SOCIAL SCIENCES

Global impacts of extractive and industrial development projects on Indigenous Peoples' lifeways, lands, and rights

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To what extent do extractive and industrial development pressures affect Indigenous Peoples' lifeways, lands, and rights globally? We analyze 3081 environmental conflicts over development projects to quantify Indigenous Peoples' exposure to 11 reported social-environmental impacts jeopardizing the United Nations Declaration on the Rights of Indigenous Peoples. Indigenous Peoples are affected in at least 34% of all documented environmental conflicts worldwide. More than three-fourths of these conflicts are caused by mining, fossil fuels, dam projects, and the agriculture, forestry, fisheries, and livestock (AFFL) sector. Landscape loss (56% of cases), livelihood loss (52%), and land dispossession (50%) are reported to occur globally most often and are significantly more frequent in the AFFL sector. The resulting burdens jeopardize Indigenous rights and impede the realization of global environmental justice.

INTRODUCTION

Indigenous leaders, scholars, and knowledge holders have long highlighted how their stewardship practices offer key solutions to maintain biodiversity, mitigate climate change, and engender positive social change more broadly (*1*–*3*). One of the ways in which Indigenous Peoples achieve these stewardship roles is by protecting their territories from extractive and industrial development pressures (*3*–*6*).

Although Indigenous Peoples have contested land encroachment and oppression from the advent of colonialism to the present (*7*–*9*), many continue to be severely affected by development projects causing environmental conflicts worldwide (*10*–*13*). Such social conflicts over extractive and industrial projects and their adverse social-environmental burdens occur despite numerous efforts to recognize and enforce Indigenous rights, including through national legislations and global policy instruments like the International Labor Organization's (ILO) Convention 169 and the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) (*14*, *15*).

In environmental conflicts, Indigenous Peoples face severe impacts, such as livelihood loss and land dispossession (*16*), environmental pollution (*17*, *18*), threats to their knowledge systems (*19*), racial- and gender-based violence (*20*–*23*), as well as intimidations and assassinations (*12*, *24*). Global reports about Indigenous rights violations have provided extensive qualitative evidence about such impacts, for instance, by compiling local testimonies, oral histories, and in-depth narratives from diverse case studies (*25*). Except for recent analyses on direct violence and killings affecting Indigenous Peoples in environmental conflicts (*10*, *26*), such global studies have left unanswered questions about the frequency of occurrence of the social-environmental impacts that conflictive development projects put on Indigenous Peoples' lifeways, lands, and rights worldwide.

To address this knowledge gap, we present here the largest quantitative analysis of reported social-environmental burdens that Indigenous Peoples bear in environmental conflicts worldwide. We quantify the extent to which Indigenous groups are affected by conflictive extractive and industrial development projects and provide extensive data on their exposure to a range of associated social-environmental impacts. Our results provide large-scale evidence of the magnitude of environmental burdens faced by numerous Indigenous Peoples worldwide and bring into focus the Indigenous rights violations associated with these burdens.

Methodologically, we build upon comparative and statistical approaches in political ecology aiming to reveal trends and patterns of environmental conflict characteristics in a more systematic way (*10*, *27*). Theoretically, our analysis is grounded in scholarship approaching environmental justice from the perspectives of Indigenous communities (*28*, *29*), showing that global environmental injustice is a structural undercurrent for many of the challenges faced by contemporary Indigenous Peoples (*29*–*32*). We share the views from Indigenous intellectual traditions where knowledge is understood as being fundamentally interwoven with practice and ethics (*1*, *33*–*35*). Largely drawing from these perspectives and following calls for the use of quantitative research approaches to

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inform policy concerned with Indigenous issues (*36*, *37*), we discuss the implications of our results for upholding Indigenous Peoples' rights and enhancing environmental justice, broadly understood here as the advancement toward the eradication of adverse social-environmental burdens compromising peoples' lifeways, lands, and rights.

Our analysis draws on the most comprehensive dataset available: 3081 environmental conflict cases, documented through the global Environmental Justice Atlas (EJAtlas) (data S1), which we collected through a crowdsourced and collaborative data collection process (*38*). Scholars have previously used selected EJAtlas data for diverse thematic, sectoral, and country-wide analyses of environmental conflicts [e.g., (*21*, *38*, *39*)] and for global characterizations of environmental conflicts and determinants of the occurrence of direct violence (*10*, *27*). This study examines the global EJAtlas dataset thoroughly from the lens of Indigeneity and through the consideration of a wide range of social-ecological impacts beyond direct violence. For this purpose, we identify through an extensive review process the names of the specific Indigenous groups involved in conflicts (see Supplementary Text) and combine the EJAtlas dataset with data on the spatial extent of Indigenous Peoples' lands (*40*) and data on the status of the languages spoken by the affected Indigenous groups (*41*, *42*). On this basis, we show the global overlap of conflictive extractive and industrial development projects with Indigenous Peoples' lands, describe the specific Indigenous groups most frequently affected in our dataset, and identify threats to Indigenous language use.

We assess the reported frequency of 11 adverse impacts globally and across six sectors and discuss their implications for environmental justice and Indigenous rights as recognized in UNDRIP.

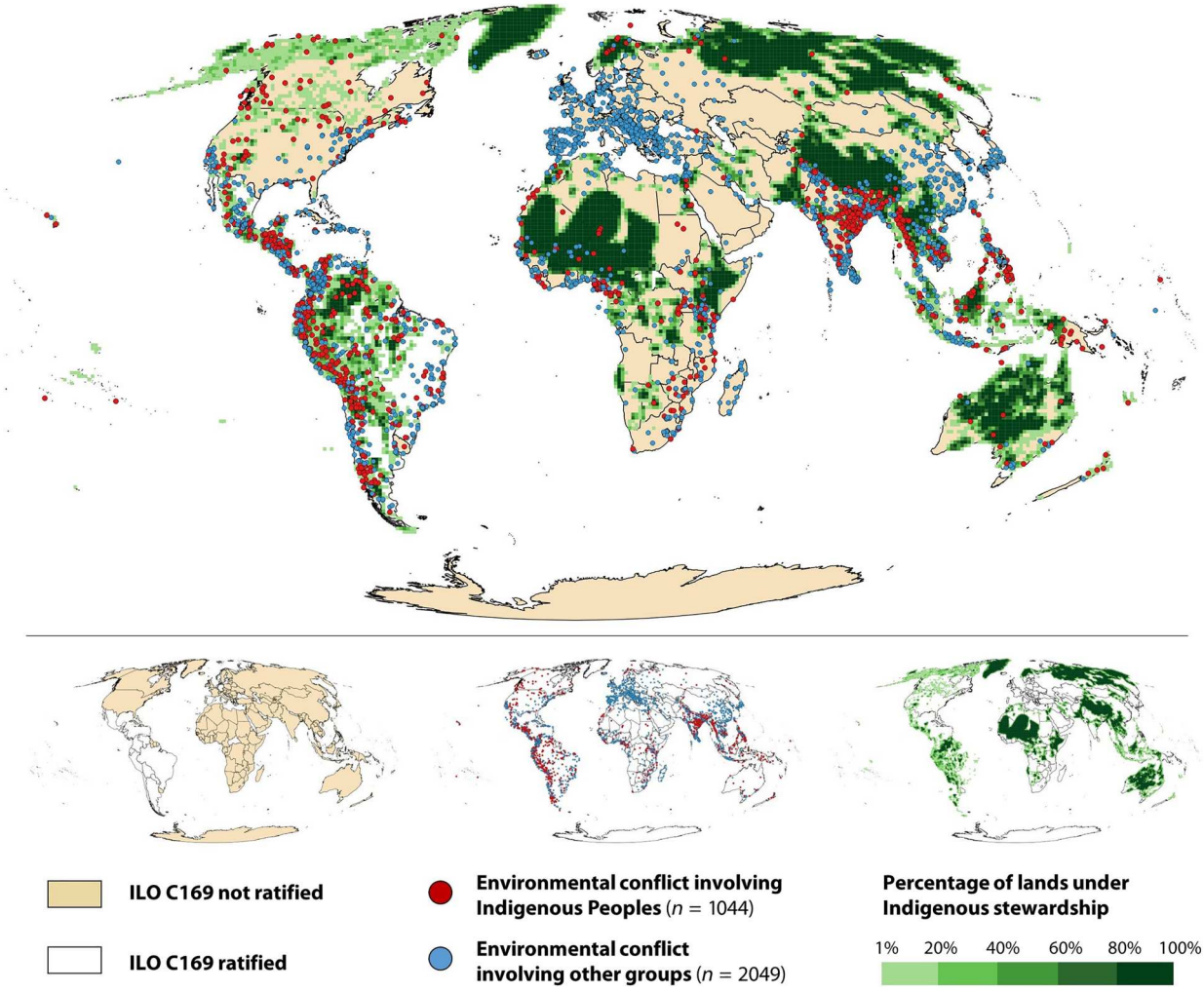

Fig. 1. Map of environmental conflicts involving Indigenous Peoples and other groups (*n* = 3081), ILO C169 signatory countries, and Indigenous Peoples' lands. The resolution is by necessity imprecise, as boundaries between Indigenous and other lands are often under dispute. Unmapped areas do not necessarily indicate an absence of Indigenous Peoples or an absence of conflicts, but areas for which an Indigenous connection cannot be inferred on the basis of publicly available geospatial data or no conflict data are available (*40*). A total of 95% of the environmental conflicts involving Indigenous Peoples began during or after the 1970s, while more than 50% of cases began between 2007 and 2020. Note that social-environmental impacts occurring in environmental conflicts have long-term effects that compromise Indigenous Peoples' lifeways well beyond the year when the conflict started. ILO C169 signatory countries are provided in table S3. UNDRIP was adopted in 2007 in the General Assembly by a majority of 144 states (table S4).

The assessed impacts include (i) livelihood loss, (ii) land dispossession, (iii) displacement, (iv) traditional knowledge loss, (v) landscape loss, (vi) militarization, (vii) impacts on women, (viii) deforestation, (ix) biodiversity loss, (x) water degradation, and (xi) soil degradation. The assessed sectors include (i) mining; (ii) fossil fuels; (iii) dams; (iv) the agriculture, forestry, fisheries, and livestock (AFFL) sector; (v) industries and other infrastructures, and (vi) other sectors (see Materials and Methods and tables S1 and S2 for definitions).

We acknowledge that the range of impacts analyzed here is necessarily incomplete and that crowdsourced convenience samples, such as the one analyzed here, have inherent data limitations arising from potential sample selection and reporting biases (see Materials and Methods for a detailed discussion). However, for global social-ecological phenomena for which the total population of cases is unknown and where access to information is constrained, the use of such datasets is often the only available alternative to advance our understanding of their patterns of occurrence. In this context, our study provides the largest global quantitative assessment of reported adverse social-environmental impacts to which Indigenous Peoples have been exposed in conflictive development projects. The findings are relevant to enhance current knowledge about the extent to which extractive and industrial development pressures affect Indigenous Peoples' lifeways, lands, and rights globally and can inform current policy efforts to uphold Indigenous Peoples' rights enshrined in UNDRIP.

RESULTS

Indigenous Peoples comprise about 6.2% of the world's population (*43*) and steward about a quarter of the world's terrestrial surface (Fig. 1) (*40*). According to our dataset, they are involved in at least 34% of documented environmental conflicts over extractive and industrial development projects (Fig. 2). This finding converges with evidence derived from other datasets, which shows that Indigenous Peoples often find themselves on the frontlines of industrial-extractive expansion (*11*, *26*). Most countries where conflicts occur endorse UNDRIP (table S4). However, only 24 countries have ratified the legally binding ILO C169 convention (Fig. 1 and table S3).

In the 1044 environmental conflicts involving Indigenous Peoples (data S2), we find at least 740 distinct Indigenous groups affected, representing at least 15% of the approximately 5000 Indigenous groups known worldwide. The Quechua (51 conflicts), Mapuche (31), Gond (30), Aymara (20), Nahua (20), Ijaw (20), Munda (19), Kichwa (19), Guaraní (18), and Karen (18) are the 10 Indigenous groups more frequently featured in the EJAtlas dataset. Substantial data gaps remain, particularly for Central Asia, Russia, and the Pacific (data S3). The actual number of affected Indigenous groups is expected to be much higher, particularly when considering that some regions have limited data coverage. Furthermore, an additional 7% of conflict cases involve other non-Indigenous place-based communities with long-term connections to their lands, including most prominently Quilombolas (35 conflicts) and other Afrodescendant communities (29).

The social-environmental impacts faced by many Indigenous Peoples in conflictive extractive and industrial development projects, as well as their long-term effects on livelihoods, lands and well-being, undermine the fulfillment of UNDRIP. Our results show the frequency of reported impacts at the global level and across sectors (Fig. 3; see Materials and Methods for a discussion of data limitations). Loss of landscape is reported most often in our dataset, with a global frequency of 56% of all cases, jeopardizing specifically UNDRIP article 25 on the right to maintain Indigenous spiritual relations with their traditionally used territories. Livelihood loss and land dispossession are reported globally in 52 and 50% of all cases, respectively. These impacts raise concerns over the fulfillment of UNDRIP articles 20 and 21, both addressing the rights to maintain, secure, and improve their economic and social systems and conditions, as well as article 26 on the right to exercise control over their lands, territories, and resources.

Other frequently reported impacts include deforestation (43%), biodiversity loss (43%), water degradation (40%), and soil degradation (31%), which severely compromise UNDRIP article 29 on the right to the protection and conservation of their environment and the productive capacities of their territories. In addition, displacement (43%) threatens article 10 protecting Indigenous Peoples from relocation without free, prior, and informed consent. Knowledge loss (43%) jeopardizes their right to maintain and protect their traditional knowledge (article 31); militarization (32%) provokes social and political concerns over the unrightful presence of armed forces in Indigenous territories (article 30); while specific impacts on women (20%) compromise the fulfillment of their special needs enshrined in UNDRIP article 22.

Extractive and industrial development also threatens Indigenous linguistic diversity (*44*). While environmental injustice puts stressors on all Indigenous languages, groups with smaller speaker populations are often less resilient to external pressures (*44*, *45*). A total of 45.7% of the Indigenous groups affected by environmental conflicts over development projects speak languages that are critically pressured (Fig. 2; see Materials and Methods for data sources and limitations). Threats to Indigenous language use and the different contexts of language awakening are generally concomitant to broader cultural pressures that undermine UNDRIP article 13.

According to our dataset, four sectors account for more than three-quarters of all environmental conflicts involving Indigenous Peoples: mining (24.7%), fossil fuels (20.8%), the AFFL sector (17.5%), and dams (15.2%) (Fig. 2). While the mining sector is implicated in the highest number of conflicts involving Indigenous Peoples (n = 258), the AFFL sector is associated with an alarmingly high frequency of reported impacts (Fig. 3). Specifically, deforestation (74% of cases), land dispossession (74%), livelihood loss (69%), and biodiversity loss (69%) are reported to occur significantly more frequently in the AFFL sector, compared to other sectors and the global average (table S5).

These impacts produce severe social-environmental burdens on Indigenous communities across all inhabited continents (Fig. 1) and pose a major barrier to advancing environmental justice and Indigenous rights globally. Our results highlight that efforts toward achieving zero tolerance of Indigenous rights violations (*46*) are urgently needed.

DISCUSSION

Our findings provide quantitative evidence of the breadth and depth of environmental injustices that many Indigenous Peoples face globally. Indigenous Peoples' lands intersect some of the world's most unexploited natural areas (*40*, *47*, *48*), which have been a target for extractive and industrial development and a

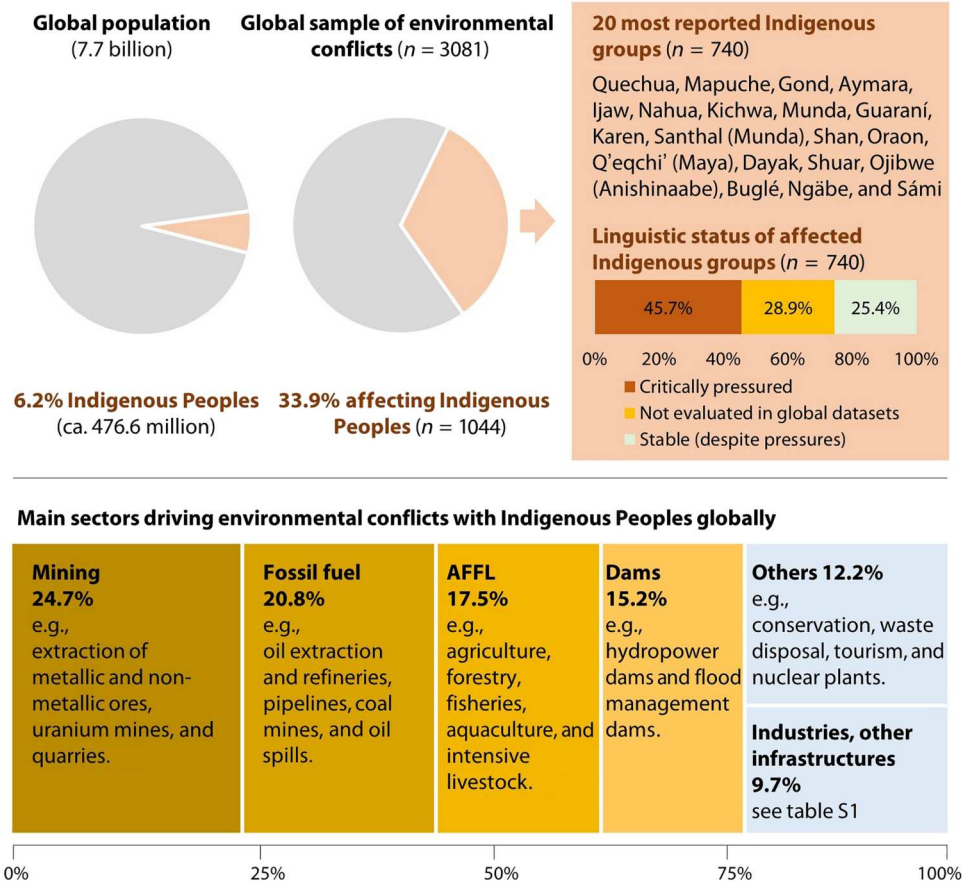

Fig. 2. Overview of environmental conflicts involving Indigenous Peoples. (**Top**) Left: Environmental conflicts involving Indigenous Peoples compared to the share of the Indigenous population of the world population. Right: Most reported Indigenous groups affected by environmental conflicts and their linguistic situation. (**Bottom**) Sectors causing environmental conflicts with Indigenous Peoples globally. Sectoral definitions and examples are provided in table S1. Population estimates refer to 2019 (*43*).

breeding ground for environmental conflicts from colonialism to the present (*7*, *11*–*13*). By showing that Indigenous Peoples' lifeways, lands, and rights continue to be substantially disrupted by the resource demands of the world economy's metabolism (*49*), this study complements previous Indigenous scholarship highlighting the colonial-economic drivers of environmental injustices (*29*, *30*). The resulting burdens are concomitant with multidimensional patterns of violence (*39*) and exacerbate legacies of intergenerational trauma and land dispossession (*50*).

Because of methodological limitations in gathering data on environmental conflicts globally, we note that our dataset cannot be considered complete and that potential reporting biases remain. The results should therefore be interpreted with caution, particularly regarding the number of Indigenous groups affected and the limited number of reported impacts discussed here. Furthermore, our data do not include information about how reported impacts are distributed within Indigenous communities and the possible differences in opinions among community members regarding the desirability of extractive and industrial development projects (*51*, *52*).

Nevertheless, the findings demonstrate the sheer size of Indigenous rights violations associated to industrial ways of life. International instruments like the ILO C169 convention and UNDRIP can play an important role for advancing Indigenous rights. Our results show that current levels of ratification, implementation, and monitoring are insufficient to ensure respect for such rights. The ILO C169 convention is now the only legally binding global instrument that safeguards the application of the principle of free, prior, and informed consent, yet most countries with lands under Indigenous stewardship and with environmental conflicts affecting Indigenous Peoples have not ratified it (Fig. 1).

While most countries endorse UNDRIP, results suggest that signatory nations are not upholding their commitments to protect Indigenous rights (Fig. 3). UNDRIP rights violations occur across all sectors addressed in this study, whereas land dispossession, livelihood loss, and environmental degradation are significantly more reported in the AFFL sector. These issues can be addressed by strengthening the protection of Indigenous rights over their lands (*53*, *54*). Furthermore, due diligence of corporations within the AFFL sector may be enacted if shareholders and consumers demand additional scrutiny, accountability, and action. Last, efforts to advance UNDRIP will require further attention to industries and corporations, causing environmental harm and violating environmental rights, which now remain insufficiently addressed in the declaration (*55*).

Reported social-environmental impacts of conflictive development projects affecting Indigenous Peoples
(UNDRIP articles specifically jeopardized by reported impacts)

	Global average	AFFL	Dams	Fossil fuels	Mining	Industries, infra-structures	Other
Loss of landscape (articles 25 and 29)	56% ***53–59%***	62% ***54–69%***	58% ***50–66%***	55% ***48–62 %***	53% ***46–59 %***	56% ***46–66 %***	52% ***43–61 %***
Livelihood loss (articles 20 and 21)	52% ***49–55%***	69% ***62–75%***	48 % ***40–56%***	47% ***40–54 %***	47% ***40–53 %***	48% ***38–58 %***	54% ***45–62 %***
Land dispossession (article 26)	50% ***47–53%***	74% ***67–80%***	53 % ***45–61%***	44% ***38–51 %***	40% ***34–46 %***	39% ***30–49 %***	49% ***40–58 %***
Deforestation (article 29)	43% ***40–46%***	74% ***67–80%***	50 % ***42–58%***	35% ***28–41 %***	39% ***33–45 %***	29% ***21–39 %***	22% ***15–30 %***
Biodiversity loss (article 29)	43% ***40–47%***	69% ***62–75%***	40% ***32–48%***	45% ***38–52 %***	34% ***28–40 %***	34% ***25–44 %***	35% ***27–44 %***
Displacement (article 10)	43 % ***40–46%***	54% ***47–61%***	52% ***44–60%***	41% ***34–47 %***	34% ***28–40 %***	34% ***25–44 %***	48% ***39–57 %***
Knowledge loss (articles 24 and 31)	43% ***40–46%***	49% ***41–56%***	42% ***34–50%***	44% ***37–51 %***	39% ***33–45 %***	39% ***30–49 %***	43% ***35–52 %***
Water degradation (article 29)	39% ***37–42%***	43% ***36–51%***	37% ***30–45%***	43% ***37–50%***	48% ***42–55%***	26% ***18–36%***	23% ***16–31%***
Militarization (article 30)	32% ***29–35%***	30% ***24–37%***	33% ***26–41%***	26% ***21–33%***	40% ***34–46%***	27% ***19–37%***	29% ***22–38%***
Soil degradation (article 29)	31% ***28–34%***	33% ***27–41%***	18% ***12–25%***	35% ***29–42%***	43% ***37–49%***	22% ***15–32%***	21% ***15–30%***
Impacts on women (article 22)	20% ***18–23%***	23% ***18–30%***	21% ***15–28%***	19% ***14–25%***	21% ***16–27%***	21% ***14–31%***	16% ***10–24%***
Number of cases (*n*)	1044	183	159	217	258	100	127

Legend: 0% 10% 20% 30% 40% 50% 60% 70%

Fig. 3. Heatmap of reported social-environmental impacts and UNDRIP rights (in parentheses) jeopardized across sectors, causing environmental conflicts with Indigenous Peoples (*n* = 1044). Confidence intervals (95%) of reported frequencies are shown in bold italics in the figure and in detail in table S5. Additional uncertainty in reported frequencies may result from potential data reporting biases (see Materials and Methods for discussion on data limitations). Impact categories are not mutually exclusive; percentages do not add up to 100% (table S1).

Current initiatives aimed at upholding Indigenous rights, and advancing environmental justice may leverage the quantitative evidence provided in this study. Such initiatives include, for example, governmental efforts to develop corporate due diligence policies and trade agreements conditional upon upholding UNDRIP responsibilities, as well as civil society and Indigenous divestment campaigns targeting corporations involved in rights violations. The case data presented here on an aggregate level are openly available through the EJAtlas (data S2) and include comprehensive and case-specific data on the specific sectors and entities involved in environmental conflicts with Indigenous Peoples. These data can be used accordingly to inform due diligence policies, accountability initiatives, and divestment campaigns, thereby supporting the transformation of the global economy toward one that respects environmental justice and Indigenous Peoples′ rights.

MATERIALS AND METHODS

Environmental conflict data

Environmental conflicts generally describe a diverse range of contentious mobilizations related to environmental issues (*56*). Here, we specifically address those types of environmental conflicts that are documented in the global EJAtlas, an online database that gathers information on conflict cases through a large network of contributors. In the EJAtlas, an environmental conflict case refers to the contentious mobilizations of civil society actors in which explicit social-environmental claims are made against a specific project or economic activity that is pursued by state, corporate, and, sometimes, also illicit actors (e.g., illegal loggers). Only cases that are verifiable through secondary sources previously published elsewhere are included in the EJAtlas. These sources include scholarly papers, civil society reports, lawsuits, formal complaints, news

articles, and others. The use of multiple sources enables to cross-check and triangulate information, thereby helping to reduce, to some extent, reporting biases produced by using only a single type of source (e.g., media sources and civil society reports) (*57*). The completeness and quality of all information about conflict cases are checked by a permanent team of moderators who are co-authors of this article. Detailed information regarding the origin, conceptual background, methodology, and general characteristics of the EJAtlas database can be found in (*10*), (*38*), and (*58*).

Sample characteristics

The sample analyzed in this study includes 3081 environmental conflicts, of which 1044 cases involve Indigenous Peoples (see data S1 and S2). This sample only includes extractive and industrial development projects that resulted in environmental conflicts, but not cases of industrial extraction in general. One conflict case includes multiple conflict events and repeated mobilizations over the same project causing the conflict. Each case entry details these events through coded fields accompanied by qualitative descriptions. The sample covers conflicts occurring predominantly during the last decades: 95% of the conflicts began during or after the 1970s, while more than 50% of the cases occurred between 2007 and 2020. We chose this large temporal coverage to include the widest information available on how often specific social-environmental impacts are reported across conflicts involving Indigenous Peoples. Furthermore, the discussed social-environmental impacts (e.g., deforestation, land dispossession, and livelihood loss) ramify through complex pathways and generate legacies that compromise Indigenous Peoples′ lifeways well beyond the year when the conflict began. The consideration of long-lasting impacts is therefore profoundly relevant to understand the challenges faced by contemporary Indigenous Peoples. For a detailed documentation of the case selection procedure used here, see Supplementary Text.

The analyzed EJAtlas sample is a large convenience sample of documented environmental conflicts over a diverse range of extractive and industrial projects, whereas the total number of environmental conflicts worldwide is unknown. The use of this type of sample has become common in environmental conflict research (*10*, *26*, *27*) and is often the only available option to enhance our understanding of global social-environmental phenomena with an unknown population and constrained data access (*10*, *38*). For example, quantitative studies of large-scale land acquisitions and their social-ecological implications commonly rely on crowdsourced databases such as the Land Matrix (*59*–*61*). Another database that offers crowdsourced data on environmental conflict events globally are Global Witness′ annual statistics of killings of environmental defenders (*46*), used, for example, in analyses of environmental conflicts involving Indigenous Peoples (*26*, *27*). However, this dataset does not provide information on the social-environmental impacts of the projects provoking the conflicts. The EJAtlas database offers the largest global coverage of reported social-environmental impacts affecting Indigenous Peoples in environmental conflicts. It enables us to improve our understanding of the reported frequency of these, at a scale that has not been possible so far.

Sample limitations

Because of the inherent characteristics of crowdsourced convenience samples, important limitations for data interpretation apply. First, the data used here are only a sample and not a complete inventory of environmental conflicts, which is not possible to obtain at the global level. Thus, the number of groups of Indigenous Peoples identified here represents a conservative lower boundary of the minimum of Indigenous Peoples affected by conflictive resource use projects worldwide but does not indicate the actual number of affected groups that is unknown. At the country level and for regions with adequate media coverage, independent academia, and strong civil society, we encourage to contrast our results with further systematic research, such as systematic screenings (*62*). Second, data gaps on environmental conflicts remain for specific geographic regions, i.e., Russia and Mongolia, Central Asia, and the Pacific. This is because of several reasons, including a lack of collaborators, or censorship, among other factors (*10*). Environmental conflicts involving Indigenous groups from these areas are therefore underrepresented in the sample. Third, information retrieved from secondary data sources, such as formal lawsuits, scholarly papers, or newspaper reports may, in some cases, dismiss the involvement of specific Indigenous groups despite their presence, for example, because of a lack of legal recognition of specific groups or lack of focus on Indigenous issues, among other reasons. Thus, the identified percentage of conflicts involving Indigenous Peoples (Fig. 2) represents a conservative and geographically biased estimate, while the actual number is possibly higher and more ubiquitous.

Analysis of reported impacts

The EJAtlas provides information on a range of reported social-environmental impacts, caused by a conflictive project. Information about these impacts is retrieved from the same secondary sources used to create and verify conflict entries, i.e., scholarly papers, civil society reports, lawsuits, formal complaints, and newspaper articles. The use of such nonacademic knowledge sources (e.g., newspaper accounts) has become commonplace in the study of protest events (*63*), and local reports about social-ecological impacts have become important data sources to complement other scientific impact assessments, particularly in the context of limited data availability (*64*, *65*). Furthermore, reported and perceived impacts are important to consider, because they partake in creating people′s realities and affected communities often act in response to them (*17*, *66*).

The reported impacts assessed in this study include (i) livelihood loss, (ii) land dispossession, (iii) displacement, (iv) traditional knowledge loss, (v) landscape loss, (vi) militarization, (vii) impacts on women, (viii) deforestation, (ix) biodiversity loss, (x) water degradation, and (xi) soil degradation. These impacts were selected on the basis of the criteria of data availability and relevance for the UNDRIP. Furthermore, given the cross-sectoral and global scope of our analysis, we selected only impacts that apply to a wide range of projects, while we did not assess more specific impacts linked to specific project types or sectors (e.g., EJAtlas impact variables "oil spills" or "mine tailings"). All impacts are mutually not exclusive, i.e., they can occur simultaneously in the same conflict. Table S2 provides definitions of all the impact variables used in this study.

We note that these impacts represent only a selection of impacts to which Indigenous Peoples may be exposed in conflictive extractive and industrial development projects. Furthermore, reported data (e.g., newspaper sources) may be subject to various forms of biases, including selection biases (e.g., impacts considered as worthy of media coverage), description biases (e.g., accuracy of impact description and framing of the event), and diverging

understanding of their specific causes (*63*, *67*). As a case in point, "impacts on women" appear in our dataset less frequently than other impacts, which our team has attributed to the fact that gender aspects are not considered equally important across all regions (*68*), thus generating a selection bias. Moreover, while we report impacts on women as an important aspect of gendered impacts, data availability and reporting bias limits the assessment of other important gendered impacts, such as impacts on people who self-identify as lesbian, gay, bisexual, transgender, queer and questioning, and two-spirit (LGBTQ2S), among others. More generally, we note that extractive and industrial development projects may provoke other human rights violations beyond the UNDRIP concerns discussed here (*69*, *70*). In addition, our dataset does not include information on intracommunity dynamics vis-à-vis conflictive projects, although there is evidence that the burdens and benefits of such projects are frequently unevenly distributed within communities and that different community members may have different opinions regarding their desirability (*51*, *52*).

We acknowledge these data limitations and the restricted scope of our analysis and note that the absence of data on these and other issues in our analysis does not imply their absence in environmental conflicts over extractive and industrial development projects. While potential reporting biases introduce some degree of uncertainty over the global frequencies of reported impacts, in addition to the confidence intervals (table S5), we believe that our results are, nevertheless, of high scholarly relevance as they push the boundaries of the knowledge frontier of Indigenous Peoples' realities vis-à-vis extractive and industrial development pressures. Our dataset provides a contextually rich yet globally relevant evidence basis to inform current efforts toward achieving zero tolerance of Indigenous rights violations (*46*).

Sectoral analysis

We classified environmental conflicts into six mutually exclusive categories according to the main sectors that provoked the conflicts: (i) AFFL, (ii) dams, (iii) mining, (iv) fossil fuels, (v) industries and other infrastructures, and (vi) other conflicts. To arrive at this classification, all environmental conflict cases involving Indigenous Peoples were manually screened to identify the main sector causing the conflict. In cases where several sectors were involved in environmental conflicts, the sector highlighted by the case contributor as the main sector, causing the conflict was chosen to classify the case. Table S1 provides definitions and examples of the sectoral categories used in this study.

Data on Indigenous Peoples' lands and languages

The definition of Indigeneity adopted here largely aligns with those of the ILO Indigenous and Tribal Peoples Convention 1989 (no. 169) article 1 [(*14*); see Supplementary Text for details]. We used the boundaries of Indigenous lands mapped in (*40*), who identified Indigenous lands across 87 countries or politically distinct areas. This dataset represents the most comprehensive assessment of terrestrial lands where Indigenous Peoples have customary ownership, management, or governance arrangements in place, regardless of legal recognition (*47*, *48*). It is based on 127 publicly available sources, including cadastral records, participatory maps, and census data. We acknowledge that voids in these maps do not necessarily imply an absence of Indigenous Peoples or their lands but rather areas for which an Indigenous connection cannot be determined from publicly available geospatial resources. Given that some of the boundaries of Indigenous Peoples' lands are fiercely disputed, we present information only as a percentage of land in 100-km^2 grid cells. We also note that, while data by Garnett *et al.* (*40*) report on Indigenous Peoples' lands, the EJAtlas data report on Indigenous actors involved in environmental conflicts. However, they may have moved to places where no Indigenous stewardship arrangements are in place. These characteristics and differences of the two datasets explain why some conflicts appearing in Fig. 1 are in areas where no Indigenous Peoples' lands are identified in (*40*). In addition, we gathered data on the linguistic status of the languages spoken by the Indigenous groups in our database, from the UNESCO's Atlas of the World's Languages in Danger (*41*), and the Ethnologue (*42*). See data S3 and Supplementary Text for details, as well as limitations about these datasets.

Statistical analysis

We used descriptive statistics to quantify and characterize the exposure of Indigenous Peoples to reported social-environmental impacts and to assess their frequency of occurrence across extractive and industrial sectors. To understand the uncertainty in our observations of reported conflicts involving Indigenous Peoples compared to reported conflicts not involving Indigenous Peoples, we conducted a bootstrap analysis, in which we sampled and summarized, with replacement, 1044 new observations from the original dataset. This step was repeated for 1000 iterations to approximate the distribution of the statistics of conflicts involving Indigenous Peoples. The bootstrap results showed a normal distribution, with a proportion of conflicts involving Indigenous Peoples at 33.8%, with a 95% confidence interval of 32.3 to 35.45%. Confidence intervals were then calculated for all assessed impacts (table S5). We used Pearson's chi-square tests of independence to examine the associations between sectors and impacts affecting Indigenous Peoples (table S5). Reported P values are two-tailed. The significance level was set at 5%.

Research positionality

We are an epistemically, culturally, and disciplinarily diverse group of authors, concerned with global environmental injustices. Each of us brought distinct perspectives to this research, on the basis of our personal and professional experiences, including our numerous engagements with civil society groups, Indigenous Peoples, grassroots organizations, and local communities working within the epistemic community of environmental justice. This positionality inevitably affects our analysis and interpretation. Four coauthors (A.H.B., D.M.D.-C., I.G., and K.P.W.) self-identify as Indigenous and bring perspectives from their cultural contexts and communities to this work (i.e., Oraon, Arawak Taíno, Karai-Karai, and Potawatomi communities, respectively). Although our overall framework is heavily influenced by Western epistemic traditions, we strive to address environmental justice from Indigenous perspectives, as informed by Indigenous intellectual and scholarly traditions (*28*–*35*). We are aware that Indigenous Peoples are not a homogenous and generalized group of people but sovereign and unique nations of peoples and communities with different values and aspirations. We understand the collective rights of Indigenous Peoples as a fundamental human right, and we respect and acknowledge the efforts associated with the development and implementation of UNDRIP (*15*).

Supplementary Materials

This PDF file includes:
Supplementary Text
Tables S1 to S6
Legends for data S1 to S3

Other Supplementary Material for this manuscript includes the following:
Data S1 to S3

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