

A global analysis of violence against women defenders in environmental conflicts

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Women environmental defenders face retaliation for mobilizing against extractive and polluting projects, which perpetrate violence against Indigenous, minority, poor and rural communities. The issue matters because it highlights the gendered nature of extractive violence and the urgent need to address the systemic patterns of violence that affect women defenders, who are often overlooked and underreported. Here we analyse violence against women defenders in environmental conflicts around the world. We use data from the Environmental Justice Atlas and employ log-linear and binomial regressions to find statistically significant patterns in displacement, repression, criminalization, violent targeting and assassinations committed against women defenders in extractive conflicts. Statistical results indicate that violence against women defenders is concentrated among mining, agribusiness and industrial conflicts in the geographical South. Repression, criminalization and violent targeting are closely linked, while displacement and assassination appear as extreme outcomes when conflict violence worsens. Women defenders experience high rates of violence regardless of countries' governance accountability and gender equality. This work contributes to the broader sustainability agenda by highlighting the need to address the impacts of extractive activities on women.

Extractivism refers to projects extracting natural resources for exportation¹. It is an inherently unequal process often inciting extractivist violence, or the institutionalized use of brute force to displace and dominate communities for extractive and polluting projects such as mines or plantations. The extractive process frequently involves militarizing communities and assassinating environmental defenders^{2–4}, those advocating to protect environmental and human rights⁵. Such violence is typically justified by dehumanizing people and denying them agency through systematically excluding them from economic, social, political and cultural activities (for example, through classism, racialization and gendering)^{6,7}. Extractive violence is also connected to ecocide, the notion that environmental destruction is criminal and has devastating genocidal impacts on affected communities dependent on the health of their environments for physical, spiritual, and cultural wellbeing². Genocidal outcomes are those exterminating and persecuting groups, assimilating survivors and erasing their culture³.

Current literature describes a connection between colonial extractive attitudes, ecocide and genocide of Indigenous peoples, minorities, the poor and rural communities¹. Ecocide typically begins with land grabbing, or forcefully dispossessing communities of their lands and natural resources. Such usurpation is secured through legal and institutional structures such as land ownership regimes disrupting common law tenure. This colonial control is also reinforced through covertly and overtly discriminatory ideological and discursive practices². Ensuing ecological destruction then becomes genocidal when causing conditions fundamentally threatening a group's cultural and physical existence. More specifically, direct physical violence gives way to indirect forms of extermination through undermining place-based livelihoods, such as deforestation causing food instability, pollution causing health impacts³, or structural inequalities increasing vulnerability to violence and ecological consequences⁴.

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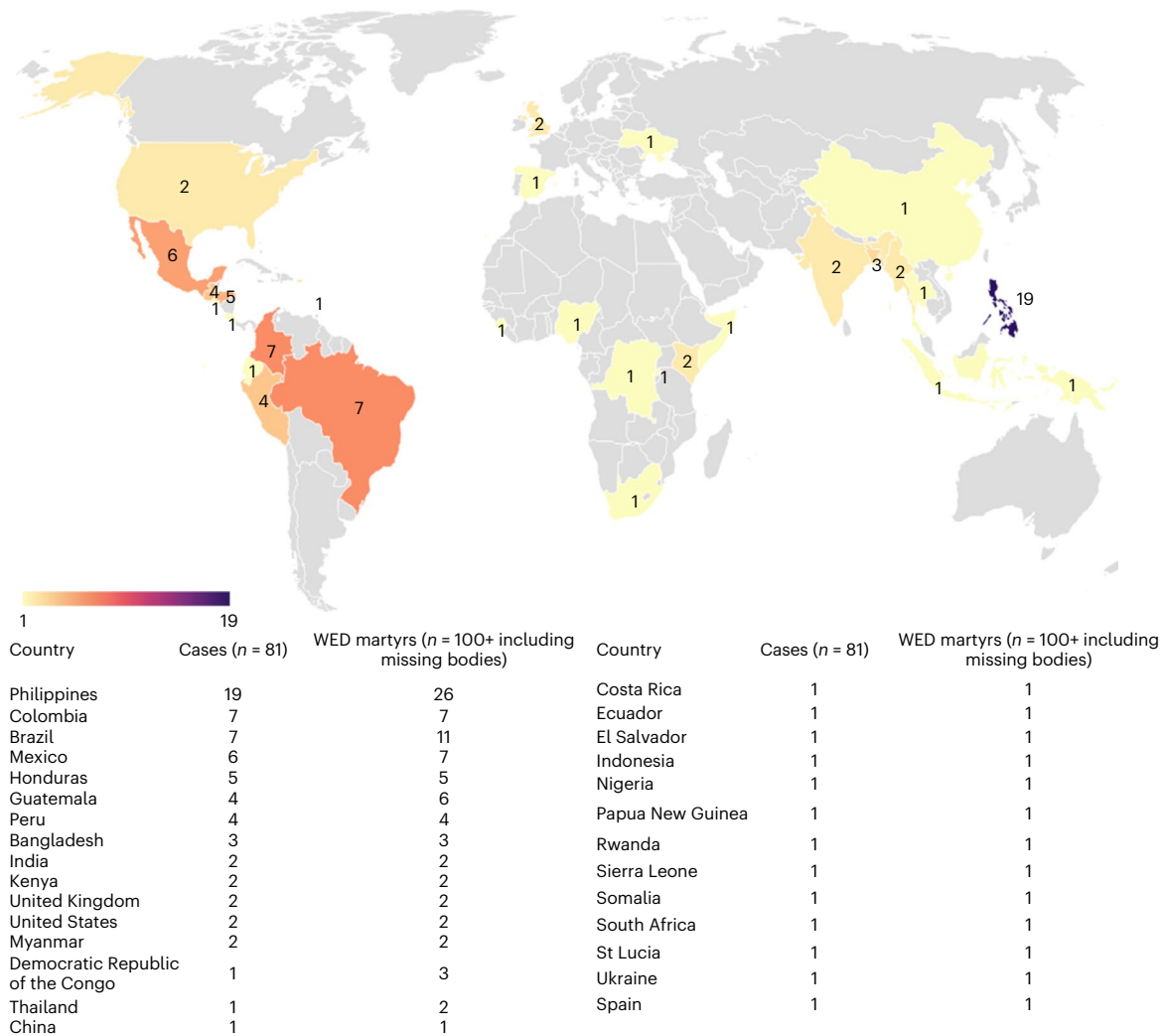


Fig. 1 | Distributions of WED assassination cases by country. *N* = 81.

There has been increasing attention to the ecocide–genocide nexus through environmental defender killings as well as slow violence wherein people suffer from long-term environmental harms^{5–9}. This study contributes an ecocide–genocide–gender connection to such literature. Violence against women environmental defenders (WEDs) is overlooked, and extractive violence is gendered^{4,10,11}. Corporations and states typically concentrate power among men during project negotiations, limiting women’s autonomy and normalizing their oppression^{12–14}. WEDs face retaliation because mobilizing defies gender expectations of docility (lack of retaliation) and sacrifice (absorption of extractive consequences)^{15,16}.

Assassinations are the most visible form of direct violence, but all threats to women defenders are difficult to document owing to censorship and a lack of data¹⁰. Lacking documentation of violence against women especially is also prevalent owing to discursive discrimination against women treating the loss of their lives as normal, deserved and ‘ungrievable’¹⁷. To address this gap, this article examines 523 cases from the Environmental Justice Atlas (EJAtlas) involving WEDs, 81 of which involve WEDs assassinated for their advocacy. Routine assassinations of WEDs are not isolated incidences, but rather political tactics forcefully making way for extractivism. Media reports often focus on gruesome details to sensationalize yet trivialize WEDs’ struggles, often not recording names, let alone their struggles¹⁶. Patterns of extractive violence against women thus remain overlooked.

In this Article, we address the following questions: (1) Where and under which circumstances do WEDs experience different forms of violence leading up to their assassinations? (2) How do structural patterns of violence affect women defenders? Log-linear regression traced distributions of violence against WEDs across conflict types, commodities and impacts. Binomial regression then addressed structural patterns in countries where WEDs were assassinated. This article contributes global patterns of violence against WEDs. We broaden analyses to circumstances leading up to and including assassinations because ecocide is not limited to killings, but rather encompasses displacement, repression, criminalization and violent targeting. Given our statistical approach and the nature of the material, we are aware of the potential dehumanization of WEDs’ circumstances and denial of their agency. However, quantitative data analysis using a large, representative sample is necessary for strengthening arguments that patterns of violence against women defenders found in qualitative, locally focused case studies are not outliers, but rather are occurring worldwide.

Results

Regarding circumstances informing WED assassinations, extrajudicial killings predominantly occurred in Latin America, Asia and Africa. Many cases were in the Philippines, Brazil, Colombia and Mexico (Fig. 1). Even in Southern cases, some in Costa Rica, Kenya, Rwanda and Saint Lucia targeted Global North expatriates. The data are skewed towards the Philippines. There were 19 WED assassination cases, more than double

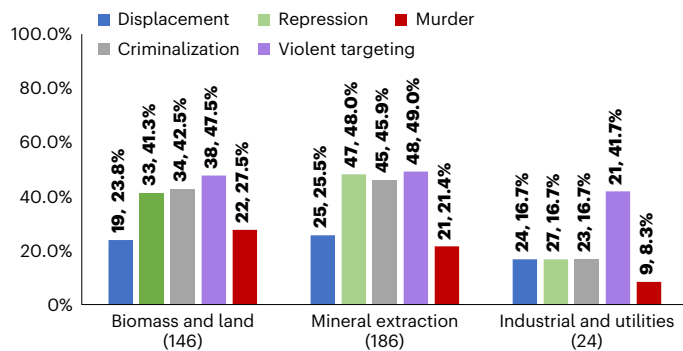


Fig. 2 | Log-linear regression. Distributions of violence across conflicts. Forms of violence towards WED across conflict types are indicated on the x axis. The number and percentage of WED cases reporting a form of violence are indicated on the y axis and over each bar. Only those conflict types indicating statistical significance with the five forms of violence towards WEDs are shown ($P \leq 0.05$). $N = 538$.

compared with Colombia in second place. Some Philippines cases were massacres or serial killings, assassinating 26 WEDs across 19 cases, whereas cases elsewhere targeted one or two at a time.

Figure 2 shows that the types of conflict with high statistical significance ($P \leq 0.05$) of violence against WEDs were biomass and land, mineral extraction and industrial and utilities conflicts. The distribution of violence throughout biomass and land conflicts ($n = 146$) was that nearly half of all corresponding cases involved repression (41%), criminalization (43%) and violent targeting (48%) of women defenders. Meanwhile, women defenders suffered a third of the displacement (24%) and assassination (28%) in the biomass cases. Mineral extraction ($n = 186$) was similar as WEDs were subject to about half of the repression (48%), criminalization (46%) and violent targeting (49%) as well as about a fourth of the displacement (26%) and assassination (21%). Industrial and utilities conflicts ($n = 24$) were different in that displacement, repression and criminalization were all evenly at 17% WEDs, whereas 41% of those suffering violent targeting and 9% of those martyred were women.

In Fig. 3a, slow violence, such as non-assassination deaths or those resulting from sicknesses or accidents, was the most serious outcome inciting women to action in 10% of displacements, 29% of repressions, 33% of criminalization, 34% of violent targeting and 20% of conflicts ultimately resulting in assassinations. WEDs were also spurred into mobilizing in response to food insecurity, for which they experienced 15% of displacements, 35% of repressions, 37% of criminalization and violent targeting, and 17% of assassinations. Ensuing mental unwellness then afflicted WEDs in 19% of displacements, 39% of repressions, 33% of criminalization, 40% of violent targeting and 13% of assassinations.

As depicted in Fig. 3b, social impacts statistically significantly affecting WEDs were those reducing their agency and mobility. WEDs appeared in 38% of displacements, 59% of repressions, 52% of criminalization, 66% of violent targeting and 35% of assassinations. Militarization often enforced extractive development, affecting women in 41% of displacements, 61% of repressions, 53% of criminalization, 60% of violent targeting and 21% of assassinations. Increased corruption was associated with WEDs in 28% of displacements, 45% of repressions, 46% of criminalization, 47% of violent targeting and 20% of assassinations. Specific impacts on women were increased sexual violence from military or worker camps. This was present in 32% of displacements, 37% of repressions, 35% of criminalization, 35% of violent targeting and 19% of assassinations. Loss of livelihood was also a common reason informing WEDs' activism, for which they experienced retaliation in 38% of displacements, 40% of repressions, 34% of criminalization, 38% of violent targeting and 16% of assassinations. Lastly, WED suffered social ills in

42% of displacements, 46% of repressions, 37% of criminalization, 40% of violent targeting and 16% of assassinations.

Table 1 indicates that violence negatively correlates with Rule of Law and gender equality, and positively correlates with WED presence. This means that, generally, when there is low Rule of Law, there is an observed increase in violence. Conversely, with higher Rule of Law, there is a decrease in observed violence. However, cases involving WEDs and in countries with low gender equality frequently involve violence regardless of high Rule of Law. The models show statistical significance for most violence except assassination, wherein positive, statistically significant relationships between gender equality and assassinations suggest that WED assassinations are more common in countries with weak gender equality.

Discussion

Hotspots for violence against WEDs in Latin America and Southeast Asia closely follow global distributions of assassinations of environmental defenders of any gender¹⁸. The distribution does not mean that violence against WEDs is a Global South issue because there were also six assassinations in the United States and Europe. The Philippines was the outlier at 26 assassinations over 19 cases despite an average Rule of Law of 0.48 and higher gender equality (0.784). While cases in other countries typically targeted individuals, many Philippines cases involved mass violence and serial killings owing to the government falsely 'red-tagging' defenders as Communist terrorists¹⁹. Meanwhile, for years, Brazil has been one of the most violent countries for environmental defenders despite having an average Rule of Law (0.53) and relatively higher gender equality (0.695) scores. Land inequality has been endemic since colonial times owing to power being concentrated among an elite patriarchy openly using violence to deter resistance²⁰. This results in systematic defender killings, which have worsened under Bolsonaro's administration brutally silencing defenders²¹. Post-election violence continues as anti-dam WED Flávia Amboss Merçom, as well as five others, were killed in a mass shooting on 25 November 2022 (ref. 22). As the cases show, women are at the heart of such struggles, yet racial, gender and class dynamics multiply their vulnerabilities²³.

WED assassinations in Colombia likewise are situated within a context of insurrections and repression. Despite being a country with an average Rule of Law (0.5) and higher gender equality (0.7), there has been a wave of recent assassinations of Indigenous and Afro-Colombian defenders carried out by paramilitary groups to the blind eye of the government since the signing of a 'peace' agreement in 2016 (ref. 24). Meanwhile, the National Development Plan promotes foreign extractive export while privileging hegemonically masculine identities and excluding everyone else²⁵. Consequently, there is typically little to no intervention in violence against WEDs²⁶. Moreover, in Mexico, in the past two decades, the government has restructured its economy in favour of international extractive markets, such as through agrarian laws privatizing communal peasant-occupied lands for large-scale agribusinesses²⁷. The government also enabled a mining boom by lifting foreign taxes and weakening regulations. Meanwhile, narcotraffickers took advantage of dismantled protections and became involved in environmental conflicts²⁸. The drug and extractive trades alike enforced masculinized models of domination and violence, fostering impunity for femicides in the EJAtlas cases, as indicated by its declining Rule of Law (0.44) yet relatively higher gender equality (0.65).

Overall, across these countries, authoritarian populism reinforced existing chauvinism wherein gendered tropes and inequalities incite and justify violence against women. These findings align with Le Billon and Lujala²⁹ and Butt et al.'s³⁰ analyses of repression, criminalization, violent targeting and assassinations indicating high concentrations of environmental defender killings in the Philippines, Brazil, Colombia and Mexico. Their studies indicate patterns of repression wherein killings are facilitated by impunity for violent land grabbing typically in countries with strong economic incentives to exploit land and natural

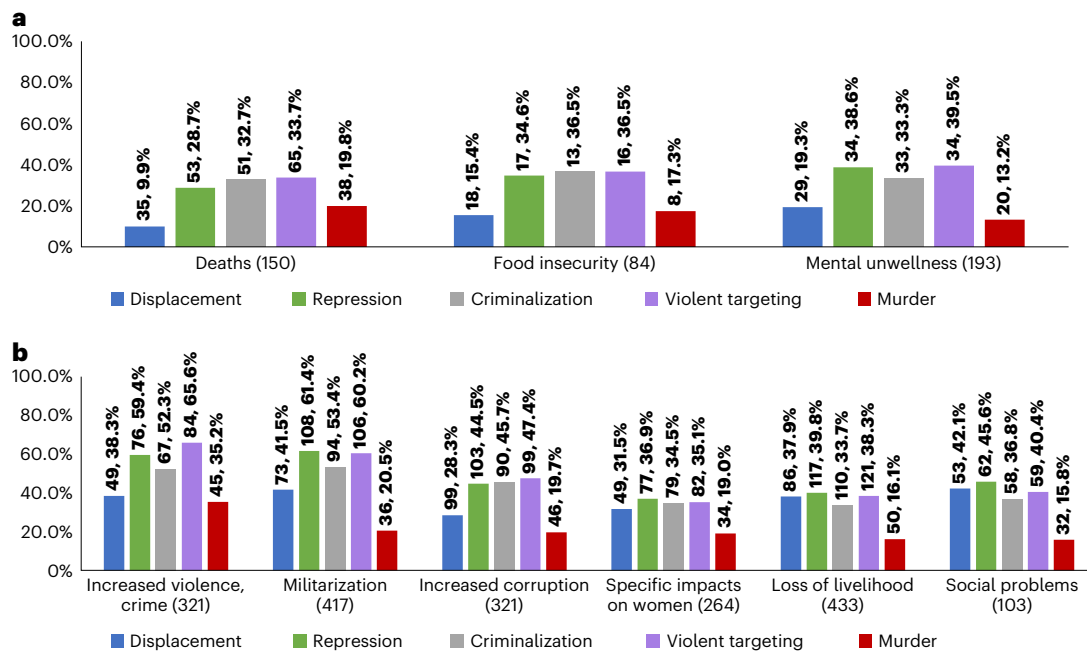


Fig. 3 | Log-linear regression. a, b, Distributions of statistically significant forms of slow violence (a) and social impacts (b) for WEDs are indicated on the x axis.

The number and percentage of WED cases reporting violence and impacts are indicated on the y axis and over each bar. ($P \leq 0.05$). $N = 538$.

resources, marginalization of those dependent on such resources, and high corruption levels. We add that, in such countries, dictators have used such masculinist violence to bolster populist ecocidal–genocidal agendas³¹. Gender underlies much of the ecocidal violence against WEDs not only in these countries but also worldwide because extractivism exterminates community leaders and dismantles previous gender relation schemes. Such cultural erasure and persecution centres power in masculinized industries owing to workforce composition, cultures of production, and its reliance on exploitation of women’s imposed caretaking roles to compensate for not investing in communities^{14,21,32}. Indeed, cases in any country involving mining, biomass and industrialization were the most dangerous for WEDs, but also defenders generally^{10,33}. All mining cases featured high rates of WED displacement and repression, backing how such masculinized industries diminish women’s agencies²¹. Such is also the case for plantation and deforestation conflicts owing to gendered, inequitable distribution of land.

Concerning gender-linked counts, of the 3,545 EJAtlas cases, only 523 (15%) involved WEDs. Proportions of coverage including women may be higher in the EJAtlas than other databases because, during the research process, we reported 147 of these cases, specifically mentioning women. Data tracking violence against environmental defenders rarely disaggregate findings by gender, and there are no established indicators analysing gendered violence in environmental conflicts³⁴. Women’s mobilizing is often overlooked, and violence against them may not be considered newsworthy. Conflict reporting frequently sidelines women as mothers, other support roles or even residents rather than as activists^{16,32,35}. Because women’s lives may also be considered less ‘grievable’¹⁷, gendered violence may be routine and under-reported, and environmental conflicts would not be an exception^{16,36}. Worldwide distributions of killings for defenders of any gender are tracked by organizations such as Global Witness¹⁸, and they are nearly indistinguishable to Fig. 1 with only WEDs. Given that aggressors kill defenders of any gender^{37–39}, there may be lacking documentation rather than a gender disparity of assassinations. However, the other forms of violence are statistically significant in association with WEDs, indicating that gender instead influences mechanisms and circumstances leading to deadly violence. Even when Rule of Law and gender

equality were average to high, WEDs faced statistically significant levels of most types of violence, including in the most violent countries with average to above average scores.

We thus add special attention to women to previous findings^{29,30,40} wherein marginalized groups experience high levels of violent repression regardless of Rule of Law. As the 538 cases showed, WEDs experience high rates of violence despite ‘democratic’ structural and gender equality. Countries with significant women-led environmental movements also appear to be no more or less peaceful towards WEDs. Some examples are that of unknown women in the women’s war against Chevron in Nigeria or of Helen Thomas in the anti-nuclear Greenham Women’s Peace Camp in England. These were major women-led movements with significant national and international influence, yet such strong WED presence did not make these contexts less dangerous to women. Rather, EJAtlas cases indicate that WEDs killed in contexts with strong women-led mobilizations were more often killed in mass or serial violence under circumstances with increased armed policing than contexts with less prominent WED leadership. WEDs’ increased recognition made them more likely to be seen as threats rather than gave them safer platforms to voice concerns. Indeed, crowd violence was the most common way WEDs were killed, in 52 out of the 81 cases deadly to WEDs. Such brutality extended towards the entire community because it normalized violence/femicide and justified lacking investigations and prevention. Before the killings, some WEDs faced weeks or even years of death threats discouraging them from incriminating corporations. The distributions of violence across each of the five manifestations almost always approximately follow the same patterns wherein repression, criminalization and violent targeting typically appeared together at similar rates, whereas displacement and murder appeared less often. Displacement and assassination are less common because they are the more extreme forms of retaliation deployed when repression, criminalization and violent targeting are not enough to deter mobilizations. All these more invisible violences occur over years of conflict, culminating in assassination. As such, the circumstances were subtly gendered at every stage, including exposure and vulnerability to conflicts, mobilization opportunities and experienced violence.

Table 1 | Binomial regression

Dependent variable: displacement (1) overall model test $P < 0.001$						
Independent variable	Estimate	SE	Z	P	VIF (<2.5)	Tolerance (>0.40)
WED	0.374	0.118	3.16	0.002	1.00	0.999
Rule of Law	-2.736	0.716	-3.82	<0.001	1.14	0.876
Gender equality	-3.985	1.087	-3.67	<0.001	1.14	0.875
Dependent variable: assassination (1) overall model test $P < 0.001$						
Independent variable	Estimate	SE	Z	P	VIF (<2.5)	Tolerance (>0.40)
WED	0.00296	0.145	0.0204	0.984	1.00	0.997
Rule of Law	-6.59842	0.911	-7.2464	<0.001	1.07	0.933
Gender equality	5.53347	1.294	4.2762	<0.001	1.07	0.932
Dependent variable: repression (1) overall model test $P < 0.001$						
Independent variable	Estimate	SE	Z	P	VIF (<2.5)	Tolerance (>0.40)
WED	0.538	0.111	0.523	<0.001	1.00	0.999
Rule of Law	-4.629	0.665	-6.96	<0.001	1.13	0.887
Gender equality	2.885	1.040	2.77	0.006	1.13	0.886
Dependent variable: criminalization of activists (1) overall model test $P < 0.001$						
Independent variable	Estimate	SE	Z	P	VIF (<2.5)	Tolerance (>0.40)
WED	0.686	0.115	5.97	<0.001	1.00	1.000
Rule of Law	-3.931	0.655	-6.00	<0.001	1.14	0.876
Gender equality	6.267	1.114	5.63	<0.001	1.14	0.875
Dependent variable: violent targeting of activists (1) overall model test $P < 0.001$						
Independent variable	Estimate	SE	Z	P	VIF (<2.5)	Tolerance (>0.40)
WED	0.883	0.114	7.76	<0.001	1.00	0.999
Rule of Law	-4.529	0.699	-6.48	<0.001	1.13	0.887
Gender equality	2.789	1.086	2.57	0.010	1.13	0.887

Structural patterns of violence towards WEDs. Note: For each nominal variable, reference levels are 1–1 (presence). $N = 2,051$. SE, standard error.

Given that WEDs experience violence owing to their marginalization as discussed above, although Le Billon and Lujala³³ only find that WED killings closely correspond to numbers of male defender killings, we argue that it is not how many women are killed versus other genders, but rather how women are killed that is gendered. For instance, slow violence was intertwined with direct violence. Health impacts including mental problems, industry-related illness or accidents, and malnutrition were often associated with women in cases with contexts with a gendered division of labour and thus gendered exposure and sensitivities to ecological consequences. Either gender's typical avenues of exposure to ecological health risks are not better or worse than the other, just different in how and where they were exposed. Notably, health impacts were not just those affecting women personally, but also consequences their communities suffered. WEDs often mobilized on behalf of family and community, supporting findings from other studies^{4,41,42}. Concerning social impacts, militarization, increased violence and crime, and increased corruption were associated with violence against WEDs because they reflect widespread impunity. Specific impacts on women such as sexual violence during environmental conflicts is not only physical, but also reinforces women's inferior positions and loss of agency/mobility by marking their bodies as less

than human^{4,43}. Social problems were associated with cases rather than women falling into vices such as substance abuse, domestic violence, gambling, prostitution and crime. Extractive industries' impoverishment of communities makes attaining socio-economic criteria for manhood difficult. Some emasculated men may engage in social ills, increasing women's burdens and vulnerability to violence⁴⁴.

Overall, an ecocide–genocide–gender connection is thus apparent in how assassinations and extractive violence were situated within contexts producing gender-specific vulnerabilities for women defenders. Ecocidal dispossession of lands and resources, as many of the EJAtlas cases corroborate, often began upon intrusion of masculinized extractive industries into communities⁵. Genocide caused cultural and physical erasure^{8,45} of peoples standing in the way of extractivism, and ecocide further accomplished such erasure through undermining women's agency. As occurred in the deadliest countries towards WEDs, changing land ownership regimes⁸ used patriarchal ideologies to foster ecocidal conditions (extermination, persecution, survivor assimilation and cultural erasure)⁴⁵ emboldening violence in subtly gendered manifestations of repression, criminalization, violent targeting and assassination. The ecocide of Indigenous peoples across Southeast Asian EJAtlas cases, for example, has distinctly gendered aspects. Many Southeast Asian Indigenous peoples formerly had alternative gender cosmologies beyond man–woman binaries and with relatively more egalitarian power relations. Colonization goes beyond territorial invasion. Consequently, colonization and ensuing extractive land grabbing brought new legal, administrative and market structures concentrating (often militarized) power among men²¹. We argue that, through discrimination and violence, these institutions committed ecocidal–genocidal–gendered violence by exterminating and persecuting Indigenous community leaders, erasing formerly egalitarian gender roles and relations, and assimilating survivors into marginalized, binary and unequal gendered labour and social divisions. Ecocide rewrites WEDs' histories and bodies as inferior and deserving of extermination. Ecocidal control of populations² then occurs as fear of and actually experienced gendered (lethal) violence not only deters mobilizations but also creates impunity as women are less able to mobilize safely and openly. Moreover, while most cases do not explicitly report WED involvement or violence, this reflects representational and mobilization inequalities. For instance, there is a difference in how Indigenous and non-Indigenous women defenders negotiate and are impacted by extractive violence in different ways^{4,46,47}. Such intersectional differences exist and should be explored in future work.

Methods

The EJAtlas (www.EJAtlas.org) is the largest online database recording environmental conflict cases in collaboration between activists and academics^{48–50}. The process of reporting cases involves four main stages. The first is identification of a case by either activists, citizens, academics or a representative of an environmental justice organization, and can be internal or external to the EJAtlas team. The second stage is writing the case according to established EJAtlas formatting and variables. The variables include conflict type (for example, fossil fuels and waste management), commodities (for example, coal, oil and land), impacted social groups (for example, farmers, Indigenous peoples and women), forms of mobilizations (for example, street protests and petitions), mobilization stage (for example, preventive, once impacts have been felt) and conflict outcome (for example, court case decision in favour of groups protesting (or not), assassinations, criminalization of activists, fostering culture of peace, project cancelled and so on). The third stage is review and feedback between report author(s), EJAtlas team members and experts knowledgeable about the case type, geographical region and/or core themes (for example, traditional knowledge, public health, gender issues and so on). The fourth stage is approving the case and publishing it under one of the five editorial members.

The database has been widely used in research about diverse themes within environmental conflict studies such as global analyses of environmental land defenders, assassinations, and mobilization types^{29,33} or regional analyses of colonialism at extractive frontiers^{40,51}. However, using the EJAtlas as a main data source has some limitations. Neither the EJAtlas nor other large-scale databases such as Global Witness cover all existing cases of environmental assassinations and violence against women defenders. The sample population is inherently limited to the information publicly available online. Because reporting on environmental injustices is geographically uneven, the data throughout the study thus are also skewed, and it is unknown how representatively the cases included capture the severity and spread of violent environmental conflicts occurring in various countries. The data here represent only a subsample of environmental conflicts related to assassinations and gender globally. Some cases are likely to be unintentionally excluded given not only biased geographical coverage, but also various countries' disparities in reporting paying attention to gender in environmental conflicts. More information is available about gendered violence and WED killings in Latin America and Southeast Asia compared with Africa. Africa indeed remains understudied across all academic disciplines and databases. Varying political tolerance towards media and academics documenting attacks means that, depending on region, not only are there fewer strong networks of contacts, but there is also less ability to speak out without brutal consequences. Disparities in rural versus urban siting, internet accessibility, language barriers and local educational attainment also mean there is weaker information exchange between existing groups, causing difficulty in obtaining regional data.

This paper, by reporting and examining global patterns of violence towards WEDs, provides novel theoretical contributions by relating extractivism⁵² and ecocide–genocide^{8,45} to issues women face. We use recorded variables from the EJAtlas case pool such as country and conflict type to understand contexts and conduct statistical tests answering the first question of where and under which circumstances WEDs are assassinated (Figs. 1, 2 and 3a,b). Binomial regression analyses using other EJAtlas variables such as the specific types of violence and impact, the World Justice Project's Rule of Law and the World Economic Forum's Gender Equality Index, as well as qualitative information drawn from reading the cases line by line were used to answer the second question of how WEDs experience structural violence (Table 1). Ecocide was then used as an analytical frame to better understand the data and draw out global patterns.

Between December 2019 and December 2022, 147 cases wherein WED were involved but not necessarily assassinated were collected by the first author and published in the EJAtlas. WED assassination cases already reported in the EJAtlas were also checked for accuracy, updated and included in this analysis. A data capture of all 3,545 cases in the EJAtlas was performed on 31 January 2022, logging variables in Microsoft Excel such as WED presence and conflict types, as well as slow violence and social impacts coded with 1 for the variables' presence or 0 for the variables' absence in the case. We then selected only cases from countries wherein WEDs were assassinated because assassinations are contextual to each country's sociopolitical factors^{29,40} and because it provides a more rigorous comparison if the cases are compared with cases not indicating WED assassinations in the countries. As such, countries with WED assassinations, to some extent, had different patterns than those without WED assassinations. For example, although Brazil is one of the top countries for defender killings, neighbouring Uruguay does not monitor environmental defender attacks whatsoever⁵³. Although there could be at least a few undocumented and unknown cases of WED assassinations there, Uruguay instead has the reputation of having an 'open government' owing to its relatively high levels of government stability and human development compared with other countries in the region⁵⁴.

Table 2 | Definition of variables

Dependent variables	Definition
Assassination (murder)	Death of one or more protestors, intentionally caused by a third party. Death can occur on the spot, for example when shooting to death environmental defenders, or be caused following wounds, rapes, tortures and so on ³³ .
Displacement	Forced or otherwise induced movement of peoples due to the conflictive project or activity. It includes displacement according to resettlement programmes or without any such scheme. It can be a direct impact of the conflictive project or an indirect, gradual consequence of it across time ³³ .
Repression	Threat to subdue or act of subduing protests by institutional or physical force. Includes a variety of tactics (frequently including violent and coercive actions, violating rights) taken by government, or security staff, militias or corporate actors, to quell dissent and protests ³³ .
Violent targeting	Physical harassment, injuring or assassinations of specific targeted persons, usually key activists, or to implant fear to defer environmental defenders' actions. Examples include violent threats to activists and their relatives, death threats, sexual threats, accident attempts and so on ³³ .
Criminalization	Criminal prosecutions of individuals and abuses of civil and human rights, the opening of criminal investigations unlikely to reach trial used to disarticulate, demoralize and discourage social protest, and the use of disproportionate sentences for offences to punish practices often deployed in protests ³³ .
Independent variables	Definition
WED	Women or women's organizations playing a key role in the mobilization against the contentious activity, either because they are affected by specific impacts (health, labour, household conditions, sexual exploitation, discrimination or assassination) or because they lead the main narratives of resistance ^{10,33} .
Rule of Law	A 0 to 1 ranked index of countries' jurisdictions maintained by the World Justice Project based on eight factors: constraints on government powers, absence of corruption, open government, fundamental rights, order and security, regulatory enforcement, civil justice and criminal justice ⁵⁷ .
Global Gender Gap Index	A 0 to 1 ranked index measuring gender equality across countries maintained by the World Economic Forum according to economic participation and opportunity, educational attainment, health, survival and political empowerment ⁵⁸ .
EJAtlas.org terms	Definition
Biomass and land conflicts	Disputes over forests, agriculture, fisheries and other sectors directly reliant on natural resources in territories with contested land use ³³ .
Mineral ores and building materials extraction conflicts	Opening and operating mines and mining-related harms ³³ .
Industrial and utilities conflicts	Disturbances from large-scale plants and the infrastructures supporting them ³³ .
Corruption	Abuse of entrusted power for private financial or political gain. Here this category captures those cases where corruption has been proven and/or condemned by a court judgement or evidenced and documented by mobilizing groups ³³ .

In addition to assassinations, we also selected displacement, repression, criminalization of activists, and violent targeting as conflict outcomes to deepen understanding of contextual, less understood violence in literature on environmental conflicts and ecocides^{9,55,56}. All five types of violent environmental conflict outcomes were selected from the EJAtlas database following their definitions (Table 2)^{33,50}. These variables were chosen owing to their established use as variables measuring violence in other EJAtlas works^{29,30,33,40} as well as their pertinence to the ecocidal–genocidal outcomes of extermination (assassination and displacement) and persecution (repression, criminalization and violent targeting)⁴⁵.

Firstly, each variable was used to calculate percentages of WEDs facing each type of violence. These calculations were based on log-linear regressions performed in Jamovi software 2.2.5, which generated *P* values and identified statistical significance. Statistical significance is the likelihood that the variables had a genuine effect on each other rather than seemed connected by chance. Variables with a *P* value of ≤ 0.05 were interpreted as having a 95% or higher probability that the variables had meaningful relationships. Variables that were statistically significant were used to analyse patterns in gender and violence. Secondly, to examine structural violence (Table 1), we performed a binomial regression analysis exploring how much increases in Rule of Law³⁰ and gender equality (independent variables) correspond to increases in each of the aforementioned five forms of violence (dependent variables)^{29,30} for martyred WEDs (factor). Rule of Law is an index rating countries' governance accountability from 0 to 1 on the basis of constraints on government powers, absence of corruption, open government, fundamental rights, order and security, regulatory enforcement, civil justice and criminal justice⁵⁷. Meanwhile, the Global Gender Gap Index measures countries' gender equality from 0 to 1 according to economic participation and opportunity, education, health/mortality and political empowerment⁵⁸. During the regression analysis, we also considered *P* values ≤ 0.05 and conducted validation checks to make sure the variance inflation factor (VIF) for the covariates was lower than 2.5 and tolerance was > 0.40 . Tolerance higher than 0.40 ensures low multicollinearity of each independent variable. Likewise, VIF < 2.5 indicates low inter-relationship among independent variables in our regression models. Definitions of each variable are in Table 2, while the methodological outline is in Supplementary Information.

Reporting summary

Further information on research design is available in the Nature Portfolio Reporting Summary linked to this article.

Data availability

All data are publicly available on the EJAtlas database (www.ejatlus.org). The database includes cases used in this paper, and each case in the EJAtlas repository contains the case summaries used for qualitative line-by-line analysis together with their original sources as well as the nominal variables used for quantitative log-linear and binomial analyses. The list of women defenders and case titles, links to corresponding EJAtlas cases, and log-linear and binomial analysis results are in Supplementary Information.

References

- Crook, M., Short, D. & South, N. Ecocide, genocide, capitalism and colonialism: consequences for Indigenous peoples and global ecosystems environments. *Theor. Criminol.* **22**, 298–317 (2018).
- Crook, M. & Short, D. Developmentalism and the genocide–ecocide nexus. *J. Genocide Res.* **23**, 162–188 (2021).
- Lynch, M. J., Fegadel, A. & Long, M. A. Green criminology and state-corporate crime: the ecocide–genocide nexus with examples from Nigeria. *J. Genocide Res.* **23**, 236–256 (2021).
- Tran, D. A comparative study of women environmental defenders' antiviolent success strategies. *Geoforum* **126**, 126–138 (2021).
- Lynch, M. J., Stretesky, P. B. & Long, M. A. Green criminology and native peoples: the treadmill of production and the killing of indigenous environmental activists. *Theor. Criminol.* **22**, 318–341 (2018).
- Moloney, C. J. & Chambliss, W. J. Slaughtering the bison, controlling Native Americans: a state crime and green criminology synthesis. *Crit. Criminol.* **22**, 319–338 (2014).
- Goyes, D., Mol, H., Brisman, A. & South, N. *Environmental Crime in Latin America: The Theft of Nature and the Poisoning of the Land* (Palgrave Macmillan, 2017).
- Dunlap, A. The politics of ecocide, genocide and megaprojects: interrogating natural resource extraction, identity and the normalization of erasure. *J. Genocide Res.* **23**, 212–235 (2021).
- Nixon, R. *Slow Violence and the Environmentalism of the Poor* (Harvard University Press, 2011).
- Tran, D., Martínez-Alier, J., Navas, G. & Mingorría, S. Gendered geographies of violence: a multiple case study analysis of murdered women environmental defenders. *J. Polit. Ecol.* **27**, 1189–1212 (2020).
- Veuthey, S. & Gerber, J. F. Accumulation by dispossession in coastal Ecuador: shrimp farming, local resistance and the gender structure of mobilizations. *Glob. Environ. Change* **22**, 611–622 (2012).
- Hartviksen, J. A matrix of violences: the political economy of violences against Mayan women in Guatemala's Northern Transversal Strip. *Int. Fem. J. Polit.* **24**, 87–110 (2022).
- Echart Muñoz, E. & Villarreal Villamar, M. del C. Women's struggles against extractivism in Latin America and the Caribbean. *Contexto Int.* **41**, 303–325 (2019).
- Sinclair, L. Beyond victimisation: gendered legacies of mining, participation, and resistance. *Extr. Ind. Soc.* **8**, 100–107 (2021).
- Sandvik, K. B. Gendering violent pluralism: women's political organising in Latin America. *Third World Thematics* **3**, 244–259 (2018).
- Tran, D. Realities beyond reporting: women environmental defenders in South Africa realities beyond reporting: women environmental defenders in South Africa. *Fem. Media Stud.* **00**, 1–18 (2022).
- Butler, J. *The Force of Nonviolence: An Ethico-political Bind* (Verso Books, 2020).
- Last line of defense. *Global Witness* <https://www.globalwitness.org/en/campaigns/environmental-activists/last-line-defence/> (2021).
- Dressler, W. Defending lands and forests: NGO histories, everyday struggles, and extraordinary violence in the Philippines. *Crit. Asian Stud.* **53**, 380–411 (2021).
- Barbosa, R. & Roriz, J. The subversive practice of counting bodies: documenting violence and conflict in rural Brazil. *J. Agrar. Change* **21**, 870–886 (2021).
- Großmann, K., Padmanabhan, M. & Afiff, S. Gender, ethnicity, and environmental transformations in Indonesia and beyond. *Austrian J. South-East Asian Stud.* **10**, 1–10 (2017).
- Tran, D. Murder of MAB defender investigating Samarco tailings dam failure in Mariana, MG, Brazil. *EJAtlas* <https://ejatlus.org/conflict/murder-of-mab-defender-following-samarco-tailings-dam-failure-in-mariana-minas-gerais-brazil> (2023).
- Quijano, A. Coloniality of power, eurocentrism, and Latin America. *Nepantla Views South* **1**, 533–581 (2000).
- Brown, K. Colombia's new killing spree: the war is over, but civilians are still being targeted. *Progressive* **82**, 55–58 (2016).
- Coleman, L. The gendered violence of development: imaginative geographies of exclusion in the imposition of neo-liberal capitalism. *Br. J. Polit. Int. Relat.* **9**, 204–219 (2007).

26. Candamil, J. & Mejia Duque, C. M. The role of women defenders of human rights in Colombia. *Forced Migr. Rev.* **41**, 33 (2012).
27. Narchi, N. E. Introduction environmental violence in Mexico: a conceptual introduction. *Lat. Am. Perspect.* **42**, 5–18 (2015).
28. Wright, M. W. Necropolitics, narcopolitics, and femicide: gendered violence on the Mexico–U.S. border. *Signs* **36**, 707–731 (2011).
29. le Billon, P. & Lujala, P. Environmental and land defenders: global patterns and determinants of repression. *Glob. Environ. Change* **65**, 102163 (2020).
30. Butt, N., Lambrick, F., Menton, M. & Renwick, A. The supply chain of violence. *Nat. Sustain* **2**, 742–747 (2019).
31. Parmanand, S. Duterte as the macho messiah: chauvinist populism and the feminisation of human rights in the Philippines. *Rev. Womens Stud.* **29**, 1–30 (2020).
32. Bradshaw, S., Linneker, B. & Overton, L. Extractive industries as sites of supernormal profits and supernormal patriarchy? *Gend. Dev.* **25**, 439–454 (2017).
33. Scheidel, A. et al. Environmental conflicts and defenders: a global overview. *Glob. Environ. Change* **63**, 102–104 (2020).
34. Fletcher, A. J. in *Water Security Across the Gender Divide* (eds Fröhlich, C. et al.) 35–58 (Springer, 2018).
35. Chiumbu, S. Media, race and capital: a decolonial analysis of representation of miners' strikes in South Africa. *Afr. Stud.* **75**, 417–435 (2016).
36. Joshi, D. K., Hailu, M. F. & Reising, L. J. Violators, virtuous, or victims? How global newspapers represent the female member of parliament. *Fem. Media Stud.* **20**, 692–712 (2020).
37. Fotaki, M. & Daskalaki, M. Politicizing the body in the anti-mining protest in Greece. *Organ. Stud.* <https://doi.org/10.1177/0170840619882955> (2020).
38. Hennings, A. The dark underbelly of land struggles: the instrumentalization of female activism and emotional resistance in Cambodia. *Crit. Asian Stud.* **51**, 103–119 (2019).
39. Park, C. M. Y. "Our lands are our lives": gendered experiences of resistance to land grabbing in rural Cambodia. *Fem. Econ.* **25**, 21–44 (2019).
40. Hanaček, K. et al. On thin ice—the Arctic commodity extraction frontier and environmental conflicts. *Ecol. Econ.* **191**, 107247 (2022).
41. Morgan, M. Women, gender and protest: contesting oil palm plantation expansion in Indonesia. *J. Peasant Stud.* **44**, 1179–1198 (2017).
42. Leguizamón, A. The gendered dimensions of resource extractivism in Argentina's soy boom. *Lat. Am. Perspect.* **46**, 199–216 (2019).
43. Sutton, B. *Bodies in Crisis* (Rutgers Univ. Press, 2010).
44. Angeles, L. Male as "Macho-Machunurin": bringing men and masculinities in gender and development studies. *Kasarinlan J. Third World Issues* **16**, 9–30 (2015).
45. Dunlap, A. The 'solution' is now the 'problem': wind energy, colonisation and the 'genocide–ecocide nexus' in the Isthmus of Tehuantepec, Oaxaca. *Int. J. Hum. Rights* **22**, 550–573 (2018).
46. Tran, D. Gendered violence martyring Filipina environmental defenders. *Extr. Ind. Soc.* **13**, 101211 (2023).
47. Tran, D. Beyond women and men: how extractive projects perpetuate gendered violence against environmental defenders in Southeast Asia. *J. Peasant Stud.* <https://doi.org/10.1080/03066150.2023.2174853> (2023).
48. Temper, L., Bene, D. & Martinez-Alier, J. Mapping the frontiers and front lines of global environmental justice: the EJAtlas. *J. Polit. Ecol.* **22**, 254–278 (2015).
49. Temper, L., Demaria, F., Scheidel, A., del Bene, D. & Martinez-Alier, J. The Global Environmental Justice Atlas (EJAtlas): ecological distribution conflicts as forces for sustainability. *Sustain. Sci.* **13**, 573–584 (2018).
50. Martinez-Alier, J. Mapping ecological distribution conflicts: the EJAtlas. *Extr. Ind. Soc.* **8**, 100883 (2021).
51. Pérez-Rincón, M., Vargas-Morales, J. & Martinez-Alier, J. Mapping and analyzing ecological distribution conflicts in Andean countries. *Ecol. Econ.* **157**, 80–91 (2019).
52. Acosta, A. in *Beyond Development. Alternative Visions from Latin America* (eds Lang, M. & Mokrani, D.) 61–86 (Rosa Luxemburg Foundation, 2013).
53. A crucial gap. *International Land Coalition* <https://www.landcoalition.org/en/resources/a-crucial-gap-the-limits-of-official-data-on-attacks-against-defenders-and-why-its-concerning/> (2020).
54. Cariboni, D. Uruguay's 'shadow pandemic' of violence against women is out of control. *OpenDemocracy* <https://www.opendemocracy.net/en/5050/uruguays-shadow-pandemic-of-violence-against-women-is-out-of-control/> (2020).
55. Navas, G., Mingorria, S. & Aguilar-González, B. Violence in environmental conflicts: the need for a multidimensional approach. *Sustain. Sci.* **13**, 649–660 (2018).
56. Christian, J. M. & Dowler, L. Slow and fast violence: a feminist critique of binaries. *ACME* **18**, 1066–1075 (2019).
57. What is the Rule of Law? *World Justice Project* <https://worldjusticeproject.org/about-us/overview/what-rule-law> (2018).
58. Global Gender Gap Report 2020. *World Economic Forum* http://www3.weforum.org/docs/WEF_GGGR_2020.pdf (2019).

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Author contributions

D.T. and K.H. contributed equally to the conceptualization and data interpretation. D.T. wrote, edited and selected cases in the EJAtlas, extracted nominal data from the cases, read them line-by-line, performed log-linear regression and was the main writer of the drafts. K.H. performed the data capture and troubleshooting, designed the statistical analysis and data visualization, performed binomial regression and supervised the drafting and literature review.

Competing interests

The authors declare no competing interests.

Additional information

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