive phases (16%).

The fact that EHCs are more often organised 'for reparations' can be explained because of the slow violence of toxic pollution. Industrially induced chronic diseases—including arsenic (EJAtlas, 2016g) and cadmium contamination (EJAtlas, 2016h)— can take a long time to be publicly acknowledged. It takes even more time for mobilisation to

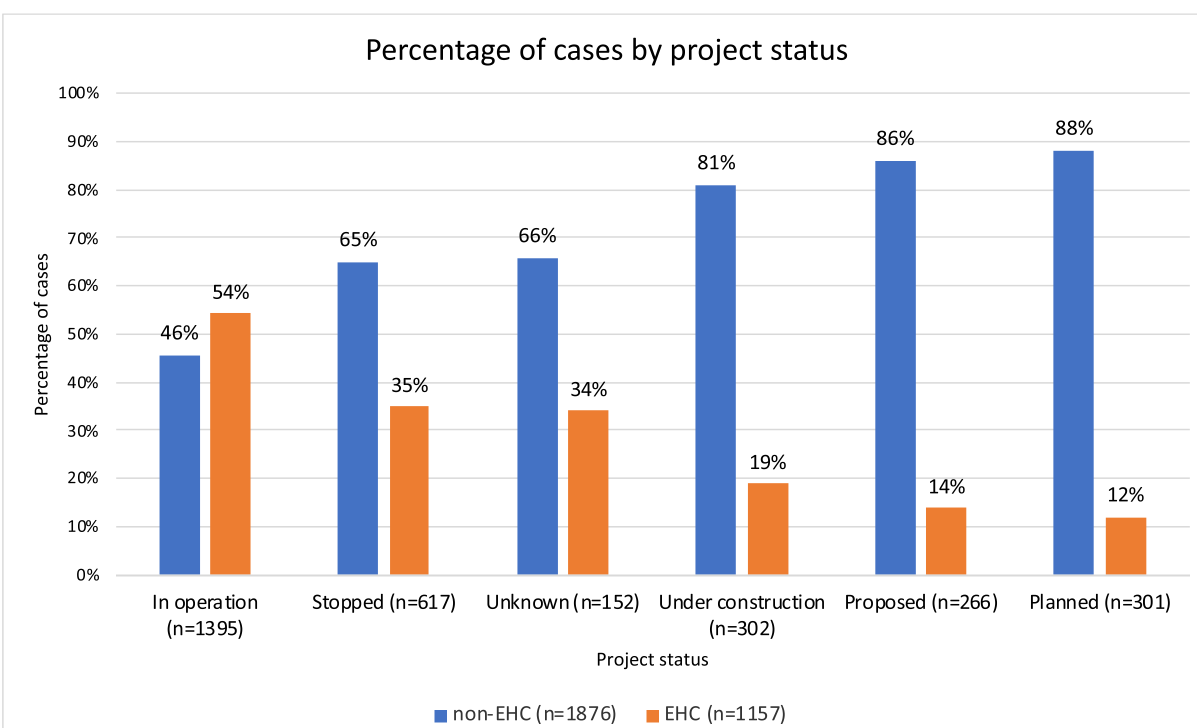

Fig. 4. Percentage of EHCs and non-EHCs by project status. Total number of cases reported n = 3033. Pearson's Chi-squared test results: Chi^2 = 361.1663; p < 0.001.

Table 2
Percentage of EHCs across groups of actors mobilising. Column 'Actor mobilising' refers to the different groups mobilising as reported in the EJAtlas. Column 'Total cases' refers to the total number of cases reporting that the specified group mobilises. Columns 'EHCs' refer to the total number of cases in which the specified group mobilises in EHCs. Column 'Frequency of EHCs' refers to the percentage of EHCs in which each actor mobilises. Test binomial and p-value columns report the statistic of the binomial test and the p-value of that test, respectively. Significant estimates have a p-value below 0.0025 and are highlighted by asterisks. This number is obtained after using the Bonferroni correction $\alpha_{BONFERRONI} = \alpha_{TOT}/n_c$, where α_{TOT} is equal to 5% (i.e. 0.05) and n_c is equal to the number of hypotheses tested (20). Note that one actor mobilising can be involved in more than one conflict, then the sum of the column 'Total cases' or 'EHCs' is higher than the EJAtlas total number of cases (n = 3033) or EHCs (=1157), respectively.

Actor mobilising	Total of cases	EHCs	Frequency of EHCs	Test binomial (approx. Gaussiana)	*p*-value
Industrial workers	222	158	71%	10,130	<0.001 *
Wastepickers, recyclers	53	36	68%	4,463	<0.001 *
Informal workers	225	131	58%	6,199	<0.001 *
Artisanal miners	117	65	56%	3,877	<0.001 *
Trade unions	339	188	55%	6,561	<0.001 *
Discriminated groups	561	274	49%	5,215	<0.001 *
Women collectives	630	290	46%	4,074	<0.001 *
International NGOs	905	382	42%	2,516	0.000
Landless peasants	331	136	41%	1,101	0.000
Scientists and other professionals	1193	487	41%	1,902	0.000
Fisher people	631	257	41%	1,335	0.000
Neighbours	2014	804	40%	1,639	0.000
Local organizations	2058	784	38%	-0,048	0.001
Government and political parties	1083	410	38%	-0,196	0.001
Religious groups	350	130	37%	-0,387	0.001
Social movements	1166	421	36%	-1,435	0.000
Indigenous groups, traditional commu	1240	445	36%	-1,638	0.000
Farmers	1389	490	35%	-2,202	0.000
Pastoralists	176	46	26%	-3,280	<0.001 *
Recreational users	231	50	22%	-5,163	<0.001 *

occur.

For instance, in Japan's Minamata Bay, from 1932 to 1968, dwellers reported muscle weakness, visual problems, and paralysis (EJAtlas, 2016b; Harada, 1995). In response, community-based research was carried out to identify possible explanations. The cause became public years later. For 35 years, Chisso Corporation Factory released methylmercury (MeHg) in the bay and, consequently, marine food ingested by locals was contaminated (Harada, 1995). Social protests occurred 'for reparations'. Through legal action, affected people demanded compensation and decontamination of the bay. By 2011, some people had received compensation, but many others had died waiting for it (EJAtlas, 2016b).

The time lag between the release of harmful substances in the environment and their manifestation as illness in people's bodies makes EHCs a complex challenge (Ahmann, 2018). When, to what extent, and to whom must the slow violence of toxic pollution be made visible to create resistance? As Davies (2019) states, toxic pollution is not invisible to all. Those directly experiencing it can see it, smell it, and feel it in their daily lives. However, because of structural inequalities, their risks and perceptions do not count (at least, not enough) for political action to be taken.

Latent conflicts, (or conflicts where there is no resistance organised) become particularly relevant in this analysis. 'Flammable' is an Argentine shantytown surrounded by a petrochemical compound (EJAtlas, 2017b). Despite severe acute and chronic health impacts linked to pollution, there is barely any local organising. Confusion and uncertainty about pollution sources are a main cause of de-mobilisation (Auyero and Swistun, 2009). Therefore, when evidence of slow violence surfaces, it does not imply that protests will rise. Scholars have shown that pollution and suffering are sometimes normalized and even accepted (Neumann, 2016; Verbeek, 2020). People often resign themselves to their toxic reality (Lora-Wainwright, 2017) or might not join in protest because they depend economically on the activity that makes them ill (EJAtlas, 2016c).

Finally, 'failure' and 'success', as reported in the EJAtlas, refer to positive and negative conflict outcomes from the perspective of mobilising actors. For instance, the 'cancelation of a project', 'compensation', the 'strengthening social networks', the 'cleaning up of an existing site', or the 'relocation of affected communities' have been referred to as a 'success' (Özkaynak et al., 2021; Hess and Satcher, 2019; Scheidel et al., 2020). We see from EHCs that when pollution and health consequences are widespread among communities and environments, there is a low chance for reparation and decontamination. What does success in environmental justice mean in EHCs?

In all of the EJAtlas cases (n = 3033), 1528 cases are deemed as 'failures', 1017 as 'not sure', and 488 as 'successes'. When comparing EHCs vs non-EHCs, there is a higher proportion of EHCs labelled as failures (47%) and a lower proportion labelled a success (24%) [see Fig. 6, Success rate]. This result is not surprising, possibly due to pollution's long-term (and often irreversible) effects, which require complex and long-lasting remediation processes and lengthy legal battles to achieve compensation (Bohme, 2015; EJAtlas, 2016a).

In some cases, EJAtlas contributors have declared success when monitoring technologies help in reducing pollution, even when the project is still operating (EJAtlas, 2015c; EJAtlas, 2016d; EJAtlas, 2014b) or because plans to address local health and environmental problems have been carried out (EJAtlas, 2015d; EJAtlas, 2015c; EJAtlas, 2016d; EJAtlas, 2014b). In keeping with Hess and Satcher (2019), monetary compensation is also deemed as a success (EJAtlas, 2015f). But others contest this mechanism, alleging that 'no amount of money can compensate for the health ailments suffered' (EJAtlas, 2015g). Instead, instilling within the community a sense of justice,

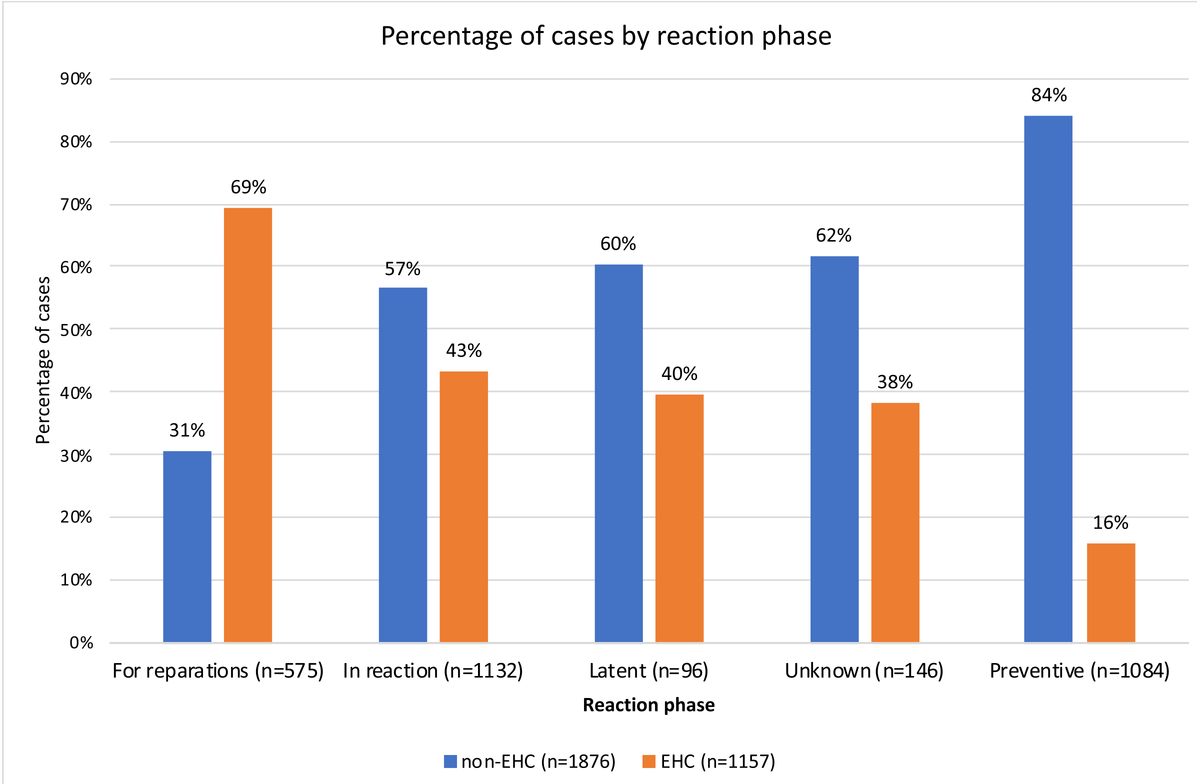

Fig. 5. Percentage of EHCs vs. non-EHCs by reaction phase. Total number of cases reported n = 3033. Pearson's Chi-squared test results: Chiˆ2 = 479.5917; p < 0.001.

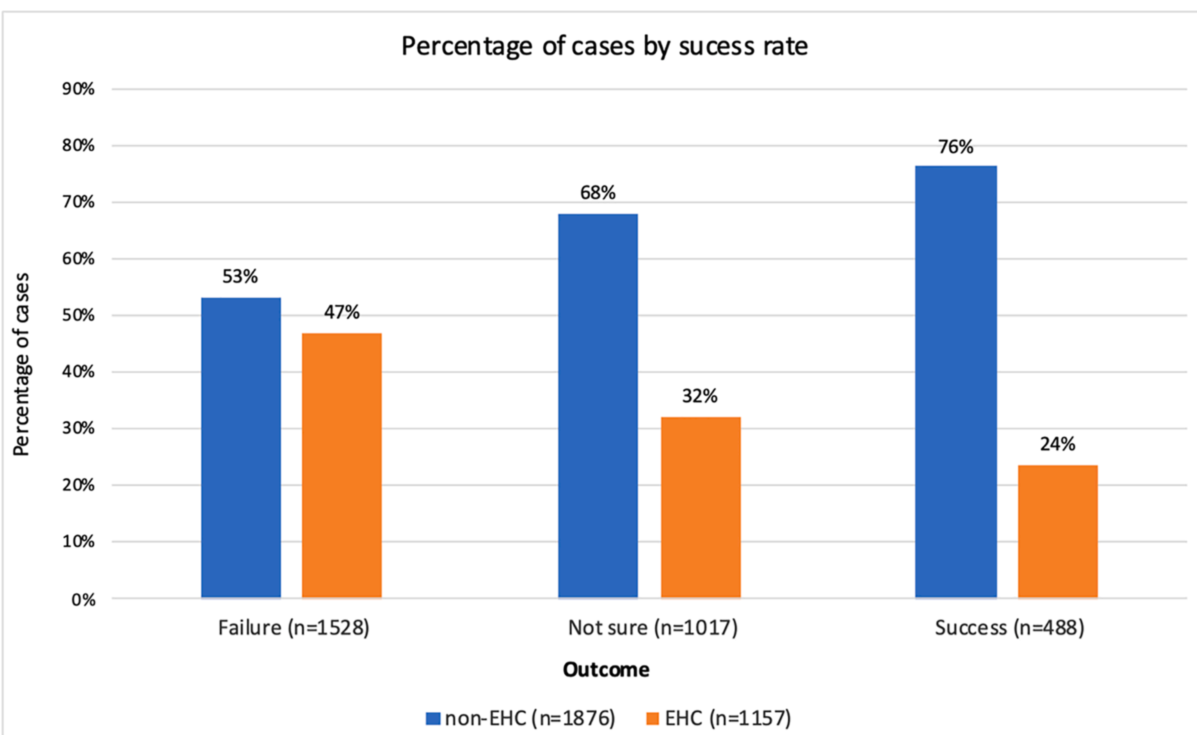

Fig. 6. Percentage of EHCs vs. non-EHCs by outcome. Pearson's Chi-squared test results: Chiˆ2 = 107.1548; p < 0.001.

recognising victims, and ensuring that toxic environments will not be created again is the true success (ídem).

Even when the project is stopped, health consequences could remain a concern for local communities, as witnessed in the Vieques case in Puerto Rico, where US Navy practices contaminated the environment (EJAtlas, 2014a). Despite efforts to recover environmentally degraded and polluted areas, some persistent pollutants are almost impossible to clean (EJAtlas, 2019h; EJAtlas, 2015e; EJAtlas, 2021).

7. Discussion and concluding remarks

Healthy environments are fundamental to the full enjoyment of life. When they are threatened, collective actions emerge in response, and environmental conflicts can arise around the globe (Martinez-Alier, 2021). In this paper we analysed a global database of 3,033 environmental conflicts to understand how and why environmental conflicts reporting health impacts (or 'EHCs') differ from those that do not report health impacts (non-EHCs).

We look at environmental conflict patterns in which health is being put at risk by different economic activities and identify what aspects (and categories from the EJAtlas) EHCs differ from non-EHCs. Our data show that industrial activities, waste management and nuclear projects are more conducive to EHCs (vs non-EHCs). As we know, industrial activities use, produce, and release hazardous pollutants in the environment and are a major source of toxic pollution worldwide (Guillem-Llobat and Nieto-Galan, 2020; Chastagneret, 2018). Some environmental movements, such as those in Japan, developed in the 1950s due to industrial pollution (McKean, 1981).

Empirical cases recorded in the EJAtlas describe how toxic pollution is lived (and survived) by workers and residents across countries (EJAtlas, 2019f; EJAtlas, 2018a; EJAtlas, 2020a). For instance, in Quintero-Puchuncaví (Chile), urban dwellers living near the Industrial Complex Ventanas confront pollution daily in their homes, schools, gardens and workplaces (EJAtlas, 2020a). The Complex holds several facilities, including mineral processing plants, thermal power plants, and metal refineries, involving 17 different companies. The place is known as a 'sacrifice zone' - an area where pollution and contamination are so high that nature and the people living there have been squeezed out for the sake of economic development (Lerner, 2010; Bolados and Sánchez, 2017). 'Sacrifice zones' are inhabited by 'sacrificed bodies' who live and work surrounded by toxic pollution (Bullard, 1993; Barca, 2014). In Quintero-Puchuncaví, slowly poisoned workers were deemed 'green men' [hombres verdes] because their skin became green through the high levels of lead, arsenic, and copper in their bodies (Tironi et al., 2018). Since the early 1990s, environmentalists, workers, and women collectives, among other actors, have organised to demand a right to a healthy environment and the reduction of toxic pollution (EJAtlas, 2020a). The struggle continues nowadays. One key aspect of EHCs regarding toxic pollution is its persistence affecting present and future generations. The intergenerational environmental justice aspect becomes key in EHCs.

Another finding of this research is that health issues are key concerns in working class communities (both informal and industrial). In EHCs—such as in asbestos-related conflicts—workers are sometimes the first to perceive and suffer the effects of toxic pollution in working environments and their own and their families' bodies. This result supports a 'working-class environmentalism' pattern in which worker communities and environmentalists struggle for occupational health and environmental issues (Foster, 1993; Barca, 2012a; Barca, 2012b; Montrie, 2018; Liu, 2021).

As noted by previous scholars, environmentalists' struggles cannot be separate from workers' struggles (Bell, 2020). For this reason, we see the need for a political re-composition of environmentalists and workers regarding global environmental health justice matters. Workers have pioneered struggles against toxic substances. Their achievements and support could be used to empower neighbours and local communities struggling against similar forms of toxic pollution or noxious substance (Barca and Leonardi, 2018) . Asbestos-related conflicts are a good example here. Asbestos's effects have a long latency period, epitomising the slow unfolding violence of toxic pollution.

However, working-class communities have been actively rendering its slow violence visible (Trimbur, 2020). Despite its lethal consequences, asbestos' production and use are banned in some countries, but not in others. Even in countries where asbestos is banned, neighbours keep fighting to withdraw asbestos from all residential and industrial buildings that may still contain it. Hence, an alliance between neighbours and workers, who have suffered asbestos-induced ailments across countries, would effectively achieve an asbestos-free future around the world.

In the same line, future research could explore how environmental justice narratives and struggles can help to develop a new forms of social and community unionism. These partnerships will lead to a just transition that considers claims of other mobilising groups (e.g., indigenous people and traditional communities) and future generations as part of their struggle for an ecologically sound and socially fair future. If a healthy and just world is desirable, environmental movements need working class communities, and workers need environmentalists. An EHC-related research agenda can analyse how worker communities' leadership can support collective actions and bring disparate mobilising actors (i.e., neighbours, farmers, indigenous groups) together and to the fore of environmental movements.

Furthermore, there is an urgent need for the global environmental justice movement to share knowledge about toxic chemicals proven to be noxious among countries with weaker regulations systems and strengthen transnational networks. Why are some toxic substances banned in some countries but not in others? How can collective action shape regulation systems for a toxic pollution-free future?

Another important result from our analysis is that EHCs manifest more frequently through demands for reparations and in reaction to the unhealthy consequences of economic activities, and less frequently as preventive efforts targeting new, potentially harmful, businesses. As noted from our results, mobilising actors tend to mobilise when conflictive projects are already operating or have operated in the past (i.e., Minamata Bay in Japan), but infrequently when the projects are planned (i.e., Indigenous Wayuú in Colombia). In hand with Nixon (2011), we could argue that slow violence becomes visible depending on the temporal and geographical dispersion of harmful contaminants, thus influencing how the affected people respond to it.

Scheidel et al. (2020) have concluded that mobilisation in preventive phases (before the project starts operation) combined with diversification of protest actions—and the use of litigation strategies—can increase the probability of halting a project and thus the probability for a success of environmental justice. Our data suggest that the time lag between the start of a particular economic activity and the emergence of its effects on people's health can affect the timing of social responses. However, it is important to note that beyond stopping a project, 'success' in environmental justice is difficult to define (Özkaynak et al., 2021). The low rate of success in EHCs could be explained because of the irreversibility and persistence of damages, even when the source of pollution stops (or the conflictive project halts).

Impacts of toxic pollution at the most local scale (the body) are embedded in a global economic system that is still requiring continuous resource extraction, materials processing, and waste disposal, constantly exposing people to dangerous health conditions, and producing 'zones and bodies of sacrifice' (Tironi et al., 2018). The inattention to slow and toxic violence leads to thousands of people slowly dying every year, often the poorest and most vulnerable (Landrigan et al., 2018). Local struggles occurring globally, such as those reported in this paper, should be considered, and understood as an urgent call for a healthier and more just world. Past and present exposures are conditioning the future.

Author contribution statement

Grettel Navas led the design and writing of the study. Giacomo D'Alisa has supported in the data curation and validation. Joan Martínez Alier co-developed the EJAtlas platform and secured funding for this research. All authors contributed to interpretation of results, writing, review and editing of the manuscript.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

Authors are grateful to Isabelle Anguelovski, Stefania Barca and anonymous reviewers for feedback provided on earlier versions of this paper. Grettel Navas and Joan Martínez-Alier acknowledge support from the European Research Council (ERC) Advanced Grant ENVJustice (No. 695446) and to the International Balzan Prize Foundation. Giacomo D'Alisa's research benefited from the financial support from the Portuguese Foundation for the Science and Technology (FCT) through the Strategic Project (UID/SOC/50012/2019). We thank Nicolás Navarrete and Michele Staiano for statistical support, and Arielle Landau for copyediting.

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