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Coastal conflicts cause environmental and social harms to Indigenous Peoples worldwide

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Socio-environmental conflicts linked to environmental change and resource use are increasing in coastal regions worldwide, with harmful impacts on ecosystems and well-being. Indigenous Peoples are often disproportionately affected due to historical and structural marginalization. Yet, impacts on coastal activities remain understudied. Here, we analyze 401 socio-environmental conflicts involving at least 275 Indigenous ethnic groups, examining their geographic distribution, drivers, and consequences. We find that conflicts are unevenly distributed, and primarily driven by energy production, mining, and biomass sectors. Reported impacts include biodiversity loss, degradation of landscapes and seascapes, well-being degradation, and the destruction of or displacement from ancestral lands and seas. Impacts differed substantially by sector and the level of Indigenous rights recognition. These findings highlight the importance of recognizing, respecting and protecting Indigenous rights, cultures and values to support more just and sustainable coastal development.

The current global polycrisis, marked by unprecedented biodiversity loss, climate change, pollution, and growing economic inequalities, is undermining human health and societal well-being through multiple direct and indirect pathways, and is fueling both the number and diversity of conflicts worldwide. Communities that are closely intertwined with nature, including many Indigenous Peoples, are disproportionately experiencing land and sea dispossession, jeopardizing the natural resources on which their livelihoods and sociocultural practices. Although Indigenous groups are unevenly affected, their experiences remain highly diverse and are shaped by distinct socio-cultural, political and ecological contexts. Dispossession often results in social and economic marginalization, with some estimates indicating that Indigenous Peoples are two to three times more likely to live in extreme poverty compared to non-Indigenous populations[1]. These inequities exacerbate environmental, economic, and social vulnerabilities, heightening susceptibility to climate change and other pressures. Within this context, the term impact is used as an analytical descriptor for the cumulative, structurally produced harms from externally driven activities that emerge due to long-standing colonial, extractive and governance inequalities. Rather than being viewed as a uni-directional outcome of isolated events, these impacts are understood as relational and historically situated[2]. These structural inequalities are particularly acute for Indigenous women, who faced compounded ethnic and gender-based discrimination[3,4]. To address the global environmental crisis, Indigenous Peoples must be formally recognized and involved in decisions, while ensuring cultural survival and environmental justice (i.e., equal recognition, participation and distribution of social and environmental benefits between different human groups, classes, ethnicities, gender, and age). This requires upholding the UN Declaration on the Rights of Indigenous Peoples (UNDRIP) and other emerging rights, recognizing customary territories, and respecting Free, Prior and Informed Consent (FPIC) before any projects are implemented. In doing so, we explicitly avoid pan-Indigenizing perspectives by recognizing that Indigenous Peoples are not a homogeneous group, but encompass a wide diversity of identities, governance systems and relationships with nature[5].

Worldwide, many Indigenous Peoples face socio-environmental conflicts, which leads to the inability to exercise biocultural rights, dispossession, environmental pollution, erosion of knowledge systems, exclusion from decision-making, threats to food sovereignty, and gender-based and ethnic violence, including intimidation and assassination[6,7]. Conflicts emerge in friction contexts[8] in which Indigenous Peoples are coping with the multiple consequences of decisions made out of their scope and of their cultural matrices, individually and collectively threatening in

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diverse ways. The burden on Indigenous Peoples living in coastal areas is even greater given the combined vulnerability of coastal areas and the marginalization of Indigenous Peoples, causing synergistic impacts. Previous research has documented socio-environmental conflicts affecting Indigenous Peoples worldwide[7], yet most studies aggregate conflicts across terrestrial and coastal contexts. Although it is known that the way many Indigenous Peoples interact with terrestrial or coastal ecosystems is different[9], and that recognition of cultural rights is less frequent in the ocean than in terrestrial lands[10], the specific ecological and socio-cultural effects of Indigenous communities in coastal zones remain poorly understood. Additionally, there is a gap in global studies investigating the relationship between Indigenous Peoples and coastal governance[11]. Coastal regions, defined here as the land up to 30 km from the coastline, are unique because they connect terrestrial and aquatic ecosystems, and are the source of livelihood for almost half of the global population[12]. Marine resources underpin both cultural identity and subsistence, making conflicts in these areas particularly acute and socially relevant. Indeed, seafood consumption among coastal Indigenous Peoples is estimated to be three times higher than the global average[13].

The oceans are historically central to diverse human societies and must be studied considering its unique importance[14,15]. For many Indigenous Peoples and traditional communities, the ocean has been central for multispecies connection, spirituality, knowledge, food and livelihoods[16]. Yet, coastal zones have also been historically at the frontiers of colonial expansion, leaving profound legacies of cultural destruction, particularly during European colonialism between the 15th and 18th centuries, and continuing into the 20th century[17–19]. Colonial processes lead to ethnocide and violations of biocultural rights through violence, enslavement, cultural suppression and the spread of European diseases. The seriousness of these colonial harms can be directly observed in the modern socioeconomic conditions of many countries and entire regions of the world[20]. For example, the Beothuk of Canada were decimated in the early 1800s[21]; the Kawésqar of Chile suffered systematic violence under the Chilean state in the late 19th century[22]; and the Tupinambá of Brazil, once considered extinct, have only recently reclaimed recognition of their rights after decades of struggle[23,24]. Indigenous resurgence, the reinvigoration and reestablishment of Indigenous ways of living, is linked to the management, restoration, and conservation of marine and coastal ecosystems[25]. Resistance to settler-colonial governance of oceans, ocean resource extractivism and commoditization have been expressed through coastal Indigenous practices based on epistemologies of the marine landscape that emphasize storytelling, reciprocity and relationality with human and nature[26,27].

Coastal areas are acutely susceptible to the adverse effects of global change, a salient issue that is further compounded by their position at the intersection of land and ocean facing critical risks. Many coastal Indigenous communities therefore remain especially vulnerable to coastal pressures, including tourism, pollution, habitat alteration, climate change, and the overexploitation of marine resources[28]. Small islands and low-lying coastal zones are particularly exposed to climate change impacts such as ocean warming, sea-level rise, flooding and coastal storms[28–30]. Coastal hazards such as flooding, sea level rise, and storm and wave effects, impose unique justice challenges, threatening marginalized human populations often due to the higher risk locations of living, reduced resources to recover from negative effects, and lower access to government and institutions[31]. Large-scale development and infrastructure projects further exacerbate the vulnerability of coastal ecosystems[32], with more than 95% of the world's coastal areas[33] now under high human pressure[34]. These pressures drive socio-environmental conflicts that often result in dispossession[28,35], cultural erosion, environmental degradation, and violations of fundamental rights[7,36]. In their most extreme forms, such conflicts involve direct violence and killings[7,37].

Many contemporary practices echo colonial patterns: even when carried out by modern states rather than historical empires, the dismissal of Indigenous rights, knowledge, and voices persists, and intimidation, coercion, and exclusion from decision-making continue, though often less overtly or socially sanctioned[38,39]). Failing to understand and address these conflicts risks undermining global sustainability goals and perpetuating environmental injustices. Yet, despite previous research on socio-environmental conflicts[7,35,37,40–43], comprehensive global assessments focusing specifically on Indigenous coastal communities remain scarce.

To contribute to filling knowledge gaps on this important topic, we created a database of socio-environmental conflicts affecting Indigenous coastal communities worldwide drawing from the EJ Atlas. These conflicts stem from economic activities such as energy production, mineral extraction, land and biomass management, and infrastructure development. We then used descriptive statistics to assess the exposure of Indigenous coastal communities worldwide to different forms of harm, identify the most affected regions, the economic activities responsible, and the ethnic groups most severely impacted. We also explore the role of political and legal frameworks recognizing Indigenous rights, analyzing statistically whether and how they contribute to securing rights and advancing environmental justice. Further detail on methods are provided at the end of the manuscript. Given the absence of a universally accepted definition of 'Indigenous Peoples', we follow United Nations guidelines, which emphasize self-identification and community recognition as key criteria. To avoid over-generalization, we use specific terms, specifically to Indigenous Peoples, such as First Nation, Aboriginal, pueblos originarios, tribes, afrodescents, or names of particular ethnic groups, when they appear in conflict datasets. In line with established usage in academic literature, and global reports, and following Brondízio et al.[41](2021), we cautiously employ the inclusive term "Indigenous Peoples" where appropriate. While we use the term "Indigenous Peoples" as an analytical category, we remain attentive to its limitations and the risk of masking important differences across groups.

Results

We identified 401 socio-environmental coastal conflicts directly or indirectly affecting Indigenous Peoples worldwide. Here, we present results on the sectoral drivers, geographical distribution, intensity, impacts, differences by sector, differences by level of rights recognition, and groups most affected.

Sectors driving the conflicts

Energy production conflicts (e.g., fossil fuels or wind farms) were most frequent, accounting for 126 cases (30% of the total), followed by Mineral ores and building materials extraction (18.4%, $N = 74$), and unsustainable management of biomass and land, including forests, agriculture, fisheries and livestock (17.9%, $N = 72$) (Supplementary Fig. 1a). Conflict intensities were predominantly high (30%, $N = 129$) or medium (40%, $N = 167$) (Supplementary Fig. 1b). Sectors with the highest percentage of high-intensity conflicts were related to water management (50%, $N = 12$), tourism (40%, $N = 6$), and infrastructure and built environment (35%, $N = 16$, Supplementary Fig. 1b).

Geographic distribution and intensity of conflicts

Geographically, Southeast Asia had the highest number of conflicts ($N = 82$), followed by South America ($N = 57$), Central America ($N = 50$), and North America ($N = 43$) (Fig. 1a). Further, regions such as North America and West Africa emerge as hotspots of high-intensity impacts due to energy production conflicts, while South America and Southeast Asia concentrate most conflicts associated with unsustainable management of biomass and land resources. Southeast Asia was also the region most affected by mineral extraction (Fig. 1a).

Environmental and social impacts of the conflicts

We categorized the impacts of extractive economic activities as environmental, socioeconomic, and health-related (Supplementary Fig. 2). The most frequent environmental impacts were 'biodiversity loss' (e.g., wildlife, agrobio-diversity), 'loss of landscape and esthetic degradation', 'deforestation and loss of vegetation cover', 'surface water pollution/decreasing water quality' (e.g., physico-chemical, biological) and 'food insecurity' (e.g., crop

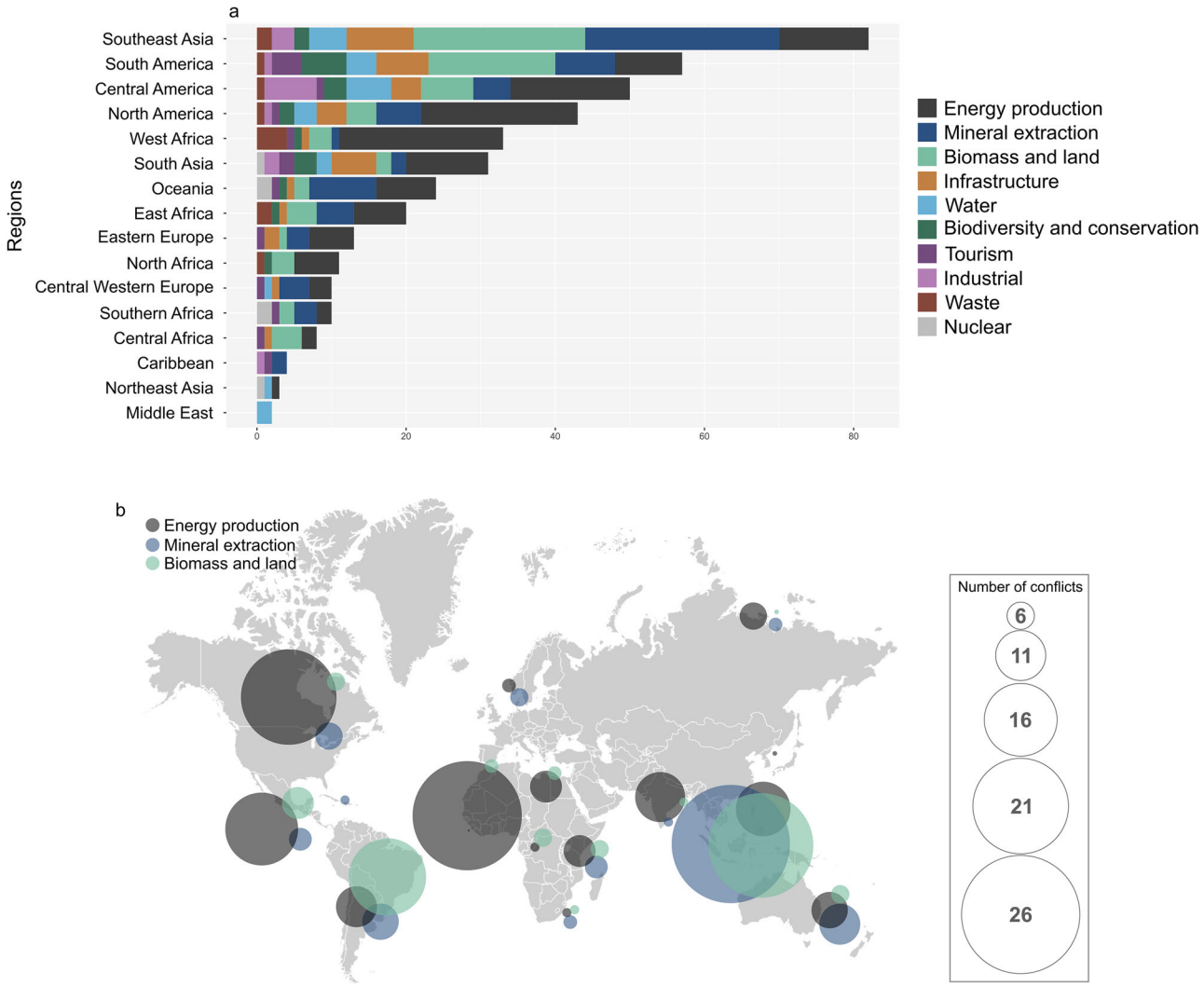

Fig. 1 | Geographical distribution of socio-environmental conflicts. a Conflict types per region (total conflicts). **b** Number of conflicts per region for the three most common conflict types: Energy production (in gray), Mineral extraction (in blue) and Unsustainable management of Biomass and land (in green).

damage) (Supplementary Fig. 2a). Socioeconomic impacts included 'loss of livelihood', 'human rights violations', 'loss of sense of place', and 'land dispossession' (Supplementary Fig. 2b). There were 83 cases of destruction of or displacement from ancestral lands or sacred sites. Health-related impacts, while less frequent, include 'mental health issues', 'exposure to unknown risks', and even 'death' (Supplementary Fig. 2c).

Sectoral differences in impacts

A "heat map" analysis further highlights sectoral differences in the environmental, socioeconomic and health impacts of conflicts (Fig. 2). Energy projects generated both environmental (e.g., 'loss of landscape' and 'biodiversity loss'), and socioeconomic impacts (e.g., 'loss of sense of place' and 'violations of human rights') at similar intensity levels.

For mineral extraction, environmental impacts were strongest (especially 'loss of landscape'); this was followed by socioeconomic (namely 'loss of livelihood') and then health impacts ('mental health'). For unsustainable biomass and land management activities, the biggest impacts were also in the environmental category ('biodiversity loss' and 'deforestation') with socioeconomic impacts ('land dispossession', 'loss of livelihood' and 'violations of human rights'), somewhat lesser. Activities related to unsustainable management of biomass and land have the strongest association with 'biodiversity loss', and 'deforestation'. This type of conflict is similarly characterized by three socioeconomic impacts ('land dispossession', 'loss of livelihood' and 'violations of human rights'), and one main health impact ('deaths'). For infrastructure-related activities, environmental impacts are less prominent while socioeconomic impacts are more acute (e.g., 'loss of sense of place', 'loss of livelihood'), as well as health impacts ('mental problems'). Infrastructure and built environment activities are characterized by environmental ('loss of landscape'), socioeconomic ('loss of sense of place'), and health impacts on 'mental problems' (Fig. 2).

Differences in impacts and resolution of conflicts by rights recognition

Conflicts are unevenly distributed across 72 countries, with 30 countries accounting for more than 80% ($N = 347$) of all recorded cases (Supplementary Fig. 3a). Most conflicts ($N = 334$, in 65 countries) occurred in the Global South, whereas only 15% ($N = 67$) were located in the Global North (22 in Canada, 21 in the US) (Supplementary Fig. 3b). Among 72 countries studied, those that mention Indigenous rights in their national constitutions (32 countries) experienced an average of about nine conflicts each, compared to about three conflicts in countries without such recognition.

For seven countries, we have no information regarding whether their constitutions mention Indigenous Peoples' rights. Statistical analyses revealed a significant positive association between constitutional recognition of Indigenous rights and energy-related conflicts ($p < 0.01$, Fig. 3a; Supplementary Fig. 4a, and 5a). However, the level of conflict impacts was similar regardless of constitutional recognition ($p = 0.35$, Fig. 3b). Countries with constitutional recognition showed a slightly higher proportion of

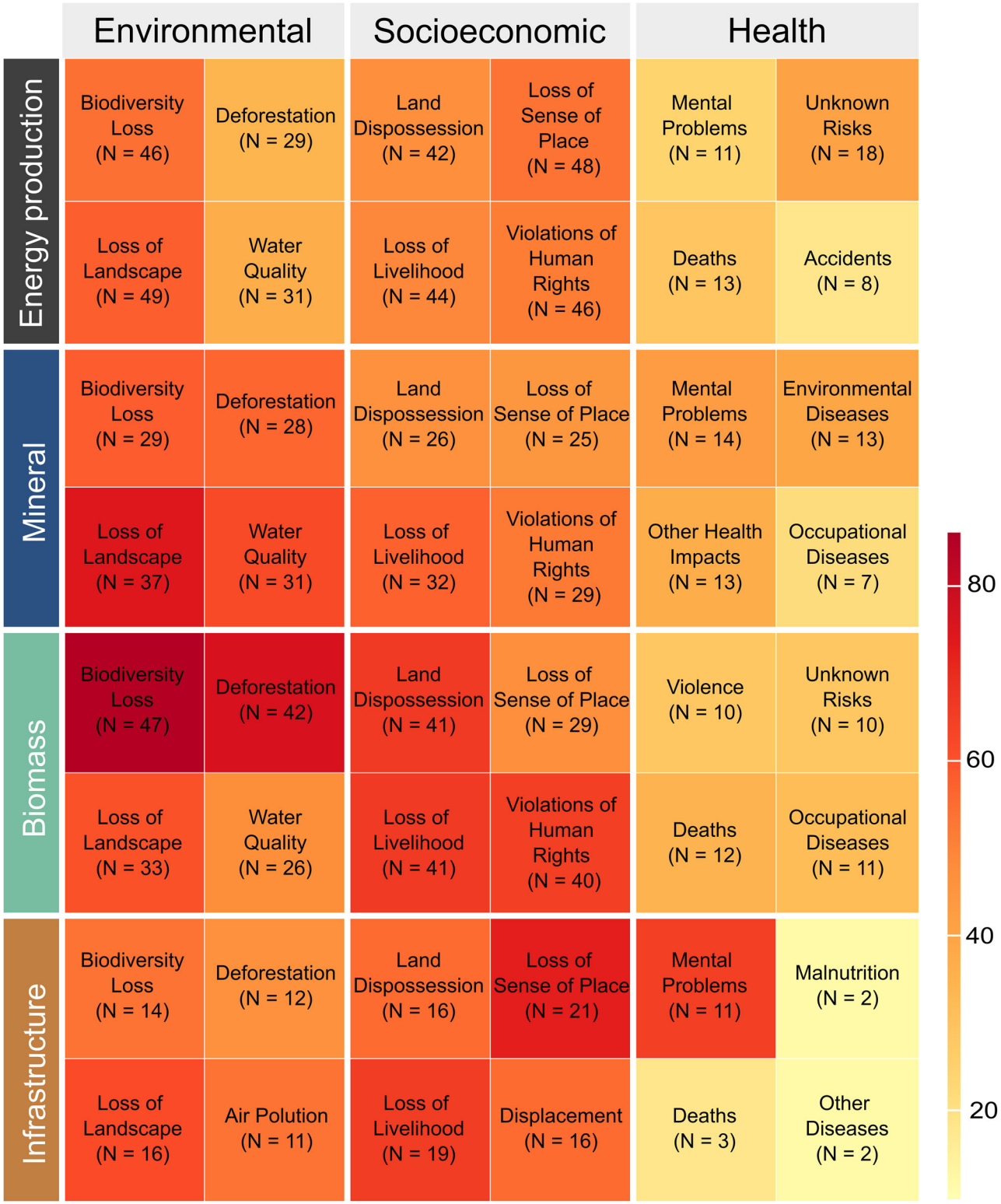

Fig. 2 | Environmental, socioeconomic and health impacts of main conflict sectors. Percentage (excluding missing data) of the most common environmental, socioeconomic and health impacts caused by economic activities related to energy production, mineral extraction, biomass and land conflicts and infrastructure development, and the total number of cases where the impacts recorded. The darkest coloring reflects the greatest intensity of impact.

resolved conflicts and fewer cases where environmental justice was not served, though differences were not statistically significant ($p = 0.55$, Fig. 3c).

Among the countries cited in our dataset, 13 ratified the Indigenous and Tribal Peoples Convention, 1989 (No. 169) from the International Labor Organization, with the ratifications happening between 1990 and 2010. These countries averaged ~7 conflicts, compared to ~5 in the 59 countries that did not ratify. Ratification was negatively associated with energy-related conflicts and positively associated with conservation-related conflicts ($p = 0.04$) (Fig. 3a, and Supplementary Fig. 4b and 5b). Conflict intensity and environmental justice outcomes, however, did not differ significantly between signatories and non-signatories ($p = 0.53$ and $p = 0.14$, respectively; Fig. 3e, f).

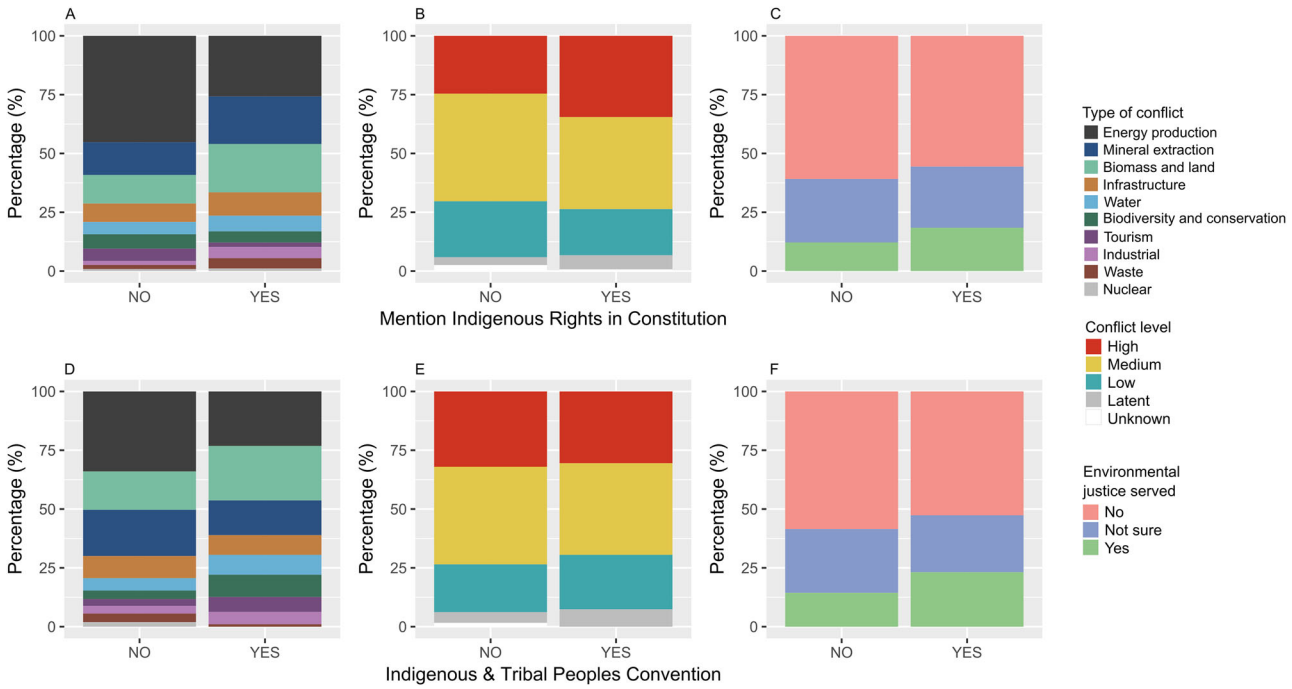

Fig. 3 | Legal and international agreements and socio-environmental conflicts characteristics. Upper plots: percentage of countries that mention Indigenous rights in the Constitution ($N = 32$) or not ($N = 33$) and **a** Sector of conflicts, **b** Intensity of socio-environmental conflicts (low, medium, high), and **c** Environmental justice was served or not until the last project update, Bottom plots: percentage of countries that ratified the Indigenous and Tribal Peoples Convention, 1989 (No. 169) ($N = 13$) or not ($N = 59$) and **d** Sector of conflicts, **e** Intensity of socio-environmental conflicts (low, medium, high) and **f** Environmental justice was served or not until the last project update.

Indigenous groups most affected by conflicts

We recorded 274 ethnic groups affected by socio-environmental conflicts, 36 of which were involved in at least three different cases. This diversity underscores that the impacts of socio-environmental conflicts are highly shaped by distinct cultural, political and ecological contexts. The Lumad Peoples of the Philippines, including Manobo, Mamanwa, and Mandaya groups, were the most frequently affected, with 12 conflicts related to mineral extraction and four to biomass/land management (Fig. 4).

The Maya (including Mopan, Qeqchi and Yucatec) in Central America, and the Inuit (including Inuvialuit and Inupiat), in North America, were involved in 12 conflicts, though with contrasting types of conflicts: Maya conflicts stemmed largely from energy, biomass, and infrastructure projects, whereas Inuit conflicts were concentrated in energy and mineral extraction, with severe effects on displacement, ecosystems, and marine-based food security.

The fourth most cited group was the Garifuna (from Honduras and Belize), who were involved in six conflict types, primarily energy production and the unsustainable management of biomass and land activities. The Sámi of northern Europe are involved in nine conflicts, mostly related to mineral extraction. The Khoi People of South Africa were cited in nine conflicts, the latter being the only group among these affected by nuclear-related conflicts. The Ogoni and Ijaw Peoples of West Africa were exclusively impacted by energy projects, particularly oil spills. For 74 conflicts, specific ethnic groups could not be identified. Conflict intensity varied across groups: while some (e.g., Nenets, Bagyeli, Akan) were primarily exposed to low-intensity conflicts, others (e.g., Garifuna, Zapotec, Tremembé, Lenca, Isleño, Dumagat) faced high-intensity disputes (Fig. 4).

Discussion

Our results provide quantitative evidence highlighting the widespread and multifaceted socioenvironmental conflicts and associated impacts experienced worldwide by Indigenous Peoples in coastal zones. These conflicts must be brought to the forefront of environmental and social research given the complex interplay of ecological vulnerability to climate and land-use changes, colonial legacies, and contemporary economic pressures driving synergistic impacts[11,37,44,45]. However, these findings should not be interpreted as reflecting a uniform Indigenous experience, but rather a constellation of situated and differentiated realities. This analysis highlights how coastal conflicts are mainly due to extractive economic activities by state and corporate actors[14,37,46,47]. Indigenous communities in coastal regions experience an array of environmental, socio-economic, and health impacts, which converge with the impacts of climate change and biodiversity loss, and ongoing various forms of social marginalization and exclusion from decision-making about their territories[11,46]. Understanding these conflicts is essential not only for ethical reasons but also for advancing forms of coastal development that are more sustainable and equitable. Protecting, recognizing and respecting Indigenous coastal communities' rights and supporting their mobilizations are essential steps toward advancing global sustainability goals (e.g., UN SDGs and the Kunming-Montreal Global Biodiversity Framework). Here we situate these results in the broader literature, and highlight their implications.

Recognizing the widespread impacts of coastal conflicts

The impacts of coastal conflicts are diverse and widespread. Zooming in on coastal conflicts reveals specific patterns that differ from broader assessments of Indigenous socio-environmental conflicts[7]. For example, 'biodiversity loss' emerges as the most frequent environmental impact in coastal zones (44% of cases), whereas previous global analyses, which included both terrestrial and coastal conflicts[7], highlighted 'loss of landscape' as the most common impact (56% of cases). Similarly, 'human rights violations' rank second in coastal conflicts, compared with 'land dispossession' in overall conflicts. In both terrestrial and coastal conflicts, 'loss of livelihood' was the most prevalent one. This pattern may reflect heightened economic pressure on coastal communities, leading to human rights violations or it might be a result of the underrecognition of ocean and sea grabbing in comparison to land-related dispossession[42].

This study highlights how extractive industries frequently operate without obtaining Free, Prior and Informed Consent (FPIC), violating

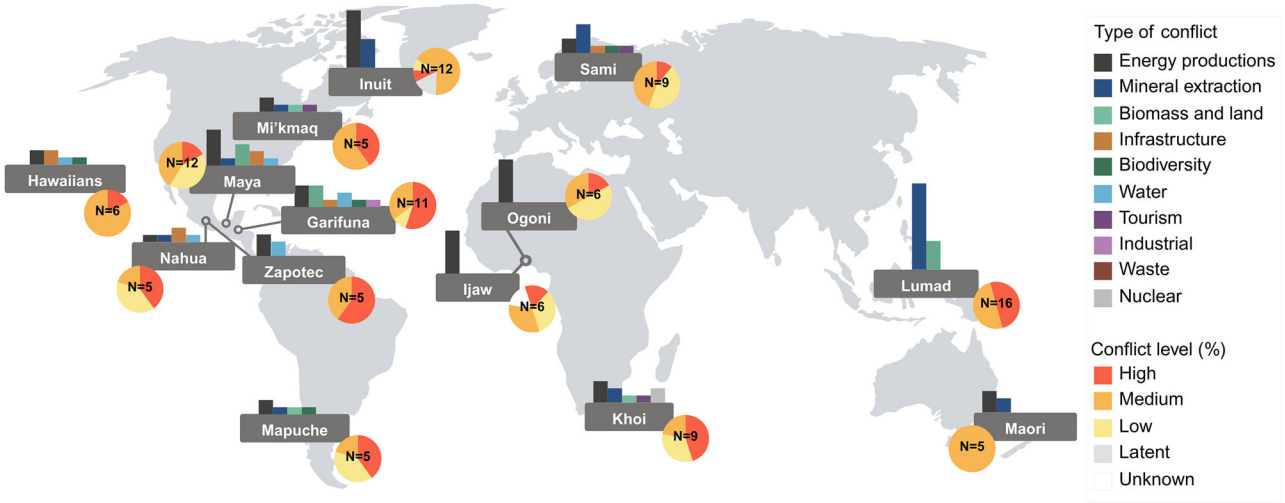

Fig. 4 | Main ethnic groups impacted by socio-environmental conflicts. The most frequently reported ethnic groups with socio-environmental conflicts, cited at least in five conflicts, sectoral distribution of conflict types among the most impacted ethnic groups, and conflict levels.

international human rights and Indigenous rights frameworks and increasing the risk of displacement, evictions, pollution, and the destruction of sacred territories[36]. In addition, current protection mechanisms, which exist predominantly on a voluntary basis, often remain weak or unenforced, exposing these populations to displacement, criminalization and violence, and loss of cultural heritage[7,48–51]. Many Indigenous groups have been the resistance against colonialism for centuries, including the forms manifested through extractive industries. Their mobilization initiatives offer the transformative potential for addressing the current environmental crisis[52,53]. Such resistance against hegemonic structures is a global phenomenon and it is clearly visible in the Amazon, where Indigenous groups continue to reject diverse large-scale industrial projects and the narrow development paradigms associated with them[54].

Impacts of and implications for energy production

Energy production activities, particularly via the extraction of fossil fuels and wind farmings, was the main activity involved in conflicts impacting Indigenous Peoples, representing more than one-third of the reported cases. This contrasts with a previous study analysing socio-environmental conflicts affecting Indigenous Peoples, encompassing both terrestrial and coastal contexts, where the most frequent sector driving conflicts reported was related to mineral extraction[7]. That said, conflicts related to mineral extractivism were also largely in the present study.

Globally, the most common type of conflict involves energy production, mainly due to the fossil fuel extractive industry, with 40% of these cases resulting in 'loss of landscape', and 'loss of sense of place'. In West Africa, such conflicts are particularly frequent, notably in Nigeria, where oil spills have polluted waterways and devastated mangrove forests, often with little to no compensation for local communities[55]. In North America, fossil fuel and energy-related conflicts also occur frequently, though they involve a wider range of industries. These include onshore and offshore drilling, which causes habitat destruction and marine biodiversity loss, affecting fauna that is relevant to the subsistence and cultural practices of many Indigenous Peoples, while also increasing the risk of oil spills.

Wind farm developments in the region have raised concerns over disturbance to cultural and historical heritage sites, while liquefied natural gas extraction has moved onto Indigenous lands. Central America emerges as the third region mostly affected by energy-related conflicts, with most cases linked to oil drilling and wind farm development. In Mexico wind farm expansion has accelerated over the past 15 years, not without consequences for local communities (Cases No. 2039, 4836, 5074, 5341, 5342 and 5406, Dataset 1[55]). Only in Mexico, our results show at least seven conflicts directly affecting Indigenous Peoples, where wind farms projects have moved forward without community consent and with minimal efforts to include locals in decision-making processes (Cases No. 2039, 4836, 5074, 5341, 5342 and 5406, Dataset 1[55]). In French Guiana, the Indigenous Kali'na people are actively engaged in the defense of their customary lands, cultural practices, and territorial rights in response to the development of a solar-to-hydrogen power plant in the Amazon rainforest (Case No. 5362, Dataset 1[55]).

The main impacts reported in these cases include harm to local livelihoods, the communities' productions, economies, and social identities, alongside environmental degradation (Case No. 5362, Dataset 1[55]). Our study shows that renewable energy projects are adding considerable pressure on coastal environments and communities. While they help reduce CO2 emissions (with the exception of large, shallow tropical hydropower reservoirs[56]), they can also cause unintended harm, particularly in the Global South and among vulnerable, often already marginalized, communities[57]. To be truly transformative, the shift to renewables must follow the international standards of just transition, going beyond technology and including equity and human rights to ensure fair outcomes, including the right to a healthy environment[29,58].

Globally, many Indigenous groups are mobilizing against energy production projects within their territories. For instance, the rejection of wind power developments by rural and Indigenous communities in Mexico has led to discussions about fair alternatives of wind power production in agreement with the local needs and beliefs[59]. Similarly, Quechua communities across the Andes are navigating the implementation of hydroelectric dams; while these projects may offer certain benefits, they often disrupt hydroterritorial rights and the ancestral relationships between land and water, for instance, by destroying sacred sites[60]. While inclusive ownership models are emerging as potential reconciliation pathways, structural inequalities in both ownership and research persist[61,62]. In some cases, this resistance leads to cancellation of projects, such as an oil pipeline project in Canada that was interrupted after protests from different sectors of society, including First Nations[63].

Impacts of and implications for mineral extraction

From all the conflicts analyzed here, 18% ($N = 74$) were related to coastal mineral ores and building materials extraction. Mining activities targeting various resources, but especially nickel, are known to be harmful to the environment, causing contamination with toxic substances and extensive landscape destruction[64]. Globally, mining is estimated to account for around 10% of annual carbon emissions associated with energy generation[65], and smaller scale mining (garimpo) is associated with elevated levels of deforestation, with limited economic benefits[66].

Additionally, the demand for several minerals, including nickel, is expected to grow in the coming years[67]. The mining industry is also a major driver of social conflicts[68], frequently impacting Indigenous Peoples and traditional communities' lands, including isolated uncontacted groups[42,69]. Among the 74 cases of conflicts related to mineral extraction, 26 occurred in Southeast Asia (17 in the Philippines and 6 in Indonesia), and nearly all directly affected Indigenous Peoples. While nickel mining dominates these cases, over ten other types of mining are also represented. The prominence of nickel mining in Southeast Asia is underscored by the 2023 global price collapse triggered by an oversupply from Indonesia[64].

Many of these mining projects in Southeast Asia and other regions are authorized by governments without proper environmental or social impact assessment or the consent of local communities. For example, the government of Panama granted mining licenses that affect Indigenous Peoples inhabiting Chagres National Park, threatening the main source of drinking water for over one million people (Case No. 2046, Dataset 1[55]). Protests against these projects are often met with violence, either by the state security forces or private security contractors (e.g., Cases No. 1720 and 1878, Dataset 1[55]), and mining frequently penetrates ancestral lands (e.g., Cases No. 1886 and 1897, Dataset 1[55]). A clear case of this is the 2017 murder of activist Sikhosiphi Rhadebe who chaired a community organization campaigning to prevent an Australian mining company from strip-mining their sand dunes for titanium along the Pondoland coast of the Eastern Cape in South Africa[70]. In Australia, more than 8000 abandoned mines are present in Indigenous lands, illustrating the long-lasting effects of this activity that should also be taken into consideration[43].

The involvement of Indigenous communities in restoring regions contaminated by mining byproducts has yielded promising results. For instance, the Ojibwa's transformation of polluted waters and shorelines into a thriving landscape has successfully restored ecological relationships across multiple scales[71]. However, continuing mining projects have led to more violent disputes and environmental degradation. The Nasa people have been resisting legal and illegal mining projects, with a strong basis on their strong moral and institutional frameworks[72].

Impacts of and implications for the management of biomass and land

Biomass and land-related conflicts mainly involve competing land uses for agriculture, forestry, livestock, or fisheries[73,74]. In our study, this type of conflict is represented by 72 cases. Southeast Asia emerges as the region with the highest number of unsustainable management of biomass and land-related conflicts, mostly driven by commodity expansion of palm oil plantations and logging activities.

Some conflicts also directly impact marine ecosystems. For example, pearl cultivation has expanded onto islands that serve as the last refuge of the Salung people (commonly known as sea gypsies) after multiple displacements (Case No. 5241, Dataset 1[55]), Similarly, shrimp farming operations have driven mangrove deforestation in countries such as Ecuador, Nicaragua, Tanzania, and India (Cases No.0460, 3302, 2440, and 2091, Dataset 1[55]), undermining critical sources of food and income for many Indigenous communities. South America, the second region with the most cases ($N = 17$), shows primarily conflicts related to monoculture plantations (e.g., palm oil or eucalyptus), driving impacts on biodiversity loss, deforestation and soil contamination (Dataset 1[55]). Examples of conflicts between the fishing industry and Indigenous communities, with positive outcomes to the Indigenous communities are also documented. For example, after decades of dispute over the herring fishing rights, the resistance of Heiltsuk women successfully returned the rights to conserve the fish for the communities and future generations, and resulted in the creation of a shared framework for the governance of resources[75].

Aligning with legal recognitions and international conventions

The constitutional mention of Indigenous rights and the ratification of international conventions are associated with a higher number of reported socio-environmental conflicts and, in some cases, with more positive outcomes in terms of environmental justice. This pattern may reflect historical pressures: countries that have experienced conflict over Indigenous lands and resources may have institutionalized recognition of rights as a societal response to past injustices[53]. Higher conflict intensity in these countries could partly indicate broader mobilization by many Indigenous communities, improved documentation, or other contextual factors, and likely reflects a combination of these dynamics. While constitutional recognition alone does not resolve conflicts, it may represent an important first step, providing legal and political leverage that can support subsequent efforts toward conflict resolution and justice.

The debate on Indigenous rights recognition is a mirror of the cumulative effect throughout history of the discrimination, marginalization, dispossession, and violence, suffered by many Indigenous Peoples under different colonial processes. So that, in some cases, the recognition of Indigenous Peoples is mentioned in constitutions, but they are not specified or defined. In other cases, they are considered as already included in recognizing the more generic aspects, such as cultural, linguistic, religious, and even way of life of communities, their identities and self-organization systems, without specifying rights or mentioning the term Indigenous. This is consistent with the fact that since the 1950s, numerous global efforts have emerged for the recognition of Indigenous Peoples' rights and knowledge; however, there is no common legal framework that considers the rights of Indigenous Peoples and local communities[41].

Continued investment in oil, gas, and mining fuels environmental destruction, human rights violations, and community conflict[76–78]. Financial institutions must align with global commitments such as the Paris Agreement and the Kunming-Montreal Global Biodiversity Framework by adopting policies that exclude support for projects that harm many Indigenous communities and ecosystems[79,80]. Divestment is not only a moral decision, it is also a scientifically supported pathway toward ecological sustainability, social equity and global resilience[81].

Preventing and addressing socio-environmental conflicts can be strengthened by adopting a "biocultural rights" approach, further developed through the framework of "biocultural jurisprudence"[82]. Following the emergence of concepts such as biocultural diversity[83], which highlights the interrelationships among biological variability, cultural diversity, and Indigenous languages, the term biocultural rights has developed to describe the rights of Indigenous Peoples and local communities to steward their lands, territories, and resources in accordance with their own worldviews, knowledge systems, and customary laws. These rights are understood as a bundle that encompasses the right to land, territory, and natural resources; the right to self-determination (including autonomy and self-administration); and cultural rights[84]. A second definition, proposed by ref. 82, complements and broadens the scope of this approach by defining biocultural rights as "a set of substantive Indigenous resource rights that simultaneously protect both Indigenous natural and cultural resources, recognizing that they are inextricably linked and interconnected." According to these authors, a critical point in understanding biocultural rights is clarifying that they do not constitute additional or new rights for Indigenous Peoples; rather, they integrate and unify existing Indigenous resource rights. Finally, biocultural rights are situated within the so-called third generation of human rights in environmental law. This emerging concept encompasses the full range of rights necessary to ensure community-based stewardship of lands and waters by Indigenous Peoples and local communities. Tools such as "biocultural community protocols" operationalize this perspective. Central to this approach is the recognition of the deep interconnection between cultural diversity, natural diversity, and linguistic diversity, which provides a culturally appropriate lens for evaluating Indigenous Peoples' concerns. As Chen and Gilmore[82] argue, this framework offers a more holistic way of protecting Indigenous resources. By affirming not only Indigenous Peoples' rights to survive, but also their rights to steward their lands, territories and resources, this approach provides the articulation of diverse impacts from external interventions as part of a broader "justice claim". However, as evidenced by a case against Shell in South Africa's Eastern Cape that reached the Constitutional Court, even when such rights

exist, their effectiveness ultimately depends on the strength of the legal system available to enforce them and the resources required to do so[85,86].

Honoring spiritual and cultural values

Many coastal Indigenous communities hold deep spiritual and cultural connections to coastal lands and oceans, including sacred sites that are central to their identities and practices[87]. However, numerous socio-environmental conflicts are directly impacting and destroying these sacred sites, with 83 documented cases in our study. One example is the 2023 destruction of a sacred area for mining in Australia, which damaged thousands of years of Aboriginal history (Case No. 5096, Dataset 1[55]), and in Russia, where the project destroyed ancestral burial grounds and sacred lands (Case No. 6191, Dataset 1[55]).

For some groups of Indigenous Peoples in Hawaii, the tallest peak in the region, the Mauna Kea, is considered to be a connection between humans and the universe. The mountain is also an ideal spot for telescope installation, which harms Indigenous Peoples' beliefs, causing conflicts between Indigenous Peoples and scientists (Case No. 4763, Dataset 1[55]). In Brazil, mining is causing the loss of Pitaguary People highlands, an area that is considered to be a sacred place where the people connect with their ancestors (Case No. 2916, Dataset 1[55]). For many African communities, the Atlantic seabed carries profound symbolic and collective identity importance, serving as a vast underwater gravesite for those who perished during the transatlantic slave trade[88]. The remains of millions rest in the ocean's depths, and their memories are honored through songs, storytelling, and other cultural practices that sustain and strengthen these enduring ties to the sea[32,58,89,90].

The current global assessment presented here recognizes and honors the profound historical and cultural connections that must be considered when evaluating coastal development impacts on many Indigenous Peoples. It underscores the need to ensure that economic or industrial pressures do not erase the heritage, livelihoods, and rights of those whose identities are intrinsically tied to these vulnerable coasts. Across diverse Indigenous communities, from the Kel Tamasheq of the Sahel to Mi'kmaq and Sámi peoples, well-being is understood as inseparable from the health of ecosystems, waters, and ancestral territories, grounded in distinct knowledge systems and languages that cannot be reduced to a single framework[91]. The conflicts documented are not only degrading the environment and undermining people's socioeconomic and health conditions, they are also severing many Indigenous Peoples' bonds with their ancestral lands and waters, while threatening the survival of biodiversity and, ultimately, all of us.

Conclusions

Our study provides insights into the multiple harms that socio-environmental conflicts are causing to Indigenous peoples in coastal zones worldwide. We argue that alternative development pathways are needed. New practices and forms of development in coastal areas should be sustainable, equitable and human rights-based, following planetary health determinants based on a diverse Indigenous perspective with Indigenous-specific methods of knowledge sharing from around the globe[92]. Investment in and support for extractive industries such as oil, gas, mining, and industrial aquaculture must be carefully assessed. While these may bring some benefits, they can fuel environmental destruction, human rights violations, and community conflict. Preventing and defunding harmful extractive projects should become a standard practice in responsible investment and conservation strategies, as well as naming specific actors causing harm. Future research on conservation[93] and policy efforts focused on coastal conflicts must be intersectoral, community-informed, and grounded in Indigenous epistemologies to effectively address the overlapping crises of our time[94].

Methods

Socio-environmental conflict data

To analyze environmental conflicts affecting Indigenous Peoples in coastal regions, we conducted a targeted selection of cases from the Environmental Justice Atlas (EJAtlas), a global database of environmental conflicts[73,74] ($N = 4296$). We based our theoretical framework on the concept of Environmental Justice used in the EJAtlas, which is an equal participation, recognition and distribution of social and environmental costs between different people (groups, classes, ethnicities, gender and age). From the dataset, we first selected all recorded conflicts located in countries with marine or oceanic coastlines. We then applied a spatial filter to retain only conflicts occurring within 30 kilometers of the coastline (Fig. 5). The concept of "coastal zone" is inherently ambiguous and has been defined in multiple ways depending on whether the emphasis is biophysical or socio-economic[95]. For example, multiple studies extend the zone up to 60 km inland[96–98], Salnikov[99] proposes 80 km, El Barmelgy et al.[100] use 100 km when demarcating coastal cities and agglomerations, while an European institution applies a 10 km coastal band criterion for EU coastal regions[101]. Given this lack of consensus, we adopt a 30 km inland boundary as a pragmatic and context-sensitive threshold. This 30-km limit captures the area where land–sea interactions are most direct, where population densities and economic activities linked to the coast are concentrated, and where coastal ecosystems and Indigenous Peoples are especially affected. Using this distance provides analytical clarity, focusing on the zones most exposed to anthropogenic impacts, while avoiding inclusion of hinterland areas that would dilute the specificity of coastal assessments.

Next, we refined this subset to include only conflicts that directly or indirectly involved Indigenous Peoples. We applied a multiple-step identification process using complementary data sources (Fig. 5). First, we consulted the LandMark platform, the first global database of Indigenous and community lands, to check for spatial overlap. If the conflict site was within or adjacent (<30 km) to Indigenous Land, it was included in our dataset. If not, we checked in the EJAtlas platform: when "Indigenous or traditional communities" were listed as mobilizing groups, we verified explicit mentions of Indigenous identifiers (e.g., First Nation, Aboriginal, pueblos originarios, tribes, afrodescendants, or specific names of ethnic groups known for the region). Cases were included if they matched our broad definition of Indigenous Peoples. We further cross-referenced our selection with Scheidel et al.[7] and with the study of Cisneros-Montemayor et al.[13] to ensure consistency, and used additional sources such as the International Work Group for Indigenous Affairs (IWGIA) and national datasets to validate group presence. This approach prioritizes inclusivity while acknowledging that Indigenous identities are context-specific and cannot be fully captured through standardized classifications. We classified conflicts as directly impacting Indigenous Peoples when groups were explicitly mentioned in EJAtlas, and indirect when groups were not cited but overlaps with the Indigenous territories were confirmed. This triangulation of sources ensured a higher level of reliability and transparency in case inclusion, capturing both direct and adjacent pressures on Indigenous territories and seascapes. This study used exclusively secondary information from publicly available sources and did not involve direct interaction with human participants; therefore, no additional ethics review or informed consent was required. The research methodology was reviewed and approved by the Ethics Committee of the University of Santiago de Compostela (Report No. USC-077-2026-H).

Data curation and coding

All case studies in the database were coded using a common methodological approach. First, each selected case from the EJAtlas database involving a socio-environmental conflict affecting Indigenous Peoples was identified and classified based on several predefined variables that enabled both quantitative and qualitative analysis. Key variables were extracted as standardized by EJAtlas, and included the conflict name, country, and region, allowing spatial mapping and recognition of geographic patterns (for the complete definitions, see ejatlas.org/backoffice/cms/en/definitions). The database integrates both historical and ongoing cases, though conflict start dates are more consistently reported than end dates.

Conflicts were categorized according to their primary type, based on a first-level classification adapted from environmental justice literature. The

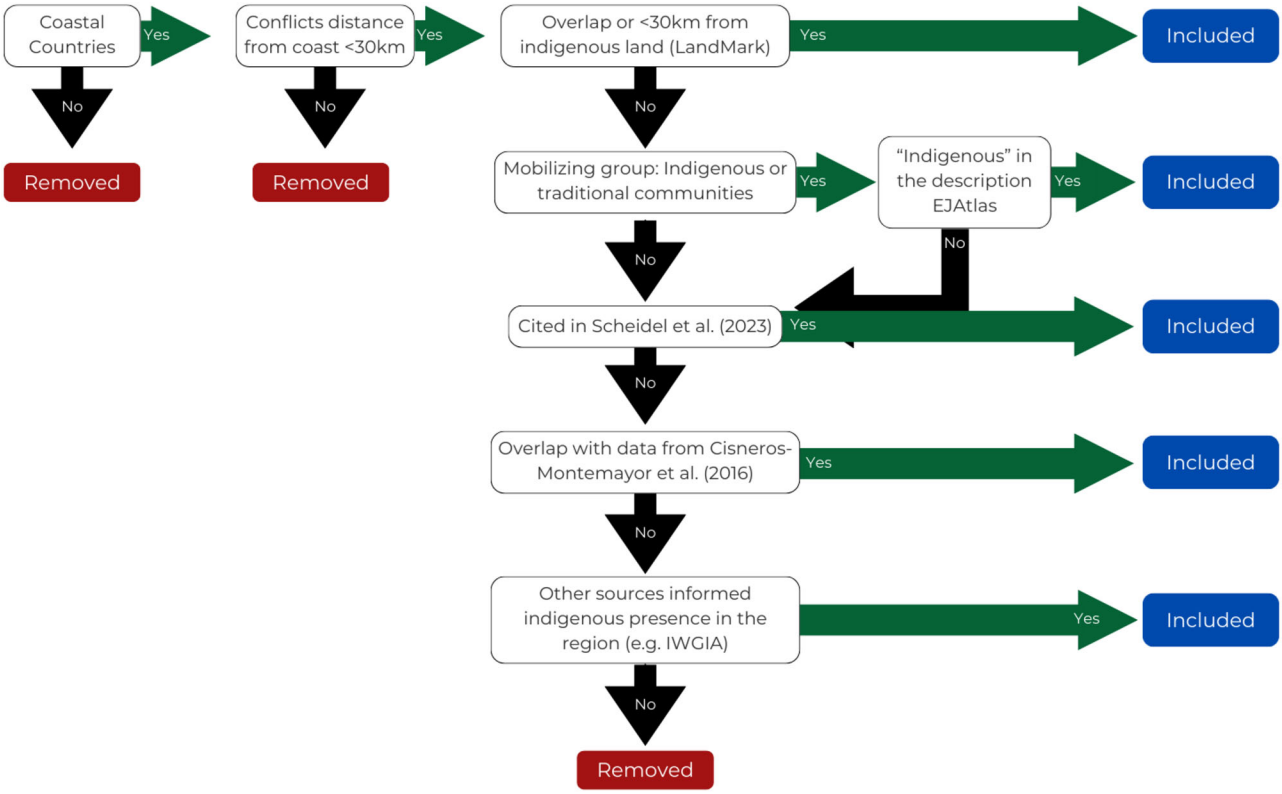

Fig. 5 | Steps for the selection of conflict cases to be included in the dataset.

categories included were: Biodiversity conservation conflicts, Biomass and land conflicts (e.g., forests, agriculture, fisheries), Fossil fuels and climate justice/energy, Industrial and utilities conflicts, Infrastructure and built environment, Mineral ores and building materials extraction, Nuclear, Tourism and recreation, Waste management, and Water management. This typology facilitated sectoral comparison and helped identify the dominant sources of pressure on Indigenous and traditional territories.

To assess the intensity of the conflict, each case was coded in the EJAtlas by conflict level, ranging from *Latent* (with no visible organization at the moment), *Low* (some locally organizing), *Medium* (street protests, some visible mobilization), *High* (when the conflict was widespread, with mass mobilization, violence cases, arrests, etc), or *Unknown*. Outcomes were coded according to whether environmental justice was perceived as served by the author uploading the case (*Yes, No, Not sure*), based on achievements such as halting projects, gaining land recognition, or influencing policy. This variable entails a degree of subjectivity in its interpretation by the authors; nevertheless, a concise explanation is provided to clarify the criteria used for its definition and application.

We extracted impact data for three domains: environmental (e.g., biodiversity loss, deforestation, pollution), socioeconomic (e.g., displacement, livelihood loss, rights violations), and health (e.g., toxic exposure, disease, psychological trauma) (See definitions at ejatlas.org/backoffice/cms/en/definitions).

Ethnic group identities were documented using national records, ethnographic sources, and community self-identification. This coding scheme allowed us to identify the most common conflict types, impacts, and affected groups. The methodological approach allows for a granular and comparative analysis of socio-environmental conflicts involving Indigenous Peoples across multiple dimensions: territorial, sectoral, social, and environmental. The use of standardized categories and structured coding enhances reproducibility and enables the development of visualizations, sectoral patterns, and region-specific insights. Furthermore, the methodology used in this analysis contributes to a more just and inclusive understanding of environmental conflict and governance.

Statistical analysis and intercoder reliability

We applied descriptive statistics to quantify the sectors driving conflicts, geographic distribution and intensity of conflicts, the environmental and social impacts of conflicts, and exposure of Indigenous Peoples to different conflict types and levels of intensity. To assess whether being a signatory of the Indigenous and Tribal Peoples Convention, 1989 (No 169), or if constitutional recognition of Indigenous rights influences the characteristics of socio-environmental conflicts, we categorized the countries as signatories or not, and in mentioning or not mentioning Indigenous rights in their constitution (see the information available in https://www.constituteproject.org/). We included these two categories because i) when Indigenous rights are mentioned in the constitution, the chances of communities complains to become visible are higher, as well as nominating a conflict as related to Indigenous Peoples, and ii) when a country is part of the Convention, they are required to apply the FPIC to any administrative or legislative measure that can impact Indigenous Peoples.

To ensure consistency in coding constitutional recognition, we conducted an intercoder reliability (ICR) assessment[65,66]. Following best practice, we re-coded 17.2% of the sample (26 of 72 countries), a value well above the 5% often recommended. Countries were selected to maximize geographic representation, include cases of uncertain classification, and ensure all coders contributed. The ICR analysis yielded an agreement score of 73%, indicating substantial consistency among the diversity of countries and four expert coders. We then used chi-square tests to examine associations between constitutional recognition or ILO ratification and conflict characteristics (type, intensity, and outcome).

Data limitations

Due to inherent limitations in combining multiple datasets, several key considerations must be examined when interpreting this study's data. This compilation does not constitute an exhaustive global inventory of coastal environmental conflicts involving Indigenous Peoples. Consequently, the identified number of conflicts and affected Indigenous Peoples' groups should be viewed as a highly conservative lower-bound estimate. The true

global number of affected Indigenous communities remains unknown due to structural data limitations, including availability, accessibility, and representativeness. Our definition of Indigenous Peoples in coastal zones could exclude many other groups or peoples that may not be officially classified or recognized as Indigenous in their legislations or social contexts. To avoid overgeneralization, we refer specifically to Indigenous Peoples, First Nation, Aboriginal, pueblos originarios, tribes, afrodescendants, or specific names of ethnic groups known for a specific region.

It is also highly probable that cases in the Global South are underrepresented due to more limited financial and human resources for conflict documentation, or because Indigenous Peoples affected by environmental conflicts are afraid to report their cases for fear of reprisals in their territories. Data gaps for specific countries or regions (e.g., Mexico) further contribute to the underrepresentation of conflicts involving Indigenous groups in those areas and therefore underrepresented in our study. In addition, the use of aggregated categories such as 'Indigenous Peoples' may obscure important intra-group differences, and therefore results should be interpreted with caution. While triangulating multiple information sources means the spatial identification of ethnic groups may not be entirely precise, the overall distribution of both the data conflicts and the ethnic groups still serves as a reasonable proxy for understanding the impacts of economic activities.

The number of conflicts does not necessarily translate into a higher vulnerability of Indigenous Peoples. Several of the more than 170 ethnic groups that were cited once in our dataset, or the countless groups that were not included here, can be as vulnerable or even more than the groups that were cited multiple times. Recognition and organization of groups are correlated with visibility and opportunities to speak up against threats. Among the ethnic groups that were cited five or more times, almost all (with the exception of the US and Nigeria) are located in countries that recognize Indigenous rights in their constitutions.

Moreover, this study does not examine the temporal evolution of socio-environmental conflicts, as the documenting sources are mostly recent, with 75% of the conflicts starting between 2001 and 2024 ($N = 301$), but also including some fewer older cases starting, for example, between 1919 and 1960 ($N = 8$). Arguably, more secondary sources documenting environmental conflicts have become available over the last decades due to the growth in internet media such as online news, conflict databases, repositories of civil society reports, etc. Finally, this study does not cover the shifting nature of these conflicts or their detailed environmental, socioeconomic, and health impacts. For example, a conflict's initial environmental impacts from extraction might later lead to economic consequences driven by factors such as actor dynamics, corporate incentives, or regulatory changes. In addition, reliance on the EJAtlas as the primary source means that regional coverage may partly reflect differences in documentation capacity rather than the actual distribution of conflicts. The operational choice of a 30 km coastal buffer, although consistent with common definitions of coastal zones, may exclude inland communities with strong marine dependence. Moreover, the impact categories available in EJAtlas underrepresent cultural and spiritual dimensions that are central to many Indigenous experiences. Intercoder reliability was tested only for constitutional variables, and our statistical analyses remain correlational, not causal, when linking legal frameworks with conflict dynamics.

Data availability

The partial databases, including the list of conflict cases analyzed (10.6084/m9.figshare.32220063), and ethnic groups involved (10.6084/m9.figshare.32224419) are available. The complete dataset connecting the ethnic groups with each conflict case can be available upon request, but it has been kept private for ethical concerns and to protect the identity and integrity of vulnerable groups.

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Competing interests

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