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Private adaptation to climate risks: Evidence from the world's largest mining companies

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ABSTRACT

Private companies have in recent years started to disclose information about their exposure and responses to climate risks. However, we still know little about how and why private actors engage in climate change adaptation, and to what extent they do so in ways that improve societal resilience. This article addresses these questions. It conceptualizes private adaptation as consisting of institutional, infrastructural and community-oriented responses to climate risks. It develops a political-economic framework about the drivers of private adaptation, where private adaptation is expected to be shaped by pressures exerted by governments, investors, and civil society actors. Empirically, the framework is explored by using an original dataset on the adaptation responses of the 37 largest mining companies worldwide. We select the mining sector as mineral extraction plays a critical role in the low-carbon transition, and can, at the same time, exacerbate climate vulnerability in extracting sites. The descriptive findings suggest that the majority of the investigated companies have set up procedures to assess climate impacts on business operations, integrated climate risks in water governance, and adapted their infrastructure. The explanatory results indicate that private adaptation is mainly driven by investor pressures, and not domestic regulations and civil society. By implication, companies rarely engage in community-oriented adaptation responses by cooperating with local communities in ways that would benefit these communities. Taken together, our findings help to better understand the limitations of private adaptation and barriers to achieve transformative change, and identify how private adaptation could help improve societal resilience.

1. Introduction

Until recently, scholars and practitioners have mainly debated climate change adaptation as a policy challenge to be addressed by subnational and national governmental bodies (cf. [Dolšák and Prakash, 2018](#)). However, as climate risks become more pressing, the private sector is increasingly seen as critical in the transition to a climate-resilient future (e.g. [Biagini and Miller, 2013](#); [Folke et al. 2019](#)). Scholars and practitioners have reflected on the tools companies have at their disposal to enhance adaptation, particularly in developing countries, where they could develop new technologies and work towards innovative solutions together with the state in public–private partnerships ([Pauw and Pegels, 2013](#); [Averchenkova et al., 2016](#); [Nasiritousi et al., 2016](#)).

Companies have started to disclose information about their exposure to, impacts on, and responses to climate risks ([Goldstein et al.,](#)

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2019). Such actions exemplify an emerging trend of private adaptation, which refers to “the process of adjustment by companies to actual or expected climate change and its effects through changes in business strategies, operations, practices, and/or investment decisions” (IPCC, 2014). How the private sector, in particular large national and multi-national companies (MNCs), responds to climate risks can have both positive and negative societal consequences (e.g. Hannah et al., 2013; UN Global Compact et al., 2015; Averchenkova et al., 2016). Against this background, it is critical to gain a better understanding of private adaptation.

Previous research on private adaptation has mainly studied adaptation from a management perspective (Berkhout et al., 2006; Linnenluecke et al., 2011; Sakhel, 2017; Averchenkova et al., 2016). Some studies have analyzed the interactions between private and public adaptation governance, and emphasized the weak integration of the private sector in public adaptation governance (Pauw and Pegels, 2013; Klein et al., 2018). Goldstein et al. (2019) show that private adaptation strategies tend to be reactive and insufficient. However, we still know little about how and why companies engage in private adaptation.

To fill this gap, this article theorizes and empirically examines the patterns and drivers of private adaptation from a political economy perspective. We develop a framework that identifies three main types of private adaptation responses (institutional, infrastructural and community-oriented responses) and argue that these responses are embedded in the competing interests of and relations between different actors (Newell, 2008a; Sovacool and Linnér, 2016). In this vein, we argue that private adaptation is primarily shaped by pressures exerted by governments, investors, and civil society organizations (CSOs). Consequently, to understand the patterns and drivers of private adaptation, we focus on how these key actors influence private adaptation and shed light on whose interests prevail in private adaptation governance.

To explore our theoretical framework, we map the adaptation activities of the 37 largest mining companies in the world and assess their main drivers. Our findings are based on document analysis, semi-structured interviews, and two case studies on the state regulations of private adaptation in Australia and Canada. Studying the largest companies in the world has the advantage that we cover companies that have the capacity and ability to address climate risks, and whose adaptation (in)actions are likely to have the most far-reaching societal consequences when compared to other companies (see also Folke et al. 2019).

The mining sector is particularly suitable for our inquiry because of its practical importance to both adaptation and mitigation. Mining plays a critical role in the low-carbon transition and the fulfillment of the UN 2030 Agenda (Hund et al., 2020). Mining is, however, also a driver of green-house gas emissions through coal extraction, energy consumption and by contributing to the loss of forest cover (Bebbington et al., 2018). Mining activities are associated with a broad range social and environmental risks in producing sites (Lèbre et al., 2020), many of which are likely to be exacerbated by climate change. For instance, extreme weather events and natural hazards can damage infrastructure and lead to the contamination of land and water. Moreover, water availability is likely to decrease as a consequence of climate change, and as mining requires large amount of water, companies’ reluctance to reduce their water consumption is likely to affect local communities’ access to water (Phillips, 2016; Odell et al., 2018).

Taken together, our inquiry contributes to a better understanding of the patterns and drivers of private adaptation in the mining sector. This, in turn, will enhance our understanding of existing governance gaps and beg questions for the theory and practice of the societal implications of private adaptation.

2. A political economy approach to private adaptation

To advance research on private adaptation, this section conceptualizes and develops a political economic approach to private adaptation that helps us to better understand the patterns and drivers of private adaptation. We build on a common assumption in the environmental governance literature that adaptation responses to climate change ought to be analyzed in the wider political-economic context in which key actors in a particular sector operate (Newell, 2008a; Eriksen et al., 2015; Sovacool and Linnér, 2016).

2.1. Conceptualizing private adaptation responses

It is more challenging to define and measure adaptation activities by companies than mitigation activities to reduce greenhouse gas emissions (Adger, 2006; Averchenkova et al., 2016; Purdon and Thornton, 2019). To clarify the concept of “private adaptation”, we therefore conceptualize in the following three main types of private adaptation responses to climate risks (institutional, infrastructural, and community-oriented responses). Of these activities, community-oriented responses have so far received little attention among researchers and practitioners.

Institutional responses and “soft adaptation” are typically used interchangeably, refer to different procedures and practices aimed at improving the management of climate-related risks (Sovacool and Linnér, 2016). Climate risks are often associated with a high degree of uncertainty, making it difficult to measure vulnerability and evaluate the effectiveness of different responses (Underdal, 2010). To understand their exposure to climate risks, companies need to set up new procedures to assess and generate knowledge about climate risks (Sovacool and Linnér, 2016; Dolšák and Prakash, 2018). Typical examples of institutional responses are climate risk assessments, related early warning systems for natural disasters and floods, and weather forecasting.

Information about identified risks could be integrated in companies risk management systems and business continuity plans, as well as water governance (Averchenkova et al., 2016; Goldstein et al., 2019). We, therefore, analyze to what extent companies have integrated climate risks in existing risk assessment and management procedures. Furthermore, we analyse the integration of climate risks in water governance. In the context of mining, water scarcity has been identified as a critical climatic impact (Phillips, 2016; Odell et al. 2018). More concretely, climate change may lead to increased water scarcity and mining companies have to adopt measures to reduce their typically high water consumption. Companies could integrate climate risks in water managements by developing regular monitoring procedures and set targets for reducing their water consumptions in areas of climate-induced water stress. Hence, in our

analysis of institutional responses, we focus on the integration of climate risks not only in general risk assessments and management procedures, but also in water governance.

Infrastructural responses, which we use synonymously with “hard adaptation” (Sovacool and Linnér, 2016; Dolšák and Prakash, 2018), refer to investments to climate-proof infrastructure (Sovacool and Linnér, 2016). Examples of such climate-proofing of infrastructure is the building of sea walls against sea-level rise, construction of water reservoirs and irrigation systems, as well as of more solid storage facilities of toxic substances. The most common infrastructural response among companies deals with water infrastructure (Goldstein et al., 2019). In the context of the mining sector, two of the most important concerns have been increased water scarcity and extreme weather events that could lead to the failure of tailing dams, which often contain highly toxic material such as arsenic and mercury. Leakages from such facilities can have severe impact on human health and the environment (Odell et al., 2018; Phillips, 2016). It is thus particularly critical in the mining sector to develop technologies to reduce water consumption and prevent leakage from mine infrastructure. In our analysis, we will investigate climate-proofing of infrastructure, broadly conceived.

Community-oriented responses include activities that primarily or partially aim at improving community resilience. Such responses can support communities to develop agricultural practices to mitigate climate vulnerability and risk, or to set up irrigation system or water storage infrastructure to enable communities to get continued access to water (Sovacool and Linnér, 2016). There is a growing awareness that community-oriented responses are necessary to ensure that private adaptation actions does not harm local communities (UN Global Compact et al., 2015). Nonetheless, private companies are primarily accountable toward investors and consumers despite the existence of global norms against human rights abuses and environmental harm (United Nations Human Rights Office of the High Commissioner (OHCHR), 2011). Most large transnational companies, not the least in the mining sector, engage in some sort of corporate social responsibility (CSR) projects that could be expected to increasingly focus on improving community resilience as climate risks become more pressing (cf. Gustafsson, 2018; Haslam, 2021). We will analyse to what extent companies have engaged in initiatives aimed at improving community resilience.

While these different types private adaptation in principle could reduce societal climate vulnerability, adaptation scholarship warns us about the risk of unintended negative consequences of adaptation interventions for the most vulnerable (Eriksen et al. 2021; Taylor, 2014). Information disclosure about private adaptation strategies to local communities and state agencies can help reduce such risks and enhance accountability. Participation in the development of adaptation strategies have also been emphasized as important (e. g., Eriksen et al., 2021; Forsyth, 2018). Hence, some degree of transparency and participation of local stakeholder would ideally characterize any private adaptation response to climate risks.

2.2. Analyzing the drivers of private adaptation

In this section, we develop a political economic account to private adaptation that focuses on the dynamic relationship between state, markets and civil society in shaping private adaptation. Such an approach seeks to understand which coalitions of interests succeed to shape private adaptation (Newell, 2008a, 2008b). Previous research on private adaptation, has emphasized a number of factors that explain why companies develop private adaptation strategies. Linnenluecke et al. (2013) found that internal decision-makers often play an important role in influencing a company’s responses to climate risks. Other studies point to exposure to climatic impacts, the regulatory environment, stakeholder and investor pressures, as important factors (Averchenkova et al., 2016). We draw on and advance on these studies when discussing how governments, investors, and civil society might shape private adaptation (Fig. 1).

2.3. Regulatory pressures in producing sites

Domestic governments can strengthen private adaptation by way of regulation. Given legal enforceability, regulation is a

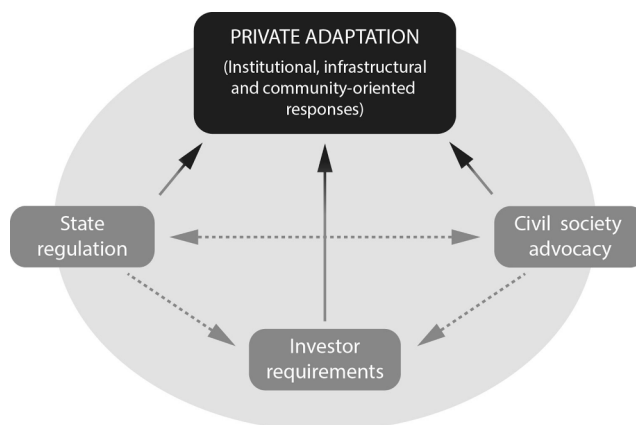


Fig. 1. Visualization of analytical framework.

potentially important driver of private adaptation (cf. Dauvergne and Lister, 2012; Österblom et al., 2015; Folke et al., 2019). Governments could, for instance, adopt so-called “market-restricting rules” that limit potentially profitable activities that would expose surrounding communities and environments to significant risks (Bartley, 2018). Through legal requirements governments can integrate climate risks in key sectorial governance tools, such as environmental impacts assessments (EIAs), water licenses, closure plans, and tailing dam standards. If effectively enforced, such measures would compel companies to address climate risks.

Such regulations can imply stricter requirements or even limits to company activities in high-risk places. For instance, in 2017, the government of El Salvador commissioned a Strategic Environmental Assessment to evaluate the impacts of mining in a context of increased climate-related disasters and water scarcity, which led to a ban of metal mining in the country (Odell et al., 2018). In other cases, companies have to show that they could mitigate existing risks through adaptation strategies, such as reducing water consumption and climate-proofing of infrastructure. Indeed, such regulations would lead to adjustment costs, and a reduction of companies’ autonomy, which is why companies are likely to be opposed to the adoption and enforcement of such laws (cf. Bartley, 2018).

We conceive of regulations of business actors as a product of the political-economic context in which they are developed (Newell, 2008a). There is a long-standing debate about the erosion or reconfiguration of state power in a context of the rising authority of global private actors (Green, 2014), affecting the ability and will of governments to regulate business. Governments are often reluctant to intervene and regulate economic actors that credibly communicate threats to relocate their operations. Instead, governments often rely on different tools of soft governance such as scientific information and guidelines, multi-stakeholder dialogues, and public–private partnerships, to incentivize private adaptation (cf. Newell, 2008a; Averchenkova et al., 2016).

However, there is great variation across states. In the more developed Global South countries, the prospect of domestic regulations has been an important driver of private mitigation, whereas this has not been the case in less developed countries in the Global South (Pulver and Benney, 2013; Purdon and Thornton, 2019). Moreover, countries heavily dependent on natural resource extraction has often suffered from a so-called “resource curse”, which has generated rent-seeking behavior among political elites, making it difficult to build and enforce environmental law that is perceived as a threat to the interests of powerful state and business elites (Ross, 2015; Gustafsson and Scurrah, 2019). While existing or prospected governmental regulation could constitute an important driver of private adaptation, it is thus important to also consider the wider political-economic context in the area of resource extraction.

2.4. Investor pressures

Private companies are primarily accountable toward shareholders and investors. Companies are facing increasing pressures from shareholders to address climate risks (Goldstein et al., 2019). Investors can, for instance, require companies to disclose information about their exposure and responses to climate risks and they may even stop investments in companies that are not handling climate risks adequately. Such actions are likely to generate discussions and raise awareness within companies about the importance of addressing climate risks (Newell, 2008a). Shareholder requirements are likely to be influenced by CSO campaigns and regulatory pressures that may impact the reputation and profitability of a company.

To comply with such requirements, different types of private governance tools, such as climate risks disclosure, standards, certifications, guidelines and best practices, have emerged (Averchenkova et al., 2016). Such tools can be understood in the context of a broader trend in which companies nowadays seek to influence environmental governance by engaging not only in lobbying but also in standard-setting – a task traditionally conceived of as being the responsibility of public actors (Büthe and Mattli, 2011; Green, 2014). However, selective disclosure, limited uptake, and symbolic compliance are evident shortcomings of private voluntary standards (Dauvergne and Lister, 2012; van der Ven et al., 2018). Therefore, investor pressure could enhance private adaptation, but only if it is backed up by stringent regulation and civil society pressures to ensure that private actors adopt responses to climate risks that do not come at the cost of increased vulnerability of societal actors.

2.5. Civil society pressures

“Civil regulation” is a civil society based form of regulation that could potentially play an important role in shaping private adaptation responses, particularly in cases where governments are perceived to fail to use public regulation to require companies to adequately address climate risks (Newell, 2008b). CSOs, such as non-governmental organizations (NGOs) or local communities, adopt different strategies to hold companies accountable. Newell (2008b) distinguishes between liberal and critical strategies. Liberal strategies refer to engagements and the use of market mechanisms to steer company behavior, critical strategies. Critical strategies refer to confrontational protests that seek to change business activities more profoundly.

CSOs could generate and disseminate other types of knowledge about climate risks and demand information about how companies handle such risks, and thus engage in what Kinchy and Shaffer refer to as “disclosure conflicts” (2018). By engaging in highly visible campaigns, the pressure on companies to integrate climate risks in corporate strategies can increase. Campaigns that expose the consequences of companies’ failure to address climate risks can lead to consumer boycotts or demands from investors to address climate risks. Companies therefore often engage in public debates to defend themselves (Newell, 2008b).

Indeed, CSOs have significantly influenced mining expansion in Latin America (e.g. Bebbington et al., 2008) and companies’ climate risk strategies (Urquidí, 2010; Kronenberg, 2013; Odell, 2021). However, it has often proven difficult to scale up localized struggles and build broader coalitions necessary to transform national decision-making and governance processes (Haarstad, 2012). The existence of CSOs that pressure companies to develop community-oriented responses and disclose information about their exposure and responses to climate risks could thus potentially be a crucial driver of private adaptation, in particular in contexts where stringent public regulations are missing or not enforced.

3. Research design

Our theoretical framework emerged from observations obtained from the following methods: quantitative and qualitative document analysis, in-depth case studies, and semi-structured interviews.

3.1. Dataset on private adaptation

To identify and map private adaptation responses, we created a dataset on the climate adaptation activities of the 37 largest mining companies in the world according to their market capitalization in 2019 (PWC, 2019, see also Appendix A). We analyzed corporate documents, such as annual reports, sustainability reports, statements, Carbon Disclosure Project, and Global Reporting Initiative-reports. We include annual reports from 2017 and onwards, since there are hardly any adaptation responses prior to that. We also included all statements, policies and reports that had a main focus on climate change and that were available through the companies' websites. On average, we analyzed 14 documents per company.¹

To analyze the documents, we developed a coding scheme, wherein we analyzed if the companies have adopted institutional, infrastructural and community-oriented responses, and if they disclosed information to and collaborated with local communities and state agencies when assessing and addressing climate risks (Appendix B). Relying on company self-reporting of private adaptation has its limitations (see also Fonseca 2010): reporting can be fragmented, biased, and vague. For instance, there is little data on private adaptation investment (Goldstein et al., 2019). Moreover, as we only analyzed English documents we might overestimate transparency toward global and transnational actors, as we miss some company communications or local initiatives in other languages. To reduce the risks for potential bias in the data, we complemented the document analysis with qualitative interviews among a broad sample of actors, which allowed us to ask questions and triangulate data about the identified patterns.

3.2. Semi-structured interviews

To analyze how investor and civil society pressures shape private adaptation, we mainly rely on 46 semi-structured interviews with representatives of mining companies, state agencies and CSOs who work with climate adaptation and/or mining (Appendix C). The interviews enabled us to get a deeper understanding of how and why company representatives developed responses and the challenges they faced. In addition, the interviews with representatives of state agencies, multilateral organizations and CSOs yielded insights into power dynamics and barriers to enhancing the quality of private adaptation. The interview data was coded in Atlas.ti (Appendix D).

3.3. In-depth case studies

Analyzing public regulations that shape private adaptation requires assessing a country's entire legal system and legal rules relevant to adaptation and mining. We selected two specific countries for this part of the analysis: Australia and Canada. These are world leaders in the production of mineral and metal commodities. The mining industry in both countries is adversely affected by the impacts of climate change, such as high temperatures, droughts and fires in Australia (Hodgkinson et al., 2010), and melting permafrost and changes in the hydrological cycles in Canada (Prowse et al., 2009). These high-income countries are not plagued by the "resource curse" or fragile institutions to the same extent as many resource dependent developing countries. Thus, adaptation-related regulations can be expected to be more advanced than in most other mining-dependent countries. If we do not find advanced regulations here, we are unlikely to find them elsewhere.

Both Australia and Canada are federal states where mining is primarily regulated at the state level, while the international climate change compromises and pledges are set at the federal level. In addition to the federal level, we pay close attention to the regulations in two mineral rich sub-federal jurisdictions: Western Australia and Ontario. We developed a coding scheme (Appendix E) to analyze how adaptation is regulated in climate governance on the basis of relevant legislation, policy documents, and plans. Moreover, we assess how climate risks are integrated in key mining governance instruments, including EIAs (which evaluate possible impacts of a mining project prior to approval), water use licenses (which determine the price and the quantities of water companies can use), and mine closure plans (which describe the activities to restore the landscape and to store mining waste in a safe way after closure) (Appendix F).

4. Empirical analysis

In this section, we analyze the patterns and drivers of the adaptation responses of the world's 37 largest mining companies.

4.1. Mapping private adaptation responses to climate risks

Among the three types of adaptation responses identified, institutional responses can be divided into water governance and risks assessments. "Water governance" refers to whether companies have integrated climate risks in procedures for measuring and monitoring their water consumption and whether they have set up targets for reducing their water consumption. "Risk assessments" are

¹ We arrive at this number by dividing the total number of documents (N=504) by the number of companies observed (N=37).

done by way of integrating climate impacts in risk assessments and business plans. “Infrastructural responses” refer to investments to adjust technology and infrastructure to cope with climate risks, whereas community-oriented responses refer to activities that primarily or partially aim at enhancing the resilience of local communities.

A key finding in Fig. 2 is that water governance is the most common response to climate risks among the companies studied (about 55 percent of the observed companies adopted this response), followed by risk assessments (about 51 percent), infrastructural responses (about 43 percent), and community-oriented responses (about 26 percent). This suggests that mining companies tend to be aware of and have to varying extents developed responses to address climate risks.

Eight of 37 companies have adopted all four response types and 16 companies have adopted at least two response types. However, a closer look at the data reveals that as many as 18 of the 37 companies have not engaged in any response type. Among those who have adopted two response type are for example Anglo American, Anglogold Ashanti, Antofagasta, Barrick, BHP, Freeport, Glencore, Newcrest, Newmount, Rio Tinto, South 32, Sumitomo Metal Mining, and Teck Resource – all members of the International Council on Mining & Metals (ICMM) that has acted as a standardsetter in private adaptation in the mining sector.

Next, we illustrate these findings by using the interviews and qualitative document analysis. We begin with the most common response type – *institutional responses*. Slightly more than half of the studied companies report to have procedures in place for integrating climate risks when measuring and monitoring their water consumption, and have set up targets for reducing their water consumption. Anglo American (2019), for instance, claims that 75 percent of its operations are located in water-stressed areas, and that procedures exist to monitor water availability for all operations on an annual basis. In addition, the company claims to monitor water withdrawal in water-stressed areas on a monthly basis.

While these measures are important, it is also important to note that few companies reported having adopted targets to improve water quality by reducing pollution. Chemical pollution of water is often a significant threat for host communities (e.g. Lèbre et al., 2020; Sovacool and Linnér, 2016), and in contexts of climate-induced water stress, the combined effects of pollution and climate change are likely to be severe. Hence, targets need to include information about impacts on water quality as well as quantity.

The observed companies vary significantly in the extent to which they integrate climate change in risk assessments. A key challenge for companies is how to combine global climate models with their own local data to make reliable predictions about climate impacts (Interviews 6, 7, and 28). Moreover, the majority of the observed companies only assess climate risks for their own operations. Only three of the companies report that they consider the impacts on communities in their climate vulnerability assessments (Interview 22; see also interviews 1 and 34).

The lack of consideration of climate change in risk assessments of roughly half of the companies in our sample could have harmful consequences for local communities. Six of the companies in our sample that have operations in countries identified as particularly vulnerable to climate risks do not conduct climate risk assessments. Three of these companies have operations in the Democratic Republic of Congo (DRC), which is ranked as the fifth most climate vulnerable country in the world (ND-Gain, 2018). Unless companies handle climate risks, the intersecting impacts of mining and climate-induced stressors are likely to increase climate vulnerability in host communities. To avoid adverse outcomes, climate risks need to be systematically integrated in risk assessments, which includes the impacts on local communities.

With regard to *infrastructural responses*, of the 43 percent of the companies reporting this type of response, many engage in investments in technological adjustments to cope with hydrological stress (water storage, water use efficiency, etcetera), as well as adapt

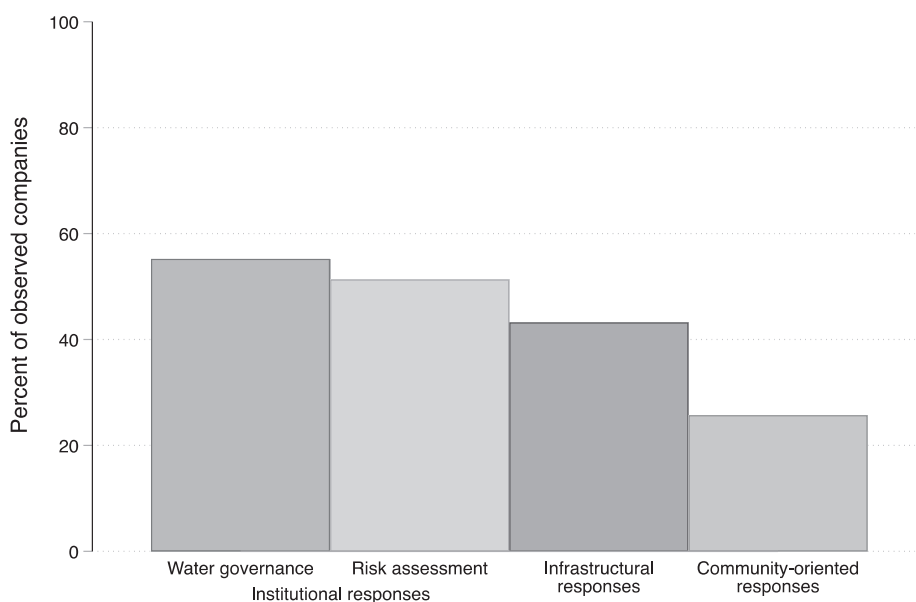


Fig. 2. Percentage of companies adopting specific adaptation response types Notes: $N = 37$. Based on a document analysis using company reports.

their infrastructure for extreme weather events. Anglo American (2018, p. 25) report upon having invested in technologies for making part of the process of extracting minerals waterless . . . Rio Tinto recycles 85 percent of the water in the Oyu Tolgoi mine in Mongolia (Rio Tinto, 2021).

In respect of *community-oriented responses*, 26 percent of the companies report that they carry out adaptation initiatives that primarily or partially seek to enhance the adaptive capacity of local communities. However, rather than having a systematic strategy, companies often report isolated cases of CSR projects aimed at enhancing community resilience. When asked about the need to consider the climate impacts on local communities as an integrated strategy, most company representatives emphasized that if companies enhanced their own climate resilience, this would automatically have positive impacts on host communities. As expressed by a company representative: “Even if we look at it very selfishly just at our own [climate] risks, it will still have a positive impact on the community because it reduces the risks (Interview 32). Yet, such commonly expressed views disregard the well-known trade-offs and risks for unintended consequences associated with adaptation interventions (e.g. Eriksen et al., 2021).

Taken together, the document and interview data combined suggest that companies have started to address the impacts of climate change on their operations, but that responses do typically not address the vulnerabilities of local communities.

4.2. Qualities of private adaptation responses

As private adaptation can have far-reaching impacts on local communities’ climate vulnerability, it is important that communities have access to information about climate risks and adaptation responses, and that companies collaborate with and are accountable to local communities and governments in developing such responses.

Fig. 3 analyzes such qualities based on the company documents. The category “Local or national transparency” captures whether a company reports any initiatives or strategies to inform local or national stakeholders about the company’s strategies in relation to climate risks. “Global or transnational transparency” measures reported initiatives to inform investors about the company’s responses to climate risks by reporting to Task Force on Climate Related Financial Disclosures (TCFD) and or Carbon Disclosure Project (CDP). “Perceived accountability” refers to whether companies acknowledge responsibility for protecting local communities from exposure to climate risks. “Local or national collaborations” refer to any reported initiatives to engage with local and national stakeholders in adaptation planning.

The results in Fig. 3 show that whereas 61 percent of the companies disclosed information to investors, only 19 percent shared information with local communities and state agencies. Finally, 17 percent of the companies reported that they engaged in collaborations with local and national actors to address climate risks. These findings suggest that companies are mainly responding to investor concerns by disclosing informing, rather than seeking to protect local communities from climate risk exposure.

Whereas some of the companies disclose technical data on water withdrawal and recycling on their websites, this information tends to be too complex and abstract for local communities to understand and verify. Moreover, although three companies report assessments of climate impacts on communities, they do not invite host communities to participate in risk assessments (Interview 29), implying that communities have little opportunity to influence such processes. Meaningful dialogues about the interconnected risks associated with the effects of climate change and mining expansion often require technical expertise that local communities may be lacking. As explained by a company representative “The complexity of climate change, that is a huge barrier for us to be able to have,

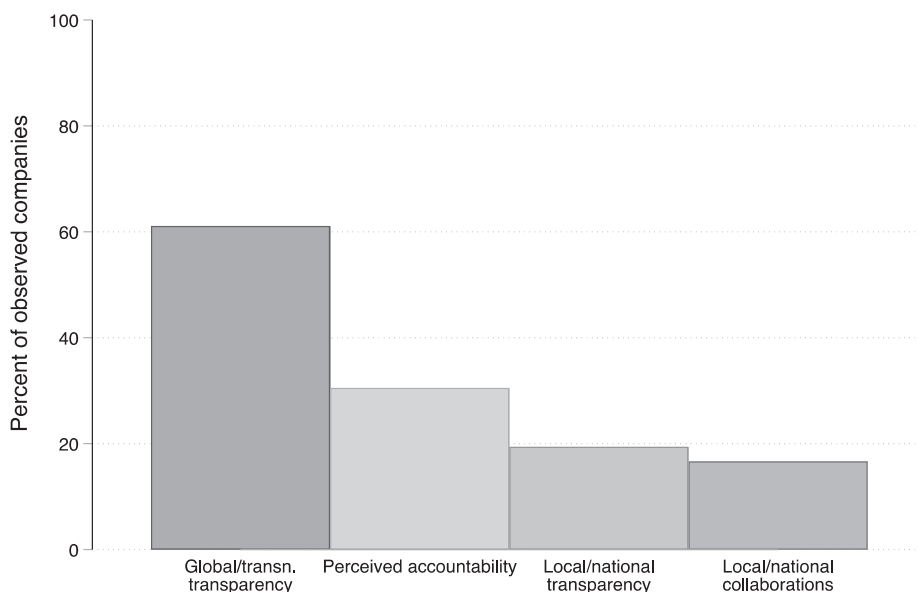


Fig. 3. Percentage of companies adopting accountable and transparent responses Notes: $N = 37$. Based on a document analysis using company reports.

you know, real conversations with communities around the developing world” (Interview 5). Indeed, to reduce power asymmetries and lead to empowerment, information needs to be accurate, clear, and resonate with communities’ everyday needs (Fung et al., 2007).

One of the most important concerns for local communities is access to water. Therefore, a more meaningful way of disclosing information and involving stakeholders is represented by the integration of climate risks in existing participatory water management initiatives (Interview 22; UN Global Compact et al., 2015). For instance, South 32 created a Community Climate Action Model to manage water consumption in a transparent and participatory manner in Colombia. Other companies report similar initiatives (Kunz et al., 2017; Interviews 5, 8, and 22). Through these processes, local communities could provide information about their needs, assess corporate strategies, and reach agreements with companies about how to share scarce water resources. However, as Odell (2021) also argues, while such collaborative initiatives may create opportunities for community influence, such close interactions with companies might also lead to internal conflicts and fragmentation among local communities.

In sum, while the majority of the companies have started to identify risks to core businesses activities, accountability and information disclosure to and involvement of local communities tends to be weak.

4.3. Drivers of private adaptation responses

Next, we analyze the role of government, investor, and CSO pressures in shaping private adaptation.

4.4. Governmental pressures

Existing or anticipated governmental regulation could constitute an important driver of private adaptation. Yet, our analysis of the regulatory pressures in Australia and Canada as well as in two rich mining-dependent sub-federal jurisdictions (Western Australia and Ontario in Canada) indicates that there are no stringent legal requirements to address climate risks in key mining policies. Both Australia and Canada are large producers of minerals and the mining sector is key for these countries’ economic development. Both countries are federal states where regulatory authority is divided between the different levels of the state. The main responsibility to regulated mining is at the state and territory level in Australia (EPBC Act, 1999) and at the provincial level in Canada (Constitution Act, 1867), where the interests in mining expansion are stronger. At the federal level, at which the international climate change compromises and pledges are set, the competencies to regulate the sector are weaker. As the following analysis suggests, this can undermine the role of the federal governments when it comes to effectively integrating adaptation at lower levels where mining governance operates.

4.4.1. Climate adaptation policy

The adaptation strategies and plans promoted at the federal level in both countries have generally been based on soft governance tools, such as scientific information and guidelines, dialogues, and partnerships, but such national policies have not been able to penetrate effectively the regulatory frameworks at state and provincial levels. In Australia, adaptation was recognized as a priority already in 2004 (Australian Government, 2005) and a National Climate Resilience and Adaptation Strategy was adopted in 2021 (Australian Government, 2021). Yet, such national policies have only insufficiently penetrated the regulatory framework in the mining-rich state of Western Australia.

Similarly, the Canadian government has sought to promote climate adaptation in the Ontario province through different policies, such as the Action Plan on Climate Change of 1998, to the Pan-Canadian Framework on Clean Growth and Climate Change (PCF) (Government of Canada, 2016). Generally, the adaptation policy in Canada has been characterized by collaboration and partnerships between the federal government, sub-federal government, and the private sector, rather than stringent federal intervention (Council of Canadian Academies, 2019). The approach to adaptation is based on voluntary processes in which the government assists company decision-making by enhancing understanding of climate risks for economic sectors, communities, and individuals (Government of Ontario, 2021). As explained by a representative of a mining company, “the [federal] government has a lot of resources to collaborate, and share learnings and advance practice. Not the same degree of regulatory engagement” (Interview 7). Taken together, the adaptation policies promoted by the federal governments in both countries have had little impacts on sub-federal regulations.

4.4.2. Mining governance

At sub-federal levels, there is generally a lack of legal requirements to integrate climate risks in key sectoral governance tools, such as EIAs, issuing of water licenses, closure plans, and tailing dam standards. In Western Australia, there is no direct reference to climate change, in the legal guidelines and standards regulating mining in Western Australia (Government of Western Australia, 2020). Likewise, the lack of integration of climate adaptation in EIAs severely limits any assessment of the extent to which mining projects are likely to exacerbate the climate vulnerability of local communities. Concerning mine closures, although information about climate change data for risk assessments is required (DMIRS Department of Mines, Industry Regulation and Safety, 2020), and local communities should be consulted and provided with relevant information, companies are not required to provide data about how their local impacts might be exacerbated by climate risks. As explained a mining company representative: “We’re taking steps to look at some of our basic engineering assumptions around extreme storms and revising some of our design criteria on that basis. But it’s not being driven by the governments” (Interview 5). Overall, Australia does not have strong regulations for how to assess climate risks in mining operations.

Similarly, the regulation of adaptation in Ontario Canada is characterized by a voluntary and self-regulatory approach, where

climate risks are not required to be considered in EIA procedures (Government of Ontario, 2021). However, legally binding regulations make no explicit reference to climate risk in EIAs. Still, adaptation has been getting relevance in Canadian EIA policy (FPTCCCEA Federal-Provincial-Territorial Committee on Climate Change and Environmental Assessment, 2003). As explained by a representative of a mining company, “they are starting to ask very specific questions about what climate scenarios we had incorporated in EIAs. They wanted to ensure that we had modelled water availability at certain times of the year and so on.”

Still, there are no legal requirements to factor in climate impacts in water use licenses, closure planning, and tailing facility design and management (OWRA, 1990; Ontario Reg. 387/04). As explained by a representative of a mining company “the requirements are really minor. They would like to see that you’ve looked at it, but the assessment and the robustness of that investigation that you’ve done or the analysis you’ve done is pretty minimal. So, we as an organisation are doing it much more voluntarily than the requirements.” (Interview 10).

Overall, only voluntary industry standards, such as the Canadian Dam Safety Guidelines, are in place to integrate adaptation in mining planning. The lack of climate risk integration in legal rules makes for a weak policy framework, which gives mining companies considerable discretion when integrating climate risks in mining planning. Weak regulatory pressures to address climate risks could be attributed to the central role that mining activities play for economic growth and the historical entrenched interests behind the expansion of mining. Regulatory pressures are constrained by developmental economic strategies and specific political economies in sub-federal jurisdictions where mining operates. In such contexts, mining companies have more room for agency in shaping the regulatory environment in mining sites.

Concerning regulatory pressures and private adaptation responses, our interview material suggests that weak regulatory pressures in mining governance tend to be accompanied by a corporate resilience strategy oriented to business expansion and growth, rather than to the vulnerabilities of local communities.

4.5. Investor pressure

Whereas domestic regulations seem to have played a modest role in shaping private adaptation, interviewees stress investor demand for information disclosure on climate risks as a key factor. Investors increasingly solicit reliable data on exposure and responses to climate risks. For instance, the Equator Principles that are supported by major financial institutions require companies to consider climate risks in environmental and social impact assessments for all major projects involving potential social and environmental risks (Equator Principles, 2020). Indeed, most company representatives describe investor pressures as the main driver of private adaptation. As expressed in this quote: “It really comes down to investors. It really comes back to the dollar sign” (Interview 1, see also 6, 9, and 28).

Increased investor pressure could be a reaction to community protests or CSO campaigns that publicly expose companies’ irresponsible practices, with repercussions for a company’s reputation. An interesting example is the Oyu Tolgoi-mine in Mongolia that is operated by the Rio Tinto company. This mine is located in the dry Gobi Desert and water availability was from the beginning a contentious issue between the mining company and the nomadic herders. In 2012, the government adopted a law that prohibited mining companies to use groundwater, and although the law has been withdrawn, companies still have to pay high fees for the water they use (Interview 8). Against this background, the International Financial Corporation (IFC), a member of the World Bank Group, made clear that in order to grant the loan for developing the project, Rio Tinto had to solve the water issue (Interviews 8, 22, 45). In response, Rio Tinto report upon having invested in costly technologies to make the Oyu Tolgoi mine one of the most water-efficient copper mines in the world. Water is sourced from deep aquifers and the company recycles 85 percent of the water used (Rio Tinto, 2021). To accompany such infrastructural investments, the company also developed a voluntary code of practice for water use, with a measurement and auditing function. However, as other company representatives highlighted, such technologies are costly. Companies are often reluctant to make such investments for this reason unless it is not necessary for the viability of the project or a requirement from financial institutions or governments. Rio Tinto also established a watershed program in collaboration with IFC to engage local communities in participatory water monitoring (Kunz et al., 2017; Interviews 8 and 22). This case illustrates how civil society pressures, domestic regulations, and investor requirements might combine in steering company responses to climate risks, with the promise of more community-oriented private adaptation responses.

In the face of the increasing requirements from the investment community, business and industry associations have played an important role in facilitating and incentivizing companies to disclose information about their exposure and address climate risks. Associations have acted as standardsetters and developed guidelines and toolkits that establish criteria for best practices (cf. Averkhenkova et al., 2016). For instance, the Task Force on Climate Related Financial Disclosures (TCFD), established in 2015, has developed guidelines to disclose information about the financial implications of climate risks to investors (TCFD, 2017). These guidelines constitute a robust framework for integrating climate into risk and vulnerability assessments. Similarly, ICMM has developed a Climate Assessment Data Tool adapted for the mining sector that was launched in 2016 (ICMM, 2019a, 2019b). The majority of the companies in our sample use both of these frameworks. Given a growing awareness of the importance to take communities’ adaptation needs into account (UN Global Compact, 2015), ICMM’s tool allows companies to assess climate risk exposure of both companies and host communities.

While such initiatives reflect an emerging awareness and trend of private adaptation, unless complemented with stringent public policies, such voluntary guidelines are unlikely to guarantee the enforcement required to hold companies accountable for their (in) actions.

4.6. Civil society pressure

In the absence of stringent public regulations, CSOs could play an important role in pressuring companies to engage in community-oriented responses. Yet, to date, there are only few examples of conflicts or advocacy campaigns asking companies to disclose information on how they handle climate risks. Consider a few examples. In 2017, CSOs won a lawsuit against the South African government for failing to consider climate change impacts in the environmental authorization of two coal-fired power stations. In 2020, NGOs appealed to a Water Tribunal in Pretoria the government's decision to grant a water license to a new coal-fired power station without consideration of future impacts of climate change on water availability. In 2012, in Mongolia, nomadic herders opposed to mining development in the water scarce Gobi desert, and led the Mongolian government to adopt stricter regulations of water licenses, and led the IFC to require water efficient technologies as a condition to grant the loan to Rio Tinto for developing the Ouy Tolgoi mine.

Kronenberg (2013) and Urkidi (2010) have reported on similar conflicts in Chile, related to the impact of mining activities on glaciers in the face of major climate change. Moreover, after the major oil spill in the Arctic, several large environmental organizations criticized the Russian company Nor Nickel for using climate change as an excuse to avoid blame (Roth, 2020). A Greenpeace representative working in the area has argued: "It is a huge company working in such an area. We already know about permafrost melting for at least 10 years. There should be monitoring systems, there should be special constructions that take climate risks into consideration when working in such areas" (Interview 33).

Whereas pressure from civil society in the Global North to enhance climate mitigation is increasing, there is much less contestation in the area of adaptation. As explained by a World Bank representative working on climate change and mining, "[t]here is just a huge push from civil society to do more in this area [mitigation]. But in the area of adaptation, I do not see much pressure from civil society in the Global South where the companies are operating.[...] I think it's because of lack of understanding of what the relationship is between climate and water" (Interview 22). Similarly, company representatives often emphasized that community members are often concerned about short-term issues such as employment and development (e.g. Interview 5, 8 and 29), thus reducing the pressure on companies to engage in community-oriented responses.

Interestingly, however, several company representatives emphasized that they have experienced pressure from NGOs and local communities related to water use: "If we don't have water available for the communities and we don't meet our commitment, the operation will shut down. I mean water is as important as gold" (Interview 2, see also 1, 7, and 32). Whereas companies often set up some participatory arrangements related to water, the weak integration of climate risks in these processes might also be due to a concern about increased conflicts. According to two water specialists, mining companies are reluctant to share information about climate-induced water stress with local communities as it might generate protests and pressure on a company to invest in water storage facilities for local communities (Interviews 41 and 36).

Indeed, the main purpose of CSR-practices in the context of mining is to reduce conflicts and perceptions of risks (Haslam, 2021). By starting to address climate risks, companies could, however, enhance rather than reduce communities' perceptions of risks. Unless climate risks is already an important concern for local communities affecting the social acceptability of a mining project, companies are, therefore, likely to have few incentives to include climate risks as part of their CSR-practices.

To put pressure on companies and to be able to engage in meaningful discussions with companies about climate risks, communities need to raise their awareness and knowledge about climate risks. This could, for instance, be achieved through different forms of community-led participatory environmental monitoring, which is often carried out in the context of mining and which is critical for communities' ability to engage in meaningful dialogues with companies (Gustafsson and Schilling-Vacaflor, 2021; Lawrence and Larsen, 2017). For instance, United Nations Development Programme's (UNDP) support Participatory Environmental Monitoring Committees (PEMCs) – initiatives where local communities are involved in collecting and assessing information about the impacts of mining on water quality and quantity. The integration of climate risks in PEMCs, could enable local communities to engage in dialogues with companies and pressure them to become transparent about how they assess and deal with climate-related risks, which is why UNDP is currently discussing to develop a pilot-project on this topic (Interview 46).

Overall, there is little evidence that CSOs have played an important role in pressuring companies to develop private adaptation responses. This weak evidence may explain some of the shortcomings that currently characterize mining companies' responses to climate risks, specifically the lack of community-oriented responses, transparency and participation of local communities. Rather, our analysis suggests that investor pressures has been the most important driver of private adaptation. Domestic regulations and civil society pressures have been important in isolated cases, but not shaped the broader trend of private adaptation in the mining sector.

5. Conclusion

In this article, we have analyzed the private adaptation responses of the 37 largest mining companies in the world using a political economic approach. The central result is that the majority of the companies respond to climate risks, but that significant gaps remain when it comes to involving and ensuring that communities benefit from such initiatives. Our results suggest that these shortcomings are at least partially due to weak government and civil society pressures that would compel companies to address climate risks in a way that would help to improve societal resilience. Rather, private adaptation is mainly shaped by investor pressures.

There are three broader implications for adaptation research and politics. First, our findings advance research on the drivers of private adaptation. While previous research has identified different factors driving private adaptation, such as the regulatory environment, stakeholder and investor pressures, the role of internal decision-makers, and exposure to climate risks (Averchenkova et al., 2016; Linnenluecke et al. 2013), we have advanced these debates by analyzing the relative importance of what we identify as main drivers. By analyzing private adaptation as a product of a broader political economic context, we have shown that certain interests

prevail and important governance gaps remain. This is clearly illustrated in the weak regulatory pressures on companies to address climate risks. Even countries with high governance standards are reluctant to impose stringent legal requirements on sectors perceived to be of critical importance for the economic growth strategies. While our findings have advanced our understanding of the relative importance of different drivers, there is a need for more research on the different regulatory environments faced by companies. Future research could explore whether companies with headquarters in countries with higher awareness of climate change are more likely to address climate risks (cf. [Levy and Kolk, 2002](#)). Moreover, our political economy framework could usefully be applied in future studies to systematically assess and compare how governmental, investor, and CSO pressure shape private adaptation in other issue areas, such as agriculture, and fisheries, where these drivers are likely differ.

Second, the significant gaps in the public governance of private adaptation beg questions about how governance of private adaptation can be improved. Previous research has emphasized the importance of coupling private governance initiatives with stringent governmental regulations to achieve transformative change (see also [Bartley, 2018](#); [Dauvergne and Lister, 2012](#); [Folke et al., 2019](#)). By situating private adaptation in a political economy context, we have contributed to shed light on the significant barriers to enhancing transformative change (cf. [Newell, 2008a](#)). Still, existing domestic regulations and voluntary private measures are insufficient. In this context, researchers and policymakers increasingly argue that there is a need for legal obligations in the home countries of the companies that could hold companies accountable for human rights violations and environmental harm in producing sites ([Moser & Leipold 2021](#)). In recent years, different types of supply chain regulations focused on environmental problems and human rights have emerged ([Schilling-Vacaflor and Lenschow, 2021](#)). It remains to be seen to what extent such supply chain regulations could improve private adaptation.

Third, our findings raise important questions about the societal consequences of private adaptation. Our data suggest that companies adapt to climate risks in order to strengthen business resilience, while taking little responsibility to improve societal resilience. This has implications for affected communities and underlines the importance of further considering how private adaptation interventions affect climate vulnerability ([Dolšák and Prakash, 2018](#); [Eriksen et al. 2021](#); [Purdon and Thornton, 2019](#); [Sovacool and Linnér, 2016](#)), not the least in the mining sector. Mining activities places immense pressure on water supplies and livelihood assets, and contaminate the environment (e.g. [Bebbington and Bury, 2009](#); [Lèbre et al., 2020](#)), and these impacts are likely to be exacerbated by climate change. Such “intersecting impacts” have, however, largely been overlooked in scholarly and policy debates about mining governance ([Odell et al., 2018](#)). Our findings shed light on the importance of enhancing community participation in the design and implementation of private adaptation, in order to avoid inequitable consequences of private adaptation initiatives. There is a need for systematic analyses of the concrete impacts of private adaptation strategies on local communities, both in the context of mining and in other issue areas.

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Declaration of Competing Interest

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

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Appendix A. Supplementary data

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References

- Adger, W.N., 2006. Vulnerability. *Global Environ. Change* 16, 268–281.
 Anglo American Integrated Annual Report Available at: <https://www.angloamerican.com/~media/Files/A/Anglo-American-Group/PLC/investors/annual-reporting/2019/aa-annual-report-2018.pdf> 2018 Last accessed 20.04.2021.

- Anglo American Water Security Questionnaire 2019 Carbon Disclosure Project. 2019 Available at: <https://www.angloamerican.com/~//media/Files/A/Anglo-American-Group/PLC/sustainability/approach-and-policies/sustainability/performance/anglo-american-water-security-response-2019.pdf> (Last accessed 20.04.2021).
- Australian Government, 2005. Climate Change Climate Change Risk and Vulnerability: Promoting an Efficient Adaptation Response in Australia. Report Prepared by Allen Consulting Group for the Australian Greenhouse Office, Department of the Environment and Heritage. Available at: <http://www.sfrpc.com/Climate%20Change/4.pdf> (Last accessed 20.04.2021).
- Australian Government National Climate Resilience and Adaptation Strategy Available at: <https://www.environment.gov.au/climate-change/adaptation/strategy-2021>.
- Averchenkova, A., et al., 2016. Multinational and large national corporations and climate adaptation: Are we asking the right questions? A review of current knowledge and a new research perspective. *Wiley Interdiscipl. Rev. Clim. Change* 7, 517–536.
- Bartley, T., 2018. Transnational corporations and global governance. *Annu. Rev. Sociol.* 44, 145–165.
- Bebbington, A., et al., 2008. Mining and social movements: Struggles over livelihood and rural territorial development in the Andes. *World Develop.* 36 (12), 2888–2905.
- Bebbington, A.J., et al., 2018. Resource extraction and infrastructure threaten forest cover and community rights. *Proc. Natl. Acad. Sci. U.S.A.* 115, 13164–13173.
- Bebbington, A.J., Bury, J.T., 2009. Institutional challenges for mining and sustainability in Peru. *Proc. Natl. Acad. Sci. U.S.A.* 106, 17296–17301.
- Berkhout, F., Hertin, J., Gann, D.M., 2006. Learning to adapt: Organisational adaptation to climate change impacts. *Clim. Change* 78, 135–156.
- Biagini, B., Miller, A., 2013. Engaging the private sector in adaptation to climate change in developing countries: Importance, status, and challenges. *Clim. Develop.* 5, 242–252.
- Büthe, T., Mattli, W., 2011. *The New Global Rulers*. Princeton University Press, Princeton.
- Council of Canadian Academies, 2019. Canada's Top Climate Change Risks, Ottawa (ON): The Expert Panel on Climate Change Risks and Adaptation Potential. Council of Canadian Academies. Available at: <https://cca-reports.ca/wp-content/uploads/2019/07/Report-Canada-top-climate-change-risks.pdf> (Last accessed 20.04.2021).
- Dauvergne, P., Lister, J., 2012. Big brand sustainability: Governance prospects and environmental limits. *Global Environ. Change* 22, 36–45.
- DMIRS (Department of Mines, Industry Regulation and Safety) Release of New Statutory Guidelines for Mining Proposals and Mine Closure Plans Available at: <https://www.dmp.wa.gov.au/News/Release-of-new-statutory-26674.aspx> 2020 Last accessed 20.04.2021.
- Dolšák, N., Prakash, A., 2018. The politics of climate change adaptation. *Annu. Rev. Environ. Resour.* 43, 317–341.
- Eriksen, S., et al., 2021. Adaptation interventions and their effect on vulnerability in developing countries: help, hindrance or irrelevance? *World Develop.* 141, 105383.
- Eriksen, S.H., Nightingale, A.J., Eakin, H., 2015. Reframing adaptation: The political nature of climate change adaptation. *Global Environ. Change* 35, 523–533.
- Equator Principles A financial industry benchmark for determining, assessing and managing environmental and social risk in projects Available at: <https://equator-principles.com/wp-content/uploads/2020/05/The-Equator-Principles-July-2020-v2.pdf> 2020 Last accessed 20.04.2021.
- Folke, C., et al., 2019. Transnational corporations and the challenge of biosphere stewardship. *Nat. Ecol. Evol.* 3, 1396–1403.
- Fonseca, A., 2010. How credible are mining corporations' sustainability reports? A critical analysis of external assurance under the requirements of the International Council on Mining and Metals. *Corp. Soc. Responsib. Environ. Manag.* 17 (6), 355–370.
- Forsyth, T., 2018. Is resilience to climate change socially inclusive? Investigating theories of change processes in Myanmar. *World Dev.* 111, 13–26.
- FPTCCCEA (Federal-Provincial-Territorial Committee on Climate Change and Environmental Assessment) Incorporating Climate Change Considerations in Environmental Assessment: General Guidance for Practitioners Available at: <https://www.canada.ca/en/impact-assessment-agency.html> 2003 Last accessed 20.04.2021.
- Fung, A., Graham, M., Weil, D., 2007. *Full Disclosure: The Perils and Promise of Transparency*. Cambridge University Press, Cambridge.
- Goldstein, A., Turner, W.R., Gladstone, J., Hole, D.G., 2019. The private sector's climate change risk and adaptation blind spots. *Nat. Clim. Change* 9, 18–25.
- Government of Canada Pan-Canadian Framework on Clean Growth and Climate Change Available at: <https://www.canada.ca/en/services/environment/weather/climatechange/pan-canadian-framework.html> 2016 Last accessed 20.04.2021.
- Government of Ontario Preparing and Reviewing Terms of Reference for Environmental Assessments in Ontario Available at: <https://www.ontario.ca/page/preparing-and-reviewing-terms-reference-environmental-assessments-ontario> 2021 Last accessed 20.04.2021.
- Government of Western Australia, 2020. *Statutory Guidelines 2020*. Department of Mines, Industry Regulation and Safety.
- Green, J.F., 2014. *Rethinking Private Authority: Agents and Entrepreneurs in Global Environmental Governance*. Princeton University Press, Princeton.
- Gustafsson, M.T., 2018. *Private Politics and Peasant Mobilization: Mining in Peru*. Palgrave MacMillan, London.
- Gustafsson, M.T., Schilling-Vacaflo, A., 2021. Indigenous Peoples and multiscale environmental governance: The opening and closure of participatory spaces. *Global Environmental Politics*. https://doi.org/10.1162/glep_a_00642.
- Gustafsson, M.T., Scurrah, M., 2019. Strengthening subnational institutions for sustainable development in resource-rich states: Decentralized land-use planning in Peru. *World Dev.* 119, 133–144.
- Haarstad, H. (Ed.), 2012. *New Political Spaces in Latin American Resource Governance*. Palgrave Macmillan, New York.
- Hannah, L., et al., 2013. Climate change, wine, and conservation. *Proc. Natl. Acad. Sci. U.S.A.* 110, 6907–6912.
- Haslam, P.A., 2021. The micro-politics of corporate responsibility: How companies shape protest in communities affected by mining. *World Dev.* 139, 105322.
- Hodgkinson, J.H. et al., 2010. Climate adaptation in the Australian mining and exploration industries. CSIRO Climate Adaptation Flagship Working Paper No. 5.
- Hund, K., La Porta, D., Fabregas, T.P., Laing, T., Drexhage, J., 2020. Minerals for Climate Action: The Mineral Intensity of the Clean Energy Transition. World Bank Group.
- ICMM Adaptation to a changing climate: Building resilience in the mining and metals industry Available at: <https://www.icmm.com/climate-adaptation> 2019 Last accessed 20.04.2021.
- ICMM Integrated mine closure: Good practice guide 2nd Edition Available at: https://www.icmm.com/website/publications/pdfs/closure/190107_good_practice_guide_web.pdf 2019 Last accessed 20.04.2021.
- IPCC, 2014. *Climate Change 2014. Impacts, adaptation and vulnerability. Annex Glossary*. IPCC 5th Assessment Report. Available at: <https://www.ipcc.ch/report/ar5/wg2/> (Last accessed 20.04.2021).
- Klein, J., et al., 2018. The role of the private sector and citizens in urban climate change adaptation: Evidence from a global assessment of large cities. *Global Environ. Change* 53, 127–136.
- Kronenberg, J., 2013. Linking ecological economics and political ecology to study mining, glaciers and global warming. *Environ. Policy Governance* 23 (2), 75–90.
- Kunz, N. et al., 2017. Shared water, shared responsibility, shared approach: Water in the mining sector. 1–48. The World Bank Group. Available at: http://www.icmm.com/website/publications/pdfs/environmental-stewardship/2017/research_shared-water-shared-responsibility.pdf (Last accessed 20.04.2021).
- Lawrence, R., Larsen, R., 2017. The politics of planning: Assessing the impacts of mining on Sami lands. *Third World Quart.* 38 (5), 1164–1180.
- Lèbre, É., et al., 2020. The social and environmental complexities of extracting energy transition metals. *Nat. Commun.* 11, 1–8.
- Levy, D.L., Kolk, A., 2002. Strategic responses to global climate change: conflicting pressures on multinationals in the oil industry. *Bus. Polit.* 4 (3), 275–300.
- Linnenluecke, M., Griffiths, A., Winn, M.I., 2013. Firm and industry adaptation to climate change: a review of climate adaptation studies in the business and management field. *WIREs. Clim Change* 4, 397–416.
- Linnenluecke, M.K., Stathakis, A., Griffiths, A., 2011. Firm relocation as adaptive response to climate change and weather extremes. *Global Environ. Change* 21, 123–133.
- Moser, C., Leipold, S., 2021. Toward "hardened" accountability? Analyzing the European Union's hybrid transnational governance in timber and biofuel supply chains. *Regul. Governance* 15 (1), 115–132.
- Nasiritousi, N., Hjerpe, M., Linnér, B.O., 2016. The roles of non-state actors in climate change governance: understanding agency through governance profiles. *Int. Environ. Agreements* 16, 109–126.

- ND-GAIN, Country Rankings: Country Index, Vulnerability and Readiness Available at: <https://gain-new.crc.nd.edu/ranking/vulnerability> 2018 Last accessed 20.04.2021.
- Newell, P., 2008a. The political economy of global environmental governance. *Rev. Int. Stud.* 34 (3), 507–529.
- Newell, P., 2008b. Civil society, corporate accountability and the politics of climate change. *Global Environ. Polit.* 8, 122–153.
- Odell, S.D., 2021. Desalination in Chile's mining regions: Global drivers and local impacts of a technological fix to hydrosocial conflict. *J. Clean. Prod.* 323, 129104.
- Odell, S.D., Bebbington, A., Frey, K.E., 2018. Mining and climate change: A review and framework for analysis. *Extr. Ind. Soc.* 5, 201–214.
- Österblom, H., et al., 2015. Transnational corporations as 'keystone actors' in marine ecosystems. *PLoS ONE* 10, e0127533.
- Pauw, P., Pegels, A., 2013. Private sector engagement in climate change adaptation in least developed countries: an exploration. *Clim. Develop.* 5, 257–267.
- Phillips, J., 2016. Climate change and surface mining: a review of environment-human interactions & their spatial dynamics. *Appl. Geogr.* 74, 95–108.
- Prowse, T.D., et al., 2009. Implications of climate change for economic development in northern Canada: Energy, resource, and transportation sectors. *Ambio* 38, 272–281.
- Pulver, S., Benney, T., 2013. Private-sector responses to climate change in the Global South. *Wiley Interdiscip. Rev. Clim. Change* 4 (6), 479–496.
- Purdon, M., Thornton, P., 2019. Research methodology for adaptation policy analysis: Embracing the eclectic messy centre. In: Keskitalo, E., Preston, B. (Eds.), *Research Handbook on Climate Change Adaptation Policy*. Edward Elgar Publishing, London, pp. 157–197.
- PWC Mine 2019: Resourcing the future Available at: <https://www.pwc.com/mx/es/publicaciones/archivo/2019/06/20190604-pwc-mx-mine-report-2019.pdf> 2019 Last accessed 20.04.2021.
- Ross, M., 2015. What have we learned about the resource curse? *Annu. Rev. Polit. Sci.* 18 (1), 239–259.
- Roth, A., 2020. Russian mining firm accused of using global heating to avoid blame for oil spill The Guardian. Available at: <https://www.theguardian.com/environment/2020/jun/09/russian-mining-firm-accused-of-using-global-heating-to-avoid-blame-for-oil-spill> (Last Accessed 10.11.2021).
- Sakhel, A., 2017. Corporate climate risk management: are European companies prepared? *J. Cleaner Prod.* 165, 103–118.
- Schilling-Vacaflor, A., Lenschow, A., 2021. Hardening foreign corporate accountability through mandatory due diligence in the European Union? New trends and persisting challenges. *Regulation & Governance*, published online 6 May.
- Sovacool, B.K., Linnér, B.O., 2016. *The Political Economy of Climate Change Adaptation*. Palgrave MacMillan, Houndmills.
- Taylor, M., 2014. *The Political Ecology of Climate Change Adaptation: Livelihoods, Agrarian Change and the Conflicts of Development*. Routledge, London.
- TCFD Implementing the recommendations of the the Task Force on Climate-related Financial Disclosures Available at: <https://assets.bbhub.io/company/sites/60/2020/10/FINAL-TCFD-Annex-Amended-121517.pdf> 2017 Last Accessed 10.11.2021.
- Rio Tinto Oyu Tolgoi, Mongolia Available at: <https://www.riotinto.com/operations/mongolia/oyu-tolgoi> 2021 Last accessed 20.04.2021.
- UN Global Compact, UNFCCC, UNEP, UNEP DTU Partnership, CDP, CEO Water Mandate, Four Twenty Seven, Oxfam, Rainforest Alliance, ARISE, ND-GAIN, WRI., 2015. *The Business Case for Responsible Corporate Adaptation: Strengthening Private Sector and Community Resilience. A Caring for the Climate Report*. Available at: https://d306pr3pise04h.cloudfront.net/docs/issues_doc%2FEnvironment%2Fclimate%2FAdaptation-2015.pdf (Last Accessed 2.04.2021).
- Uunderdal, A., 2010. Complexity and challenges of long-term environmental governance. *Global Environ. Change* 20, 386–393.
- United Nations Human Rights Office of the High Commissioner (OHCHR), 2011. *Guiding Principles on Business and Human Rights*. United Nations, Geneva.
- Urkidi, L., 2010. A glocal environmental movement against gold mining: Pascua-Lama in Chile. *Ecol. Econ.* 70 (2), 219–222.
- van der Ven, H., Rothacker, C., Cashore, B., 2018. Do eco-labels prevent deforestation? Lessons from non-state market driven governance in the soy, palm oil, and cocoa sectors. *Global Environ. Change* 52, 141–151.

Further reading

- South 32, Our Approach to Water Stewardship Available at: https://www.south32.net/docs/default-source/sustainability-reporting/fy2019-sustainability-reporting/s320034-our-approach-to-water-stewardship-2019-d7.pdf?sfvrsn=81fbfb6_6 2019 Last accessed 20.04.2021.