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Climate, nature, land-use change and human rights

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Abstract	A transition to a low-carbon society is deeply needed, as a combined response to both the nature crisis and the climate crisis. To achieve a sustainable transition - built on inclusion, equity, and protection of nature and human rights - these challenges need to be handled in integration. This report is based on a review of existing research and knowledge. It focuses both on how climate change impacts societies, individuals, and current land use, and on a set of climate change mitigation solutions that potentially conflict with other land-use interests. The report highlights different ways in which the low-carbon transition leaves a clear footprint on, and under the ground. For example, through renewable energy production, privatised areas for forest carbon storage, and mineral extraction. A main goal of the report is to provide knowledge for public authorities and development-cooperation agencies on how to reduce negative effects of climate change, facilitate rapid transitions to low-carbon societies, while simultaneously avoiding policies and measures that may challenge human rights or have a negative impact on the attainment of other sustainability goals.
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Contents

Summary

A shift towards a low-carbon society is urgently required to address both the environmental and climate crises. This necessitates an integrated approach that prioritizes inclusion, equity, and the preservation of nature and human rights. Drawing on a comprehensive review of existing research and knowledge, this report examines the societal impacts of climate change on societies and current land utilization. It also explores a range of climate change mitigation strategies that may intersect with competing land-use interests.

The report sheds light on how the transition to a low-carbon economy manifests both above and below ground. This includes among others the expansion of renewable energy infrastructure, the establishment of privately managed forest carbon storage areas, and the extraction of minerals. A primary objective of this report is to provide knowledge to public authorities and development-cooperation agencies on how to mitigate the adverse effects of climate change, facilitate the rapid transition to a low-carbon society, and avoid policies and measures that may undermine human rights or hinder progress towards other sustainability goals.

The impacts of climate change on human rights

Unevenly distributed impacts: Impacts of climatic changes have negative effects on human rights, and these are expected to aggravate as climate change advances. Individuals' exposure to climate impacts should be understood *contextually*, i.e. conditioned by individual as well as geographical and political factors. In areas with poverty, violent conflicts, poor governance, and a high degree of climate sensitive livelihoods, the human deaths from floods, droughts and storms were estimated to be 15 times higher than in low-vulnerability regions in the period 2010-2020. Geographically, the global South is more exposed to climate hazards and biodiversity loss. Among groups of people identified as being more contextually vulnerable are women, children, elderly, indigenous peoples, migrants, and others already marginalised. The contextually vulnerable should however not only be understood as victims of climate change and end-users of climate solutions. Such an approach risks overlooking their knowledge and potential contribution to developing policies and measures.

Acknowledging responsibility: The United Nations concludes that a human rights-based approach to climate change is needed, meaning that rights-holder are enabled to make their claims and duty-bearers enabled to meet their obligations. In states' ratification of international agreements lies the acceptance of being duty-bearers. One can therefore argue that parties to the Paris Agreement are obliged to follow a human-rights based approach to climate policy.

The global biodiversity framework is important for climate change mitigation and adaptation policy

Nature conservation built on human rights: In 2022, the Kunming-Montréal Global Biodiversity Framework, the so-called nature agreement, was adopted. While initiated as a framework to address biodiversity loss, its relevance transcends to discussions on land use, human rights and the transition to a low-carbon society. A main obligation in the agreement is to restore 30% of degraded ecosystems and to conserve 30% of the area on land, water, and sea by 2030. These targets, in addition to the other goals and targets in the framework, set clear premises for how and where to upscale the production of renewable energy. However, the nature agreement will also be important for ensuring nature's capacity to absorb and store carbon, among others in marshes, wetlands, and forests, and to protect against the effects of climate change (Target 10 and 11). Ultimately, the framework points out important pathways forward, emphasising that the sustainable use of land must be based on human rights, through inclusive processes, respecting the rights of indigenous peoples and local communities (Target 1 and 2). The nature agreement concludes that a *whole-of-government and whole-of-society approach* is needed (paragraph 8 J).

The geopolitics of a low-carbon transition

Change in important assets: The change in asset values following a global transition from a fossil to a low-carbon economy has geopolitical implications. Countries that control critical minerals, such as copper, cobalt, lithium, nickel, and rare earth elements (REE) will increase their relative power compared to holders of fossil resources. The demand for critical minerals will increase heavily as a result or population growth, digitalisation, and the extensive mineral requirements of low-emission technologies. Mining is already one of the largest sources of conflicts involving indigenous peoples, and several large mineral reserves are located in areas with fragile or pristine nature, like tropical forests and salt plains.

China's control of low-carbon assets: China is a dominant actor when it comes to the extraction and processing of green-technology minerals. Between 2021 and 2022, China produced 62% of the world's total REEs and had 34% of the world's total reserves. Further, China has over the last decade worked systematically to access strategically important markets. For instance, China has become the largest trading partner of both D.R. Congo – the world's largest producer of cobalt, and Chile – the world's largest copper producer and second largest lithium producer. Increasing US-Chinese polarisation and geopolitical rivalry over low-carbon assets manifest in local land conflicts.

Geographically uneven and contested upscaling of renewable energy

More energy, more land: 2022 had the largest increase in renewable energy capacity to date with 295 GW new capacity. Yet, to attain the Paris Agreement's temperature targets, an estimated 1000 GW needs to be added annually until 2050. This will undoubtedly require a lot of land, land of which much is already in use. Following Climatescope's ranking of the most attractive markets for energy transition project investments, Denmark and the Netherlands are the most attractive of what they define as developed markets. Chile and India are the most attractive for renewable energy investment of the emerging markets.

The geography of renewable energy: The last decade Asia has increased its share of total renewable energy capacity, while the capacity and upscaling in South America and Africa are marginal. Geographically, renewable energy potential and investments do not match. For example, Africa has 40% of the world's solar power potential, but only 1% of the built capacity. Regulatory, physical, technical, and financial conditions set strong premises for where renewable energy upscaling is implemented in practice.

Combining land use: We still do not have clear conclusions regarding solutions for reducing pressure on land. For example, estimates of the potential for upscaling renewable energy solutions in already built environments (e.g. solar panels on roof-tops and in transport infrastructure) vary considerably. By combining renewables with agriculture (*agrivoltaic),* solar panels could provide shade for crops and workers, increase yield and reduce water use, but there is a risk of a gradual shift away from agriculture to only power production, and we know little about effects on wildlife. For wind-power, the debate on ecosystem effects centers around discussions over bird casualties and degree of effect on animal grazing patterns (among these reindeers), in addition to the cumulative effects of interventions and fragmentation caused by infrastructure. An emerging solution of new use of areas for power production is floating solar panels (*floatovoltaic),* with potential to reduce evaporation from water reserves while producing power in low-contested areas.

A socially just transition to the low carbon society

Renewable-energy displacements: Upscaling renewable energy has both environmental and social impacts, for example displacement of communities. Around 80 million people have been displaced because of large dam projects worldwide. Typically, these end up worse off regarding social networks, housing, education, and employment. While global hydropower investments are declining, large dam projects are increasingly targeting developing countries, particularly in river basins such as the Amazon, the Congo, and the Mekong.

Loss of rights and access to value created: Climate mitigation measures may result in land use conflicts following loss of rights. For example, when private companies get access to large land areas for forest carbon storage, local communities may lose their right to hunting, animal grazing and farming on the land. Land use change may cause biodiversity loss and ecosystem degradation. The so-called *green grabbing* - where people are disposed form their lands, justified by environmental objectives, breaches human rights. This can be avoided by strong frameworks combining local community involvement and a fair distribution of the benefits created by a project. Awareness is also needed regarding whether projects empower certain stakeholders over others, and whether they create or sustain conflicts and inequalities.

A global map to identify overlapping interests in the green transition

A spatial understanding of competing land interests: The low-emission transition is already causing land conflicts. We therefore need a spatial analysis of the competing land-use interests that are relevant for the coming acceleration in climate change mitigation policies. The map (in section 5.7) takes an overall, global and descriptive approach, and roughly illustrates where the potential for overlapping and conflicting land-use interests is higher. It shows overlaps of indicators of population growth, production and reserves of important green transition minerals, potential for renewable energy investment, land formally held by indigenous peoples, and important areas for biodiversity. Even though there are big uncertainties due to limited data and data quality, the map gives an overall picture. Many of the countries which are shown to have competing land interests lie in the "belt" around the Equator, spanning from Chile, throughout the Amazon, Africa, Southern Asia, and to Indonesia. Several of the countries are among those experiencing poor governance and strong structural inequalities. Because many of these countries also have a high score on human vulnerability to climate change, the geographical distribution of the double challenge is striking.

Introduction

The world faces complex and interlinked challenges related to climate change, nature, and land use. First, are the impacts of climate change and biodiversity loss faced by societies, groups of people, and ecosystems. Second, there are challenges related to the policies and measures implemented to protect biodiversity and mitigate climate change, as these affect areas and sectors already regulated and/or used for other purposes. A double challenge arises if the same societies, groups of people or ecosystems are negatively affected by climate change and by climate change mitigation measures. Nevertheless, a wide range of measures need to be implemented if we are to act in accordance with the Paris Agreement and pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels. It is therefore important for public authorities and development-cooperation agencies to reduce negative effects of climate change and facilitate rapid transitions to low-carbon societies, while simultaneously avoiding policies and measures that may lead to a worsening of other sustainability goals or challenge human rights.

The nature- and climate crises are interlinked. According to the global assessment report of The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services' (IPBES), nature across most of the globe has now been significantly altered by multiple human drivers (IPBES 2019). Seventy-five per cent of the land surface is significantly altered, and over 85 per cent of wetlands (area) have been lost. Human actions now threaten more species with global extinction than ever before. An average of about 25 per cent of species in assessed animal and plant groups are threatened, suggesting that around 1 million species already face extinction, many within decades, unless action is taken to reduce the intensity of drivers of biodiversity loss. Severe challenges relate to overexploitation of animals, plants, and other organisms, mainly via harvesting, logging, hunting and fishing. An estimated 3,2 billion people in the world are already negatively affected by degraded ecosystems (IPBES 2019). An increase in land use fragmentation and unsustainable land use will aggravate this situation.

A transition to a low-carbon society is deeply needed, as a combined response to both the nature- and climate crises. However, the transition needs to be built on inclusion and fair distribution of burdens and benefits. Climate action therefore needs to consider potential competing demands for land, protect biodiversity, and ensure that policies and their implementation are in line with, protect, and respect human rights. Hence, while a rapid transition to the low-carbon society undoubtedly is needed, it is also important to be aware of the challenges it implies. Two such challenges are the requirements for land and mineral resources. According to Smil (2015) and van Zalk and Behrens (2018), renewable energy requires more land than fossil energy sources. Further, an onshore wind plant will require nine times more mineral resources than a gas-fired power plant and a standard electric car requires six times the mineral inputs of a conventional car (IEA 2022).

These examples illustrate how important it is that public authorities and development cooperation agencies gather knowledge about different challenges, and gain a holistic and spatial understanding of competing land-use interests. The global governance frameworks of climate change, biodiversity, sustainable development, and human rights lay the overarching decision-making framework for domestic and local climate governance and action. However, integrating different sustainability concerns across sectors and policies is a large governance challenge - few political systems are rigged for large cross-cutting decision-making. Several states already have weak governance structures and institutions, hampering their ability to meet their obligations. We already see that in facing trade-offs between interests and concerns, states are not always willing or able to protect ecosystems and marginalised groups, thus increasing the climate stress of people already experiencing climate impacts. These challenges will continue to grow as both climate change impacts and the use of climate mitigation measures intensify.

Outline of the report

This report consists of seven sections, collectively providing a comprehensive understanding of the complexities inherent in climate change and climate mitigation policy. A particular emphasis is placed on potential conflicts related to land-use change in the context of climate change mitigation. The initial section establishes the scope and methodology, offering insights into the report's focus, core concepts, and the rationale behind framing the literature review. The choices made in narrowing the report's focus are elucidated here. Following that, section 2 highlights relevant governance frameworks central to the report, laying the groundwork for subsequent discussions. Section 3 delves into the intersection of climate change impacts and human rights, providing a nuanced understanding of their interplay. In section 4, the report explores the geopolitical considerations inherent in the green transition. Section 5 examines the multifaceted role of land-use in the green transition, covering renewable energy, mineral extraction, and carbon storage in nature and in tree plantations. A global map concludes this section, offering an aggregated view of potential competing land-use interests. Section 6 analyses the relationships between human rights and climate aid. Finally, section 7 concludes the report with a discussion and a set of recommendations.
The report hopefully offers insights into the challenges and opportunities of climate mitigation policy, emphasizing potential conflicts, but also synergies related to land use. By showcasing examples from various case countries, the report aims to guide governmental bodies and development-cooperation agencies towards a transition to a low-carbon society that prioritizes ecosystem preservation and stakeholder involvement. For each case country their scores in the different indicators which comprises the global map (section 5.7) are presented.

1. Scope and methodology

A core topic in this report is current and potentially future conflicts relating to land use in the transition to the low-carbon society and the geographical distribution of these conflicts. The negative consequences of climate change and biodiversity loss are unevenly distributed geographically, and between population groups and individuals. In the report we refer to this as contextual vulnerability. Nature degradation will usually increase negative consequences of climate change. Further, some communities will be more exposed to draughts and crop loss, and coastal societies more exposed to sea-level rise. In such situations climate change may negatively affect human rights, such as the right to life, the right to health, food and water security. Protection of robust ecosystems is an important adaptation measure to avoid the most serious impacts of climate change.

The need for land-based renewable energy production puts pressure on biodiversity, ecosystem functions, food production, and other land resources. Combined with a projected steep increase in global energy use in the coming decades, expansion of renewable energy may increasingly conflict with biodiversity conservation and land-intensive interests such as agriculture, urban infrastructure, and indigenous people's traditional lifestyles. While a rapid transition towards non-fossil energy sources, and extensive carbon sequestration in nature, are needed to mitigate climate change, it is also important to understand other effects of these strategies. There may be synergies, for example when new renewable energy production positively strengthens other human or ecosystem needs. There are, however, also trade-offs, pertaining to increased social and environmental stress and risk. Knowledge of both is required for a socially just transition to the low-carbon society, and to ensure the legitimacy that is needed for the transition to pick up pace and momentum.

In this report we therefore focus both on how climate change impacts individuals and current land use, and on a set of climate change mitigation solutions which may conflict with other land-use interests: Renewable energy expansion (wind, solar, and hydropower); mineral extraction for renewable technology and electrification; and nature conservation. In order to illustrate and understand where these challenges may come to exist, we take a spatial approach and map out a set of land-related indicators.

While there are some limitations regarding comparability when quantitative data are applied on a global scale, trading off detailed context-specific information for the indicators to be comparable globally, the global map presented in this report gives a rough overview of where land-use interests overlap (more information about how the global map was created is presented in Section 5.7 and the Appendix). The data collected from existing research and already available data sets are also presented in case examples throughout the report.

The report is based on existing research and knowledge, and there are currently knowledge gaps and limitations to what we know about both climate impacts on people and effects of climate solutions. We know that the global South is, and will continue to be, more affected by climate impacts and biodiversity loss, but research on for instance health impacts is scarce in many of the areas where we expect the largest climate effects. Large middle-income countries like India and Brazil have strong research communities that continuously produce new knowledge. These two countries have also had climate policies for more than 15 years, and can provide important lessons learned for countries in the global South that are only at the very beginning of their low-carbon transition. Several of our case examples are therefore drawn from these countries.

Climate finance and aid has been at the top of the global agenda for some years now. However, apart from case specific research on renewable energy expansion, the full consequences of the planned global roll out of renewable energy and increased mineral needs are yet unknown. Global climate finance initiatives like REDD+, that has been implemented for more than a decade, can provide some important learning points for climate change mitigation finance and aid in other sectors.

It is not within the scope of this report to include a through discussion of agriculture and food security, but we refer to these issues if relevant to the abovementioned focus. Similarly, although nuclear power and carbon capture and storage (CCS) are included in modelled scenarios for reaching the Paris Agreement's temperature targets, discussing their role as climate change mitigation solutions is outside the scope of this report. Last, the report does not cover the question of biofuel, although this too touches upon questions of climate mitigation and land use.

2. Overarching global governance frameworks

2.1 The Sustainable Development Goals (SDGs)

In 2015, the United Nations (UN) adopted the 17 SDGs as a universal call to end poverty, protect the planet, and to ensure peace and prosperity across the world. The 17 goals are "integrated and indivisible", and all goals are in one way or the other directly or indirectly linked to land use and the difficult trade-offs that the transition to a low-emission society will have for different development goals. Further, the SDGs are interlinked with several human rights dimensions such as health, work, and gender equality. Goal 7 - Clean and Affordable Energy for All – for example, involves a core topic of this report (hereunder subgoal 7.2 to increase the share of renewable energy). Achieving this goal will increase the demand for energy and thus impact land use and nature significantly. Energy access is also fundamental for decent life quality and health as asserted in the human rights obligations (Standal, Winther and Danielsen 2018).

Goal 8 - Decent Work and Economic Growth – pertains to the aim to promote sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work for all. Subgoal 8.1 addresses the need for a more even distribution of economic growth, with at least 7 per cent gross domestic product (GDP) growth per annum in the least developed countries. Subgoal 8.4 launches an 'endeavour to decouple economic growth from environmental degradation'. Without entering the large and complex discussion on the sustainability dimensions of economic growth, it is worth noting that a focus on GDP as a measure for societal development has been criticised both by researchers and policy makers (see e.g. Rai et al. 2018 for discussion of tension between the SDG 8 and 5, the latter calling for recognition of the value of unpaid care and domestic work).

Goal 15 – Life on Land – focuses on the need to protect, restore, and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat deforestation, halt and reverse land degradation, and halt biodiversity loss.

Addressing global development so far, IPBES (2018) concludes that expanding human requirements and economic activities continue to put pressures on biodiversity, ecosystems, and land resources, which creates competition, conflicts, and suboptimal use of resources. The link between biodiversity loss and economic activity is also problematised by a range of researchers, among these Otero et al. (2020). Their study also includes a literature review of international biodiversity and sustainability strategies, and they conclude that most of these strategies advocate further economic growth. In contrast, IPBES (2019) calls for incorporating the multiple values of ecosystem functions and of nature's contributions to people into economic incentives. Such incorporation, they argue, will permit better ecological, economic, and social outcomes.

2.2 Human rights

There is an increasing focus on the link between climate change and human rights. The Office of the United Nations High Commissioner for Human Rights (OHCHR) underlines the findings of the Intergovernmental Panel on Climate Change (IPCC) concerning the impact of climate change on human rights and refers to the resolutions of the Human Rights Council, in calling for a human rights-based approach to climate change. Such an approach aims to mainstream a human rights-focus in policies and programmes, and that the implementation of these should be guided by "principles and standards derived from international human rights law" (OHCHR 2023). Essential in this approach is the identifying of *rights-holders* and *duty-bearers*, with the goal of enabling these to make their claims and meet their obligations, respectively. Right-holders can be negatively affected by both climate change impacts, and by climate measures taken to mitigate climate change. States are central duty-bearers in relation to both these kinds of effects. States are thus obliged to both provide protection from, and means of adapting to, climate impacts in accordance with human rights and other legal rights, *and* to implement measures to mitigate climate change (NIM 2020)[1].

2.3 The Paris Agreement

The UN climate regime is comprised by three multilateral global cooperative agreements: 1) the United Nations Framework Convention on Climate Change signed in Rio De Janeiro in 1992 2) the Kyoto Protocol from 1997, and 3) the Paris Agreement from 2015. The latter two are legal instruments under the UNFCCC (Patt et al. 2022). While the long history of negotiations of these agreements is outside the scope of this report, some references to the history of the climate regime is relevant for understanding its connections with other global governance frameworks.

In short, the Paris Agreement settled a long ongoing discussion between the global North and South regarding the breadth of issues to be included in a global climate agreement. The global North, in particular European countries, had long favoured a strictly climate focused deal similar to the Kyoto Protocol, with emphasis on mitigation targets and timetables, while the global South, using the G77 and China as well as other alliance to voice their opinion, argued in favour of a broad understanding of climate in relation to other aspects of sustainable development (Roberts and Parks 2007; von Lucke et al. 2021).

[1] A report published by the Norwegian National Human Rights Institution in 2020, elaborate in detail on states' legal obligations in relation to climate change (NIM, 2020).

The years prior to the Paris Agreement coincided with the drafting and adoption of the SDGs, and it had become much clearer that the climate issue had to be seen in connection with other processes and commitments, not least nature conservation and human rights. The OHCHR made a considerable effort to establish a rights-based approach to climate impacts as part of the climate regime before the Paris negotiations. The Paris Agreement preamble therefore "lists several factors that provide the interpretative context for the Agreement" (Patt at al. 2022, p. 1464), including human rights.

The overarching targets of the Paris Agreement is to hold the "increase in the global average temperature to well below 2 °C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5 °C above pre-industrial levels" (UNFCCC 2015). To attain these targets, all parties to the agreement are obliged to hand in Nationally Determined Contributions (NDCs), and these are requested to state each party's "highest possible ambition, reflecting its common but differentiated responsibilities and respective capabilities, in the light of different national circumstances" (UNFCCC 2015). Parties are expected to ratchet up their ambitions over time, and deliver new or updated NDCs every five years.

2.4 The Kunming-Montréal Global Biodiversity Framework

According to IPBES, 75% of the earth's land area has been significantly changed, partly because of the expansion of cities, roads, industrial agriculture, and forestry. The IPBES (2018; 2019) concludes that land use has a large impact on ecosystems, causing declining biodiversity. 3.2 billion people suffer as a result of destroyed nature, and 25% of all known species are threatened with extinction (IPBES 2019). On a global average, forests cover about 30% of total land area (World Bank 2022a). Deforestation is a major cause of biodiversity loss, and destruction of rainforests is a significant environmental problem. The IPBES further concludes that biodiversity loss also has severe consequences for productivity and for the protection of nature habitats and human settlements against the effects of climate change (IPBES 2018).

As a response to these challenges, the Kunming-Montréal Global Biodiversity Framework, the so-called nature agreement, was adopted in 2022. While initiated as a framework to address biodiversity loss, its relevance transcends to discussions on land use, human rights, and the transition to a low-carbon society. A main obligation in the agreement is to restore 30% of degraded ecosystems and to conserve 30% of the area on land, water, and sea by 2030 (Target 1 and 2). These targets, in addition to the other goals and targets in the framework, set clear premises of how and where to upscale the production of renewable energy. However, the nature agreement will also be important for ensuring nature's capacity to absorb and store carbon, amongst others in marshes, wetlands, and forests, and to protect against the effects of climate change (Target 10 and 11). Ultimately, the framework points out important pathways forward, emphasising that the sustainable use of land must be based on human rights, through inclusive processes, respecting the rights of indigenous peoples and local communities (Target 1 and 2). The nature agreement concludes that a *whole-of-government and whole-of-society approach* is needed.

3. Relationships between human rights and climate change

Climate change impacts pertain to effects on ecosystems, people, and infrastructure caused by both incremental and abrupt changes in temperature (e.g. heat waves, cold waves), sea level rise, and precipitation (e.g. floods and droughts), increase in the number of storms, cyclones, and wildfires, as well as the effects of changes in seasonal weather phenomena (e.g. the monsoon). The effects of climate change on species of plants, animals, and fish, and on the spread of diseases are also included in this impact definition. Ecosystem functions and robustness are important for the degree of impacts of climate changes on society. Impacts of ongoing climatic changes have a number of negative effects on human rights. Examples are impacts on the right to life, the right to health, right to an adequate standard of living and the right to work, the rights of children and indigenous peoples, and the right to self-determination, culture, and development (IPCC 2022). The negative effects of climate change and biodiversity loss on human rights are expected to increase as climate change advances.

3.1 Understanding contextual vulnerability

Although there is no scientific agreement on the term "climate vulnerability", it is used by the IPCC to identify groups that are particularly exposed to climate hazards because they live in an area with both high climate impact risk and low ability to cope with the impact (Birkmann et al. 2022). Biodiversity loss and ecosystem degradation increase the vulnerability. People's exposure to climate risk and ecosystem degradation varies among and within regions "driven by patterns of intersecting socioeconomic development, unsustainable ocean and land use, inequity, marginalization, historical and ongoing patterns of inequity such as colonialism, and governance" (IPCC 2022, p.12). Climate vulnerability can thus be understood as contextual vulnerability, where parts of the population have limited ability to handle the combination of pressures from reduced or inadequate welfare services, few income opportunities, and climate change (Ensor et al. 2019; O'Brien et al. 2011).

While using terms such as "vulnerable" may create an understanding of rights-holders as victims, it is important to identify these groups in order to develop appropriate measures. Gender studies have shown that in the processes of enabling rights-holders to make their claims and duty-bearers to meet their obligations, it is important to focus on the agency and knowledge of rights-holders. It makes more than a semantic difference whether policies and measures to mitigate climate impacts are aimed at "reaching", "benefiting", or "empowering" rights-bearers, where only the latter implies challenging and changing existing structures of inequality (Lau et al. 2021). Approaching climate vulnerability as contextual avoids labelling people as passive victims, and instead places the focus on interlinked structures of inequality and lack of social protection. It thus pinpoints concrete dimensions for political action for duty-bearers and the international community. An example of such vulnerability, is that areas with poor governance, poverty, violent conflict, and a high degree of climate-sensitive livelihoods (self-subsistence farming/fishing), had 15 times higher human mortality from floods, droughts, and storms than areas with very low vulnerability in the period 2010-2020 (IPCC 2022, p. 12).

3.2 Geographical climate change impacts

The risks that climate change may have for different types of ecosystems, land use and populations depend on the kind of event (heavy precipitation or extreme heat, etc.), where such, single or consecutive, events will take place, what kind of land (use) is located at that place, and how robust the ecosystems and population/sector in that location are (NIM 2020). Individuals' contextual vulnerability thus depends both on individual factors, where the person lives (NIM 2020), as well as on the types of, and robustness of, ecosystems in the impacted areas. The IPCC concludes that climate change increases both physical and mental health risks globally, and will likely increase the spread of vector-borne diseases (Birkmann et al. 2022). With changes in temperature and precipitation, the vectors (e.g. insects) can live in new areas, and more vectors will survive when winter-temperatures are higher. Climate change also increases the cross-species viral transmission risk, and Southeast Asia is identified as a "future hotspot of cross-species transmission" of viruses (Carlson et al. 2022:562).

To highlight geographical areas with high climate impact and low ability to cope with the impact, the IPCC has developed a climate vulnerability map, see figure 1 (Birkmann et al. 2022). Geographically, people living in West-, Central- and East Africa, South Asia, Central and South America, Small Island Developing States and the Arctic are most exposed to climate hazards (ibid.). At an aggregate level contextual climate vulnerability is thus much higher in the global South, compared to the global North. This aggregation has some shortcomings however, for instance it does not show intra-regional vulnerability or that major and deadly climate events also happen in low vulnerability countries. To amend for the shortcomings, the map also identifies groups (see blue numbering in the map) in each geographical region that are particularly exposed. This vulnerability is closely connected to existing structures of power, inequality, and marginalisation.

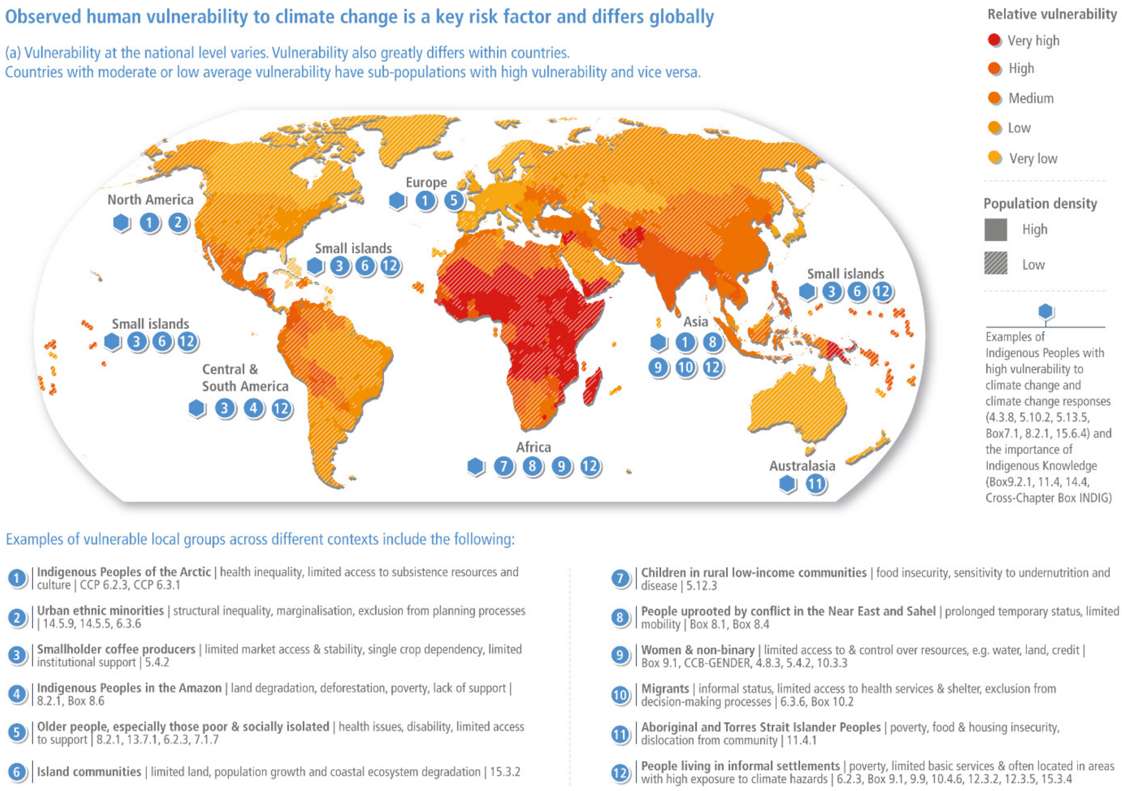

Figure 1: Vulnerability to climate change. Source (Birkmann et al. 2022, p. 1052).

3.3 Climate change impacts on groups and individuals

Increased understanding of global climate vulnerability as described in the IPCC's map is a basis for finding efficient and just measures to reduce contextual vulnerability. However, the literature increasingly underlines that the *agency* of the vulnerable tends to be disregarded when such measures are developed (Eriksen et al. 2021, Standal and Aamodt 2022). When groups of people, e.g. women, indigenous peoples, or poor, are mainly understood as *victims* of climate change, one risks overlooking the knowledge and agency of these groups, thus also disregarding their expertise in the processes for developing policies and measures for mitigating climate change impacts and reducing vulnerability. Examples are the knowledge of indigenous peoples in forest and ecosystem protection, and local community women's knowledge about water use when water security systems are developed (Standal and Aamodt 2022). Understanding the exposure to climate impacts in the context of existing power and inequality structures is particularly important when developing a human-rights based approach to climate. For instance, if users of land without formal land ownership are not included in discussions of land-use change, their needs may be disregarded, and they become increasingly marginalised. Duty-bearers at both national and local level may also be those gaining, directly or indirectly, from upholding existing structures of inequality that prevent individual rights to self-determination and informed participation in processes.

Furthermore, there is a need to integrate an intersectional understanding of people's contextual vulnerability in the face of climate change that also includes the understanding of the need for robust ecosystems that play a vital role for climate mitigation and adaptation. This has been disregarded in most policy and research up until now (Standal and Aamodt 2022). For example, studies show that to understand gender differences in adaptation strategies, one must differentiate between roles in the household (Adsawla et al. 2019). In many global South contexts young newlywed women are at the bottom of the social hierarchy but have the greatest responsibility for family care work (Standal and Feenstra 2022). Without such in-depth understanding, the opportunities to find good climate measures are limited and may even harm the purpose (Adsawla et al. 2019).

While we here will identify groups whose human rights are particularly at risk from climate impacts, it is important to underline that there are knowledge gaps. Much of the research on contextual vulnerability is either quite macro-oriented, like the research on health effects of heat stress, or case and context oriented, like research on extreme weather in Bangladesh. We here present knowledge from both macro- and case level, while the issues of agency and power structures are further elaborated on in sections 6 and 7.

Some individual factors increase exposure to climate impacts. Elderly, children, infants, and people with chronic illness or disabilities are identified as particularly exposed to health-related climate impacts, and this exposure is aggravated if these individuals are also poor, migrants, indigenous, and/or live in an area with weak governance and poor infrastructure (Najjar et al. 2021, Onyango et al. 2021, He et al. 2016, Currie and Rossin-Slater 2013, Khan et al. 2011). Regarding heat waves, people living in cities, in particular the abovementioned groups, are at risk of the "heat island" effect that can severely increase heat stress in particular urban areas (Venter et al. 2020; Zhao et al. 2021). Having green areas and vegetation inside cities decrease the heat island effect (ibid.), and is especially important for urban planning in poor neighbourhoods where people on average have fewer resources to reduce own climate vulnerability.

Elderly, children, and people with disabilities are particularly exposed as they often partially or fully depend on the actions of others to cope with climate impacts, and have limited access to decision making and processes relevant to their well-being. In general, individuals and groups that are already marginalised and have limited options for action and change, are more exposed to climate impacts. However, literature reviews of knowledge on heat stress impact on people find that, with an exception for China and India, very few of these studies focus on the global South, the majority focuses on the US, Australia, or Europe (Chapman, et al. 2017; Son et al. 2019). Hence, we know less about heat stress and health impacts in the areas where people are already most vulnerable to climate impacts because of other factors.

Women as a group are in general more exposed to climate impacts than men, and women's climate adaptive capacity in many countries and local contexts is low because they do not have the same access to land, resources, credit, information, and technology that men have (Standal and Aamodt 2022). Also, in countries with low climate vulnerability and where women have a more equal access to both resources and decision-making, for instance in the Nordic countries, the understanding of how climate change affects women and men differently is poorly integrated in climate policymaking (Eggebø et al. 2023; Magnusdottir and Kronsell 2015). However, women's exposure varies significantly, and gender differentiation should be understood in terms of intersectionality and the compound and interlinking effects of several aspects of marginalisation, as illustrated in the case from Lesotho below.

In Sub-Saharan Africa and Southern Asia, areas highly vulnerable to climate impacts, women make up almost 60% of the agricultural labour force (Nyasimi and Huyer 2017).

These are also areas with high gender inequality, and women in agriculture have fewer livelihood opportunities and less means to diversify income in times of stress, as well as lack of land rights and access to information and resources (Nyasimi and Huyer 2017; UN women 2022). Similar challenges are faced by rural women in Central Asia, a region where we have limited research on contextual vulnerability, and where women have experienced diminishing access to social protection post-Soviet (Standal et al. 2023). In the wake of male migration from farming communities, women and their children experience increased workload and food insecurity (Holmelin 2019; Hummel 2021; Choithani 2020). Climate change impact is also linked to increased violence against women as a result of heat, disasters, and crop failure, especially in areas of the global South where women already experience marginalisation (Zhu et al. 2023, Thurston et al. 2021, Eastin 2018,). But similar findings are also known from global North contexts such as in the US after hurricane Kathrina in 2011 (Schumacher et al. 2010, Anastario et al. 2009).[2]

The IPBES (2019) concludes that there are clear negative trends in nature in areas inhabited by **indigenous people**, and that this undermines local livelihoods, well-being and health. Among the trends are resource extraction, mining and infrastructure for transport and energy. Under the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP), indigenous peoples have - among other rights - the right to self-determination, self-government, and to preserve their distinct institutions and practises (UN 2007). According to the IPBES "[a]t least a quarter of the global land area is traditionally owned, managed, used or occupied by indigenous peoples" (2019, p. 14). Nevertheless, research on indigenous peoples and climate change, and the indigenous communities themselves, increasingly refer to the cumulative effect of climate change impacts, ecosystem degradation, and infrastructure developments on their traditional territories and cultural practices (e.g. Adams et al. 2023, Human Rights Watch 2020, UN 2018). Indigenous peoples' traditional lifestyles in all parts of the world are closely connected to the nature and landscapes where they live, and the land required to preserve these lifestyles are under cumulative pressure from new energy infrastructure, mining, roads, pipelines, expanding urban dwellings, agriculture and other kinds of land-use change, intervention, and fragmentation. That climate impacts change ecosystems used for traditional livelihoods, adds to this cumulative risk to indigenous lifestyles. The case example from India, presented later in the report, illustrates these cumulative effects. Both researchers and indigenous communities warn that due to this cumulative effect, many areas in the Arctic and the Amazon are now approaching socio-ecological tipping points, where beyond these points the areas will be too small and/or changed/damaged to maintain indigenous traditions (Human rights Watch 2020, Landauer et al. 2021, Pereira and Viola 2022). Passing the tipping point will also induce processes that release greenhouse gas emissions, for instance from melting permafrost and forest degradation, aggravating climate change (ibid.).

Migration is an important adaptation strategy in the face of more unpredictable and extreme weather events that hinder livelihood (Hummel 2021, Reswana 2021, Cattaneo 2019, Holmelin 2019). Most often some family members migrate, and mostly male family members. However, climate and migration is a relatively new field of study and the

[2] For further elaboration on gender and climate, a CICERO report commissioned by the Norwegian Ministry of Foreign Affairs in 2022, provides a holistic overview of current knowledge on gender and climate change globally and gives recommendations for foreign and development policies in the field (see Standal and Aamodt, 2022).

causal links are not well understood (Hummel 2021, Gioli og Milan 2018). Still, people leaving small island states due to sea level rise, as well as water and soil salination could be defined as "climate displaced people", and e.g. Pouponneau (2022) argues that there is a legal gap in the protection of these people. Migrants are often marginalised, both before migrating, during migration, and when settling in a new place. One example is migrants from Central America after hurricane Mitch in 1998 (McLeman and Hunter 2010). It is established that migrants are more exposed to crime, both trafficking and violence, also domestic violence (Standal and Aamodt 2022, UNODC 2022). It is also necessary to highlight the vulnerability of those who do not have the opportunity to migrate, so-called 'trapped populations' (Najjar et al. 2021). There can be both economic and cultural reasons why some do not have the opportunity to move despite the fact that livelihoods and security are threatened. In many contexts, for example, women have less opportunities for mobility than men, and cannot choose whether they want to move (Braun 2021).

Lesotho: Hydropower, land use changes and gender implications

Country ranking when competing land uses are added: Number 119, score 0.97 of 5

Population growth rate: Low growth (1.2)

Potential for renewable energy investment: Score 1.08 of 5, ranks as number 122 in the global ranking

Important minerals for the green transition (% of world total):

- *Production:* None
- *Reserves:* None

Land area formally recognised as held by Indigenous peoples or communities (% of total land area): 76.8%

Biodiversity:

- *Aggregate threat of species extinction:* Low (0.83)
- *Change in total forest area, 2000 to 2020 (% of total land area):* None, 1.14%
- *Particular biodiversity hotspot:* None

A study of hydropower development in **Lesotho** illustrates how such projects may divide local communities both geographically and socially, as well as contribute to reducing women's mobility and freedom (Braun 2021). Construction of the Lesotho Highland Water Project dam meant that many households had to be relocated. For the inhabitants, this resulted in a large loss of both agricultural land and grazing areas that had mainly been used for subsistence agriculture. Many, especially women, had specific knowledge related to plants and herbs used for nutrition and medicine which were lost when the area was submerged. The hydropower project also introduced regulations on the water and the inhabitants could no longer fetch water for free or use the water for irrigation as before, which meant large financial expenses to drill for or buy water. In addition, especially the older population, had a spiritual and religious relationship with the rivers. Hence, there was great opposition to the construction of the dam. The area that was submerged caused local communities to be divided as travel distances increased and not everyone had the opportunity to travel by boat. Furthermore, there was a split between family members and former neighbours, between those who welcomed the opportunity to move and those who actively opposed it. In this context, women had less room for action than men as the cultural norms and economic factors meant that they had to stay where their husbands or fathers had decided. For some women, the harrowing division of the local community meant they were cut off from seeing their children, relatives, and friends. They lost much of their safety net as well as bearing the consequences of the family's lost financial resources.

3.4 Obligations of duty-bearers

Both the Kunming-Montréal Global biodiversity framework and the preamble of the Paris Agreement call for a human-rights based approach (see section 2). Both treaties explicitly mention the rights of women, children, indigenous people, and persons with disabilities. While the Paris Agreement also describes the rights of migrants, the biodiversity framework several times emphasises the importance of indigenous peoples' knowledge in implementation of the framework. In combination with the indivisibility of the SDGs, international climate and nature governance thus clearly identifies states' obligation to protect people from climate change impacts and implement climate change mitigation measures in compliance with human rights.

States' abilities and willingness to comply with these obligations are however varying. States that already have poor governance and infrastructure, also usually lack the resources to protect people and infrastructure in cases of extreme weather and other climate impacts. One example is **Malawi**, a country dependent on hydropower, and with one of the lowest energy access rates in Sub-Saharan Africa (McCauley et al. 2022). The last years' climate impacts on precipitation have caused both floods and droughts, leading to nationwide blackouts (ibid.). To mitigate the dual challenge of low energy access and frequent blackouts, the use of wood fuel has increased. This increase leads to aggravated health consequences from indoor air pollution, and increased deforestation (ibid.). The already resource poor country is thus left worse off on numerous sustainability indicators.

In addition to questions of resources, states' failure to meet their obligations also relate to the law enforcement, policy implementation, and the rights and needs of marginalised persons. Protesting against the lack of social and environmental protection can have fatal consequences. According to Global Witness (2023), at least 1910 land and environmental defenders were killed between 2012 and 2022, with a significant number of incidents taking place in Mexico, the Philippines, Brazil, and Colombia. Many indigenous peoples live in areas where the state does not prioritize or have the capacity to implement environmental and other regulations, making them exposed to the impact of illegal activities. An illustrative example is Brazil.

Brazil is the world's fifth largest country, and much of its area is sparsely populated and difficult to access, particularly the Amazon region. The implementation of social and environmental protection in these areas is difficult because of organized crime and lack of governmental territorial control and state monopoly on violence. Exemplifying this is the illegal mercury-based gold mining in indigenous Yanomami territories in the Amazon (Ramos et al. 2020, Vega et al. 2018). The mercury pollution of soil and water is a direct health risk to the Yanomami, causing severe malnutrition, increased infant mortality, cancer, and other diseases (Garcia et al. 2022, Vega et al. 2018). In periods when the national government gives little priority to law enforcement in the Amazon, these human rights violations grow in severity, which was the case under the government of Jair Bolsonaro (2018-2022) (Garcia et al. 2022). The many possibilities to appeal in the Brazilian judicial system also lead to several examples of lenient environmental law enforcement, where non-compliance with regulations has no practical consequences for the responsible party. The tendency of authorities prioritising business interests over human rights, is also illustrated in the India example below.

The interest of national and local governments in attracting foreign capital has led to aggravation of land conflicts and human rights violations in several countries. An example is the massive increase in Chinese investments in the global South. A report by South American civil society organizations that have investigated eighteen projects involving Chinese banks and companies in Argentina, Bolivia, Brazil, Ecuador, and Peru, documents several human rights violations across the projects (FIDH et al. 2018). As noted in the report: "These 18 case studies demonstrate that the human rights violations being committed by Chinese companies are not isolated incidents, but reveal a recurring pattern of behaviour" (p. 24). The Norwegian NGO Norwegian People's Aid have also documented land conflicts between Norwegian green transition business interests and local and indigenous communities in Chile, Honduras, and Mozambique (Norwegian People's Aid 2023).

Human rights abuses and harm to nature embedded in supply chains and returns on investments, have led to critique against companies. Several initiatives to certify products have been launched. Certification puts pressure on producers and importers to address human rights and environmental questions that would otherwise maybe go under the radar, but there are also several issues to be aware of in the context of certifications. First, there are numerous different certifications, and it can be difficult, especially for consumers, to find out which indicators each certification includes and how these are measured. Second, products from certified production areas are often mixed with other products at some point, and tracing back exactly where parts of a product come from is very challenging (Wang and Lloyd 2022). Many companies produce both certified and non-certified products (ibid.). Third, the certifications may not change the root causes of human rights violations, and the structures of inequality the production is based on, are thus not addressed (Panella and De Putter 2022). Fourth, some studies find that deforestation-free supply chain certifications can have negative consequences for smallholders because these actors have fewer resources to spend on understanding and adapting to the bureaucratic and technical requirements for joining the initiative and/or having their products certified (Jopke and Schoneveld 2018, Lambin et al. 2018). See also the discussions in sections 6 and 7.

India: Reproducing inequality in the global and domestic energy transition

Country ranking when competing land uses are added: Number 24, score 1.89 of 5

Population growth rate: Low growth (0.8)

Potential for renewable energy investment: Score 2.57 of 5, ranks as number 10 in the global ranking

Important minerals for the green transition (% of world total):

- *Production:* Copper (0.1%), Rare earth elements (1%)
- *Reserves:* Rare earth elements (5%)

Land area formally recognised as held by Indigenous peoples or communities (% of total land area): *0.4%*

Biodiversity:

- *Aggregate threat of species extinction:* Medium (0.67)
- *Change in total forest area, 2000 to 2020 (% of total land area):* 7% increase, from 22.73 to 24.27%
- *Particular biodiversity hotspot:* The Western Ghats region – unique in species, particularly plants, and home to more than 30% of all plant, fish, reptile, amphibian, bird and mammal species in India. The forests are in high demand for timber and agriculture land.

India is seeing an increasing displacement of people from their land for the purposes of private sector accumulation (Dungdung et al 2022, Nielsen et al. 2020). Various national and provincial level authorities are eagerly promoting expansion of renewable energy, but the relevant land areas often have other uses of natural resources, including livelihoods and biodiversity (Lakhanpal 2019).

The populations who are displaced, largely follow old lines of marginalization. Especially the indigenous Adivasi population, who is already marginalized in terms of poverty, education, and social status, has been affected (Dungdung et al. 2022, Kashwan et al. 2019, Debasree 2015). According to a government mapping, Adivasis, who comprise about 9 % of India's population, constituted over 40 % of the estimated 30 million people displaced due to megadevelopment projects, e.g. dams, mines, power plants and other large-scale industrial installations (Kashwan et al. 2022). The Adivasi population traditionally reside in forest areas, which are strongly connected to their livelihoods and culture. Loss of land results in loss of cultural identity and social network, and displaced Adivasi constitute a large portion of India's unskilled informal and seasonal labour force, working under poor conditions (Shah et al. 2018). In large mining projects tribals lose their land not only to the project authorities, but also to non-tribal outsiders who converge on these areas and corner both land and the new economic opportunities in commerce and petty industry (Debasree 2015).

In addition to the threat of land displacement resulting from India's ambitions in the domestic and global energy transition, the Adivasi population also face displacement due to environmental protection of the forest areas they reside in (Kashwan et al. 2022). The Adivasi population has to some extent managed to secure significant statutory and legal rights, which address the goals of land rights and food sovereignty, sustainable development, and socially just climate action through mobilisation (Kashwan et al. 2022). However, powerful actors and agencies opposed to these rights hold considerable sway over India's political and judicial institutions.

4. The geopolitics of climate transition

The geopolitics of energy have for decades been dominated by the relationship between oil producers and consumers, with Middle Eastern oil producing countries in a core position. The United States', China's, and other countries' oil import dependence has given the producing countries structural power (Bazilian et al. 2020). A successful low-emission transition would imply a decline in demand for oil (IRENA 2023a), and in the longer run also natural gas, to be replaced by low-carbon sources.

A change in the asset value of resources imply changes in the geopolitics of energy and critical assets. Those experiencing clearest change in asset value from a global green transition are the fossil fuel exporting countries, the countries in the Middle East in particular. The region already experiences water scarcity and temperature increase as impacts of climate change, and its policy-makers express concern about reductions in their future geopolitical bargaining power with the declining asset value of oil. As natural gas is likely to be a transition fuel for many countries, a gradual shift in power from Saudi Arabia (oil) to Iran (gas) may have wider implications both in the region and beyond (Bazilian et al. 2020). Increased migration within the region and from the region may also result from the combination of growing climate change impacts and economic changes.

China is the number one on most parameters related to a global green transition. In addition to being the largest producer of solar and wind power, and exporter of these technologies and related equipment, China's dominance is striking when considering control of the extraction, processing, and transport of the minerals needed for a green energy transition (Altiparmak 2022). In 2021, China produced 62% of the world's total production of rare earth elements (REE) and 30% of lithium. China also has the world's largest reserve of REE (World Mining Data 2023). In addition, these numbers only describe the production and reserves within China, but the country has also for at least a decade worked systematically with bi-, mini[3]- and multilateral relations to ensure access to markets of strategic importance. Through its Belt and Road Initiative (BRI), China has since 2013, among other things, used these relations to invest in development projects for energy infrastructure and other critical infrastructure improvements in several

[3] Mini lateral refers to agreements and partnerships between a few (more than two) countries. An example is the Just Energy Transition Partnership (JETP) between South Africa, Germany, the US, the UK, and France.

countries in Asia, Africa, and Latin America (Rodriguez and Rüland 2020). Examples are the China Development Bank's funding of Latin America's largest solar plant in Jujuy in Argentina, and the Punta Sierra wind park in Coquimbo in Chile (Roy 2023).

Latin America was not originally included in the BRI, but from 2018 onwards China expanded it to include the region, particularly to the natural resource-rich South America. This illustrates "BRI's tacit upgrading to a geopolitical strategy of global scale" (Rodriguez and Rüland 2021, p. 477). Since 2018, Argentina, Bolivia, Chile, and Peru, together hosting more than half of the world's total lithium resources, have all signed Memorandums of Understanding (MoUs) with the BRI, and 34% of Chile's and 28% of Peru's and Brazil's total trade is now with China (Roy 2023). The surge in mineral extraction with Chinese involvement has increased existing conflicts over water and land in the region (Rodriguez and Rüland 2021).

Bazilian et al.'s (2020) ideal scenario for a global green transition is one involving multilateral cooperation for a rapid and deep decarbonization while "bringing about significant welfare effects in line with the SDGs" (2020, p. 3). However, this is far from where the global energy system is currently heading. We are in a global context of multiple crises, energy and food insecurity crises following the war in Ukraine and drought in several food producing regions, in combination with post-pandemic economic crises in many countries. In this context, increasing US-Chinese polarisation and general mistrust between the global North and South is already dominating international relations. The US and the EU have become increasingly aware of China's mineral dominance and have taken new steps to increase own access to minerals (Bridge and Faigen 2023, Riofrancos 2023). The EU has developed a new Latin America strategy to improve trade with the mineral rich continent, and in 2022 the US launched its Minerals Security Partnership with the EU and 13 country members to "catalyze public and private investment in responsible critical minerals supply chains globally" (US Gov. 2023b). At the other end of the rivalry, China initiated an expansion of the BRICS (Brazil, Russia, India, China, and South Africa) group, now including energy transition powers like Saudia Arabia and the United Arab Emirates (UAE), large oil exporters; Iran, large natural gas host; Egypt, host to the World's largest solar power plant outside India and China; and Argentina, host to the third largest lithium reserve in the world. Although the coming geopolitical developments are unknown, current developments point towards a further decrease in the liberal international order of free trade and multilateralism, and increasing polarisation, rivalry and mini lateral deals over access to resources. The geopolitical tensions also materialise in local conflicts of land and water access.

5. Land-use conflicts and solutions in the green transition

Different energy sources and associated natural resources have different implications for land and societies. Here, we focus mainly on three: solar-, onshore wind- and hydropower. Hydropower is the world's largest source of renewable electricity, but wind and solar PV[4] are currently by far the largest and most rapidly *increasing* renewables in terms of current global investments, while hydropower investments are much smaller and declining (IEA 2023). Hydropower is nevertheless included here, because large dams have traditionally caused substantial land-use conflicts and displacement of communities. Hydropower is also included due to the conflict between climate mitigation and renewable power production when forest areas are put under water when constructing hydropower dams.

The concept **power density**[5] is useful in this discussion, as it enables comparison of land requirements between energy forms. However, calculations of power density vary substantially related to for instance calculations of material footprint, considerations regarding impact area, and potential for density of installations[6]. Of the three renewables focused on here, Zalk and Behrens (2018) considered solar power to have the highest power density, followed by wind- and hydropower. Richie (2022) has a similar approach, but emphasizes that the power density of onshore wind will vary substantially according to the method of land use quantification employed: the *direct impact area* (the wind-turbine spots and its surrounding excavation) or the wider project site area.

5.1 Global distribution of renewable-energy capacity installation

Renewable energy is estimated to account for 40% of the world's installed power capacity (IRENA 2023b). 2022 had the largest increase in capacity to date, with 295 gigawatts (GW). However, to limit global temperature increases to 1.5°C there is a need to add 1 000 GW

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[4] Solar PV (photovoltaic) is a common form of solar electricity generation and involves solar power being converted directly in the technical devise. This is different from CSP, where solar power is used to produce heat which is thereafter converted to electricity.
[5] Concretely power density describes the output of different forms of energy in watts per m2 of surface land.
[6] This involves for example whether the material and mineral input should be part of the land footprint, what should be considered as the impact area of a wind turbine and how densely solar panels and wind turbines technically can be placed.

annually until 2050 (IRENA 2023b; see Figure 2)[7]. Such expansion would require large land areas for power production.

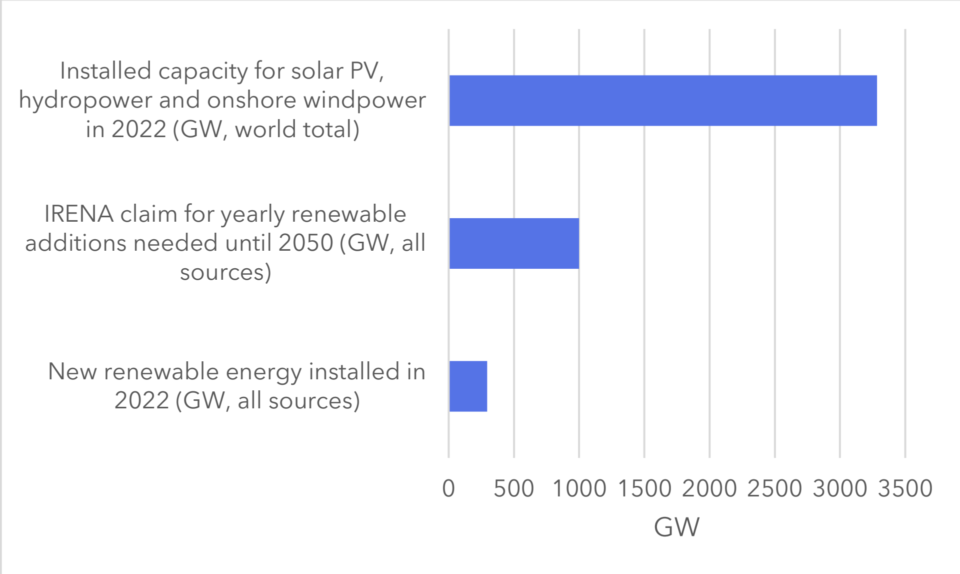


Figure 2: Renewable energy sources – maximum installed capacity, development and claimed need. Source: IRENA 2023b and 2023c.

As shown below in Table 1, Asia has the largest share of installed capacity for solar PV. Further, Asia's share of maximum installed capacity worldwide has increased over the last decade – particularly with Europe's share decreasing. Both Africa and South America have minor shares of the world's solar PV capacity. A resembling pattern is evident for onshore wind: Asia is large and continue increasing its installed capacity, Europe's share of installed capacity worldwide decreases, while Africa and South America have marginal roles. And last, with the rapid expansion of solar and onshore wind-energy production, it is important to keep in mind that hydropower is the leading source of renewable energy (International Hydropower Association 2022). Differently from wind and solar power production, the continents' shares of hydropower have been relatively stable over the last decade (Table 1). Still, as for solar PV and onshore wind, also for hydropower Asia has a large and Africa a marginal share.

[7]To exemplify the magnitude of this task, 1 GW has been estimated to equal 2,5 million photovoltaic (PV) solar panels or 310 wind turbines. Source: The US public agency Office of Energy Efficiency renewable Energy: How Much Power is 1 Gigawatt? | Department of Energy

	Solar PV		Onshore wind		Hydropower	
	% of world (2022)	Change 2012 - 2022 (percentage points)	% of world (2022)	Change 2012 - 2022 (percentage points)	% of world (2022)	Change 2012 - 2022 (percentage points)
Africa	1	1	1	0	3	0
Asia	57	41	47	16	44	6
Europe	21	-49	25	-14	16	-3
North America	12	3	20	-6	14	-3
South America	3	3	4	3	13	0
Oceania	3	-1	1	0	1	0

Table 1: Maximum installed capacity of solar PV, hydropower and onshore wind - share of world total and development since 2012. Data source: IRENA 2023b and 2023c

There is a clear geographical pattern in terms of where the new hydropower dam projects are implemented. While North American and European countries built many large dams until the mid-1970s, the recent trend involves large-scale projects in developing countries, particularly in river basins such as the Amazon, the Congo, and the Mekong (Moran et al. 2018). China stands out in terms of capacity and plans of expansion. While China added 20.8 GW in 2021, no other country added more than 1 GW (International Hydropower Association 2022). It has also been announced plans for China to double their national capacity by 2030. Such plans will likely involve extensive displacement of communities.

As renewable energy needs to be scaled up, it has been called for better use of marginal lands. The argument is that more use of degraded or barren land will reduce the pressure on more viable land (see e.g. King et al. 2023). However, there are large geographical differences in access to such land areas. A study of the densely populated Japan concluded that less than 1% of all contiguous land was available for solar and wind power production (Obane et al. 2020)[8]. Other countries may have available land areas, but a low rate of renewable-energy investments due to regulatory, physical, technical, and financial conditions (see e.g. Dunnett et al. 2022, van de Ven et al. 2021, Wyat and Kristian 2021). Hence, renewables do not spread out evenly, but clusters following the influence of a range of factors. For example, Africa is estimated to have 40% of the globe's potential for solar power yet inhabiting only about 1% of the total global capacity for solar electricity generation (Abdelrazik et al. 2022).

5.2 Renewables combined with grazing and agriculture – conflict or synergy?

Combined use of land for food production and renewable power production is a central theme for wind and solar PV. In Japan, for example, there are about 3000 farms with solar installations above agriculture land (Battersby 2023). Advocates for such combined land use argue that it creates a win-win situation as panels can reduce the need for irrigation, and give shade for crops, workers, and grazing animals (Amaducci et al. 2018, Miskin et al. 2019, Barron et al. 2020). However, co-use of land requires that the solar

[8] Nature reserve areas were excluded in this study.

power installations are well designed for agriculture. If not, agriculture land is in practice being converted to power production plants (Obane et al. 2020, Battersby 2023).

Power production in combination with agriculture and grazing is also a central topic for onshore wind. In the Nordic counties the co-use of land for wind power and reindeer herding is contested. A core element in the debate is the avoidance behaviour of reindeers when encountering wind turbines, influencing their patterns of grazing (Skarin and Åhman 2014). In Norway, the Fosen area has been a hotspot for such a land use conflict. In 2021, the Norwegian supreme court concluded that establishing the wind-power parks here violated the Sami reindeer farmers' human rights. Since then, there have been repeated and massive public protests until an agreement was reached in December 2023.

Further, there is a discussion over the biodiversity consequences of wind- and solar farms. As noted by Roddis et al. (2020) - there may be synergies between land use for solar power and agriculture, but it is uncertain how the installations impact wildlife. For wind power, the occurrence of bird casualties is a well-known phenomenon. A range of mitigation strategies have been suggested, such as onsite bird protection (e.g. Garcia-Rosa 2022) and localisation of plants to certain areas with reduced potential of bird casualties (e.g. Kati et al. 2021).

5.3 Renewables in new areas – a way to reduce land conflict?

Central in discussions over land use for renewable energy is implementation in already built environments. The IPCC (2022a) points at the potential for solar PV systems to be integrated on roofs, on public and commercial buildings and in built-up areas and environments, such as highways and sound barriers. Studies have also found large energy potentials of covering commercial parking lots with solar panels (Deshmukh and Pearce 2021) and in placing panels along roads, in noise barriers and at major intersections (Norconsult 2023). In addition to reduced land use, the IPCC (2022b) emphasises benefits relating to the energy saving of such production, as it implies reduced loss in the network as electricity is produced at the point of use. While such installations undoubtedly reduce pressure on other more viable land, the estimates of power potential from such installations vary substantially. From expectancy of large upscaling and power-production potential (see e.g. Obane et al. 2020) to those emphasising limiting factors due to roof slopes and shadows between buildings (e.g. van de Ven et al. 2021).

Another example of solar power production in new areas, are floating solar panels - so-called floatovoltaics. These may be particularly beneficial if installed on hydro-power reservoirs where they can help reduce evaporation (Battersby 2023). Floatovoltaics may also increase power production as the solar panels are cooled by water (Hayibo and Pearce 2022a). Ultimately, floatovoltaics may help restore endangered ecosystems. In a study of the Walker Lake in Nevada, USA, which is terminal and disappearing due to drought and environmental stress, Hayibo and Pearce (2022b) have found not only solar-power potentials from floatovoltaics, but that it also may help reduce evaporation and thereby reduce ecosystem challenges.

Last, there is a discussion over instalment of renewable power production in low-populated areas. Renewable power installations placed in arid regions, with high solar insolation and wind resource values exemplifies this. However, while land conflicts between stakeholders and population groups may be low in such instances, it is important to be aware of the cost in terms of disruption of ecosystems and endangering of species (King et al. 2023).

5.4 Conflicts and violations – renewables, local societies, and land rights

While highly needed, green investments have environmental and social impacts. In an extensive literature review involving 332 case studies, Sovacool (2018) found a range of negative consequences for local communities inhabiting areas where climate-mitigation projects were implemented. Among the negative consequences identified were capture of land resources, destruction of environmental qualities, and increased vulnerability.

One of the most severe negative consequences is displacement of communities because of climate-mitigation projects. For example, with hydropower, estimates centre around 80 million people displaced as a result of large dam projects worldwide (Walicki 2016). In addition are those displaced by smaller dams. The displacement consequences vary significantly according to the size of the dam and the terrain. Nevertheless, dam displaced communities tend to end up worse, with typical negative impacts relating to poorer housing, less access to education, fewer employment and income-generating opportunities, and fragmented social networks and communities (Moran et al. 2018, Walicki 2016). From a land-conflict perspective a transition from large-dam towards micro hydropower could be beneficial, although there will also be negative externalities associated with the latter (see e.g. Engen et al. 2023). Still, as shown in the Nepal case below, micro hydropower can provide electricity in rural areas previously uncovered.

Social impact of renewable power described here are also those related to ownership and distribution of the values these generate. While renewable projects may generate local jobs and income, it is a question of how this is distributed locally. A case study of the Indian state of Gujarat (Yennetti and Day 2016) found that the benefits tended to accrue at regional and national level, as well as within the upper caste locally. In contrast, pastoralists and small farmers were found to suffer most from loss of land resources and associated livelihoods. Loss of land rights is also covered below where forests managed as carbon plantations is described.

Another example where renewables conflict with local societies, concerns new wind power installations in the wind-rich, but economically poor Northeast **Brazil**. Poor communities with a small income from fishing or tourism have experienced worsened conditions after wind power instalments, because the turbines have made the area less attractive for tourists and have brought few new income opportunities (Dantas et al. 2019, Frate et al. 2019, Gorayeb et al. 2018). Studies of wind power projects in the Northeast find a lack of the consultation with local communities that is required under Brazilian law, increased deforestation, expropriation of subsistence arable land, and extinction of cultural traditions, among other consequences (da Silva and Galvão 2022, Gorayeb et al. 2018). Studying the construction of a wind farm in Ceará state, Gorayeb et al. (2018) find that because of lack of secure land tenure "the planning processes 'erased' a traditional community, making residents 'invisible' to decision makers who provided necessary state approvals for construction of the wind farm" (2018, p. 83).

Nepal: Micro hydropower – community involvement and less land consequences

Country ranking when competing land uses are added: Number 42, score 1.69 of 5

Population growth rate: Medium growth (2.3)

Potential for renewable energy investment: Score 1.87 of 5, ranks as number 69 in the global ranking

Important minerals for the green transition (% of world total):

- *Production:* None
- *Reserves:* None

Land area formally recognised as held by Indigenous peoples or communities (% of total land area): 14.4%

Biodiversity:

- *Aggregate threat of species extinction:* Low (0.83)
- *Change in total forest area, 2000 to 2020 (% of total land area):* 3% increase, from 40 to 42%
- *Particular biodiversity hotspot:* Parts of Nepal are situated in the Himalaya Biodiversity Hotspot. This hotspot has diverse ecosystems and is home to important populations of large bird and mammal species, including tigers, rhinos, and vultures.

Nepal has vast potential for hydropower in its many Himalayan rivers. Still, the country suffered from varying degrees of electricity deficits for close to two decades until 2020, with regular power cuts throughout the country. Critics cite the reason for the supply problems to be a political push towards large projects which have either failed or taken long to implement (Gyawali and Dixit 2010). Such megaprojects affect large land areas in and around the watershed and studies report broken promises of compensation to local inhabitants in the form of free electricity, company shares, and job opportunities (Lord and Rest 2021).

However, a change has occurred, and micro hydro projects have electrified more than 200 000 households in mountain areas where grid connection is lacking (Pandit 2018). Micro hydro installations have less environmental impact, make less demand for land and are more amenable to local ownership and control. Once an effective structure for the building of community hydro was in place, it contributed to a rapid rise in electrification across the country (Kumar et al. 2015, Pinto et al. 2019). In this way micro hydropower provides a viable alternative to the large dams, involving fewer land consequences and a potential for community involvement and rural electrification.

India: Ambitious renewable energy targets in a land-constrained country

India is grappling with providing economic growth and decreasing considerable socio-economic inequality. The country is thus in the midst of two overarching energy transitions: the first is providing energy access to all (including energy for economic growth and population growth) as well as transitioning from fossil energy to a low-carbon society (Standal and Fenstra 2021). India has made great achievements in extending electricity supply to rural areas, but still needs to transition to clean cooking and fulfil a growing energy demand. The government is facilitating new energy solutions and new actors into the energy system, and have ambitious targets of reducing India’s emissions intensity by 45% below 2005 levels by 2030 and to increase the share of non-fossil power capacity to 50% by 2030. Most of this capacity is planned to be wind and solar power. Policies and incentives to some extent also relate to energy justice dimensions such as redistribution of resources and wealth, though implementation and cross-sectoral coordination is lagging (Sharma and Bhatia 2022). In addition to the energy-related targets, India aims to create an additional carbon sink of 2.5 to 3 GtCO2e through additional forest and tree cover by 2030, meaning an expansion of forest cover from 23% to 33% of the country's area (Gopalakrishna et al. 2022). This carbon sink target would thus require large land areas, and the coordination of land use across sectors is lacking, leading to fragmented policy implementation and large potential for land conflict.

India's low carbon transition has significant social and environmental sustainability trade-offs. While India has a policy framework aimed to attract foreign investment, the investors in mining extraction are mainly domestic (with the technology sourced from abroad) and the products are mainly sold to the domestic market. The absence of international companies or financial institutions in the mining sector has resulted in an evasion of influence of international policies or standards, including the discussion of corporate social responsibility and community relations programs (Okarsson 2018). The expansion of renewable and mineral extraction has also been associated with decreased labour bargaining power because it favours private sector (Dsouza and Singhal 2021). Coal has been associated more firmly with public sector enterprises and the National Coal Wage Board instituted in 1962 has ensured representation of workers' representatives in sector decision-making.

5.5 Critical minerals in low-emission technology

Global distribution and control: Some of the most central minerals required in green-shift technologies are lithium, cobalt, nickel, and copper (IEA 2022). In addition, there are REEs – metallic elements necessary in many different devices, such as computer hard drives and electric vehicles. Figure 3 shows the distribution of the world's production of these minerals in the 15 largest producing countries in 2021. While REE are abundant globally, it is only sufficiently concentrated to be mined and processed economically in certain locations. China is one such location, producing 62% of the world's total REEs in 2021, and estimated to have 34% of the world's total reserves (World Mining Data 2023). Further, cobalt is a core component in lithium-ion batteries. While the Democratic Republic of Congo (DRC) is the world's largest producer of cobalt, producing 70% of the world's total production in 2021 (World Mining Data 2023), Chinese-owned companies control about 70% of the cobalt mining and 70% to 80% of the refining (U.S. Geological Survey 2023, 61).

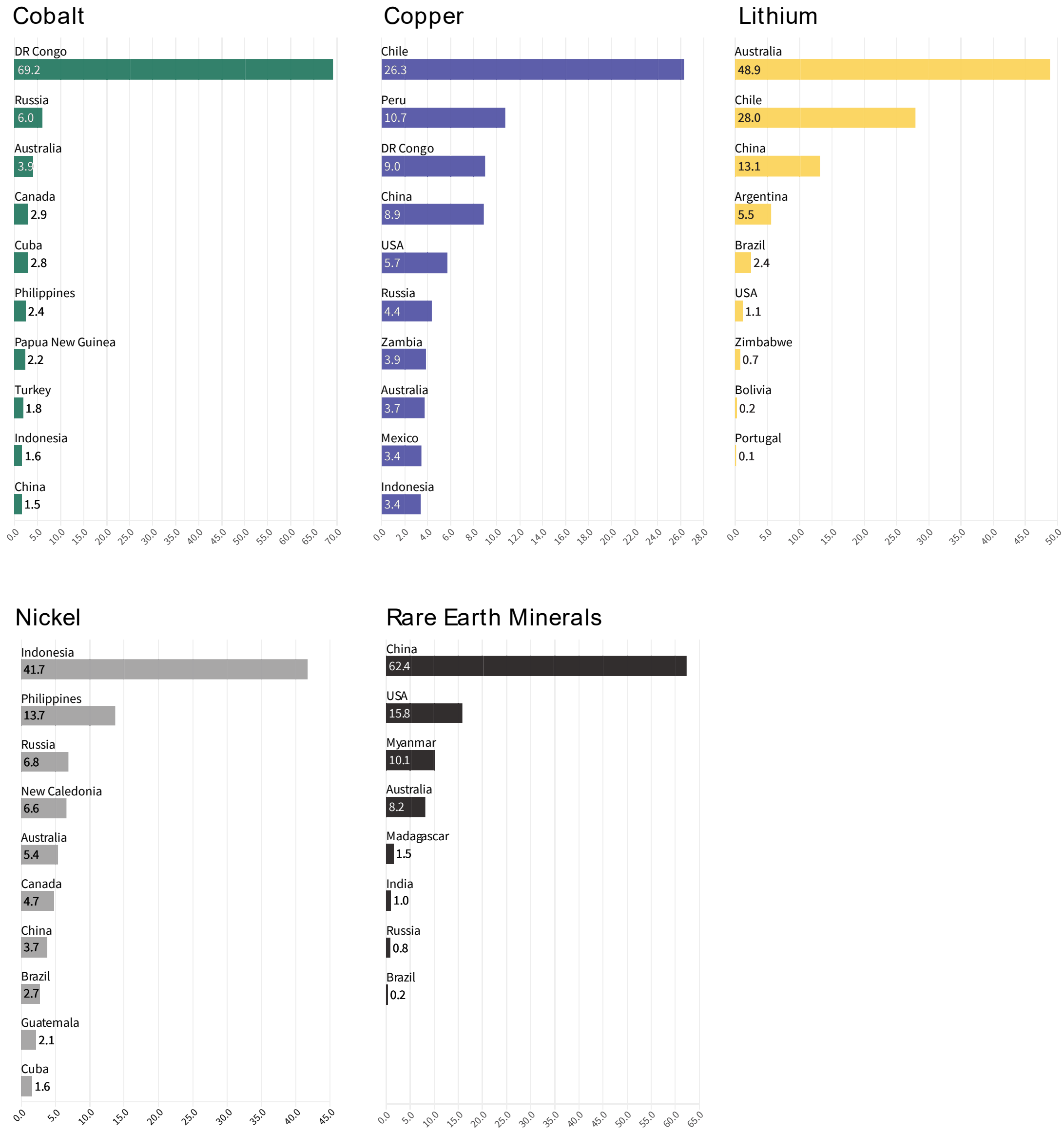


Figure 3: World distribution of critical mineral production in 2021, as percentage of total world production. Shows the 10 largest producers of each mineral. Data sources: World Mining Data 2023.

Conflicts and violations – mineral extraction, environmental- and human-rights: Mining is a main factor in environmental conflicts involving indigenous peoples (Schneidel et al. 2023). Among the environmental and social impacts of mining are extensive use of sparse water resources, inadequate waste management (hereunder pollution to soil and water), deforestation, low worker safety and loss of access to land (either through community displacements or loss of land rights).

A distinction is often made between larger and formalised mining and the *artisanal and small-scale mining sites* (often abbreviated ASM). While both may contribute to local livelihood and may be an important backbone for many communities, the latter is more associated with environmental pollution and human-rights violations. The unregulated and informal characteristics of ASM involve dangers such as exposure to toxic chemicals, unstable underground mines, accidents, and child labour (IEA 2022). Frameworks to ensure companies' and financial institutions protection of environmental qualities and the rights of local communities can be found in policy agreements, such as the Kunming-Montréal Global Biodiversity Framework (Target 15, see section 2). There is also a five-step framework for responsible supply chains, established by the OECD (2016) to push companies towards responsible sourcing of minerals and avoid contributing to conflicts, human rights violations, and economic crime. And there are partnerships such as the Extractive Industries Transparency Initiative (EITI), involving commitments of member countries to disclose information along the extractive industry value chain, involving for instance information on local community benefits and burdens.

While there are a range of environmental challenges related to mineral extraction, it is also important to note initiatives and innovations to reduce them. For example, a study from copper production in China found a range of benefits from recovering minerals from waste streams, among others decreasing direct heavy metal emissions in air and water (Hong et al. 2018).

D.R. Congo: A weakly governed land-superpower

Country ranking when competing land uses are added: Number 1, score 3.44 of 5

Population growth rate: Strong growth (3.2)

Potential for renewable energy investment: Score 1.05 of 5, ranks as number 123 in the global ranking
Important minerals for the green transition (% of world total):

- Production: Copper (9%), Cobalt (69%)
- Reserves: Copper (3%), Cobalt (48%)

Land area formally recognised as held by Indigenous peoples or communities (% of total land area): 0.9%

Biodiversity:

- Aggregate threat of species extinction: Low (0.88)
- Change in total forest area, 2000 to 2020 (% of total land area): 12% decrease, from 63.47 to 55.65%
- Particular biodiversity hotspot: Part of the country is included in the Eastern Afromontane Biodiversity Hotspot, home to a variety of ecosystems as well as bird and mammal species. The Critically Endangered Mountain gorilla can be found here.

D.R. Congo (DRC) is one of the most carbon- and biodiversity-rich countries in the world. However, it also has low institutional capacity, strong projected population growth, and high vulnerability to land exploitation. It is thus a land of wealth in terms of nature qualities, but with a limited capacity to protect these resources.

In this way, future development of 'land-superpowers' such as DRC is of vital importance to mitigate and handle climate change. The conservation of the tropical forest is key, both due to its role in removing emissions from the atmosphere and from being a biodiversity hotspot. However, deforestation occurs at an alarming rate in DRC, with more than 500,000 hectare of forest lost in 2019 (King et al. 2023).

DRC is also a key location for copper- and cobalt reserves, which are core minerals in low-carbon technology. While much of the production occurs in large and formalized mines, the country also has a large occurrence of ASM, reportedly involving more environmental- and human-rights violations. Child labour has been found in about 30% of cobalt ASM (IEA 2022). Strengthening the capacity of land superpowers in their management of forest-, biodiversity- and mineral resources is key to mitigate climate change and to preserve human rights.

Chile: Competing water demands between people and mineral extraction.

Country ranking when competing land uses are added: Number 3, score 3.01 of 5

Population growth rate: Low growth (0.9)

Potential for renewable energy investment: Score 2.58 of 5, ranks as number 9 in the global ranking

- Production: Copper (25%), Lithium (28%)
- Reserves: Copper (21%), Lithium (36%)

Land area formally recognised as held by Indigenous peoples or communities (% of total land area): 3.1%

Biodiversity:

- Aggregate threat of species extinction: Low (0.75)
- Change in total forest area, 2000 to 2020 (% of total land area): 15% increase, from 21.28 to 24.49%
- Particular biodiversity hotspot: Part of Chile is included in the Tropical Andes Biodiversity Hotspot – the most diverse in the world and increasingly facing threats from agriculture expansion and mining. Also, the Chilean Winter Rainfall-Valdivian Forest is its own biodiversity hotspot, rich in endemic species.

Chile is one of the world's most mineral-rich countries and mineral extraction has been the cornerstone of the Chilean economy for decades. Lying in the rain shadow of the Andes, the mineral-rich Northern region is also one of the driest in the world. The large quantities of fresh water needed for both copper and lithium mining is a source of severe water stress for local ecosystems, farmers, indigenous people, and local communities in the region. The stress is aggravated by climate change impacts on snowfall and water access in the Andes. Some solutions to these water challenges have been launched. Desalination of seawater is a promising technology, but studies also warn that the desalinated water likely will be used in addition to, and not as substitute to the fresh water, thus permitting an expansion of mining activities and its environmental and social impacts (Odell 2021).

To avoid further environmental degradation and violations of indigenous people's rights, several issues need to be addressed in addition to the introduction of new desalination technologies. The underlying structural inequalities in water access need to be changed to ensure water access to indigenous and local communities, herein renegotiations of the water rights of mining companies versus other users. The legal framework and regulations around water use, including the legal ambiguities regarding differences between desalinated and regular fresh water also need to be addressed in light of ensuring human rights and sustainability (Campero and Harris 2019). The conflicts over business needs and human rights to water have also been large in the avocado industry in Chile, causing long-term water stress to local communities (Madariaga et al. 2021). Policies in the water-energy-mining nexus in Chile build on strong institutional traditions that have systematically failed to prioritise human rights, as expressed in the many conflicts over land, forest, and water rights between the state and local communities, in particular the Mapuche indigenous population.

5.6 Nature as carbon sink and tree carbon plantations

Ecosystems play a vital and irreplaceable role in the cycling and storage of carbon. Furthermore, ecosystem fragmentation and intervention cause leakage from the soil and potentially also reduces ability to carbon sequestration. Well-functioning ecosystems have the capacity to absorb and retain substantial amounts of carbon, thereby mitigating atmospheric CO_2 levels and curbing greenhouse-gas emissions resulting from land-use practices. This underscores the significance of the nature agreement, which aims to restore 30% of degraded ecosystems and conserve 30% of land and sea areas (see section 2), in addition to other measures for securing sustainable use of ecosystems. The recognition of the imperative to conserve and restore nature is echoed by the IPCC (2022). They emphasize the crucial role of minimizing the conversion of forests and other ecosystems, carbon sequestration in agriculture, and the restoration, afforestation, and reforestation of ecosystems as central strategies for emission reduction.

Marshes, wetlands, and forests are commonly referred to as terrestrial 'carbon sinks,' but the carbon storage capacity within each habitat type varies due to multiple factors. While specific distributions can be identified, Figure 4 demonstrates that carbon sequestration differs between land habitats overall. Wetlands exhibit the highest carbon storage capacity, though significant variations exist among different wetland types. Forests follow second, with their robust capacity attributed to above and below-ground carbon content.

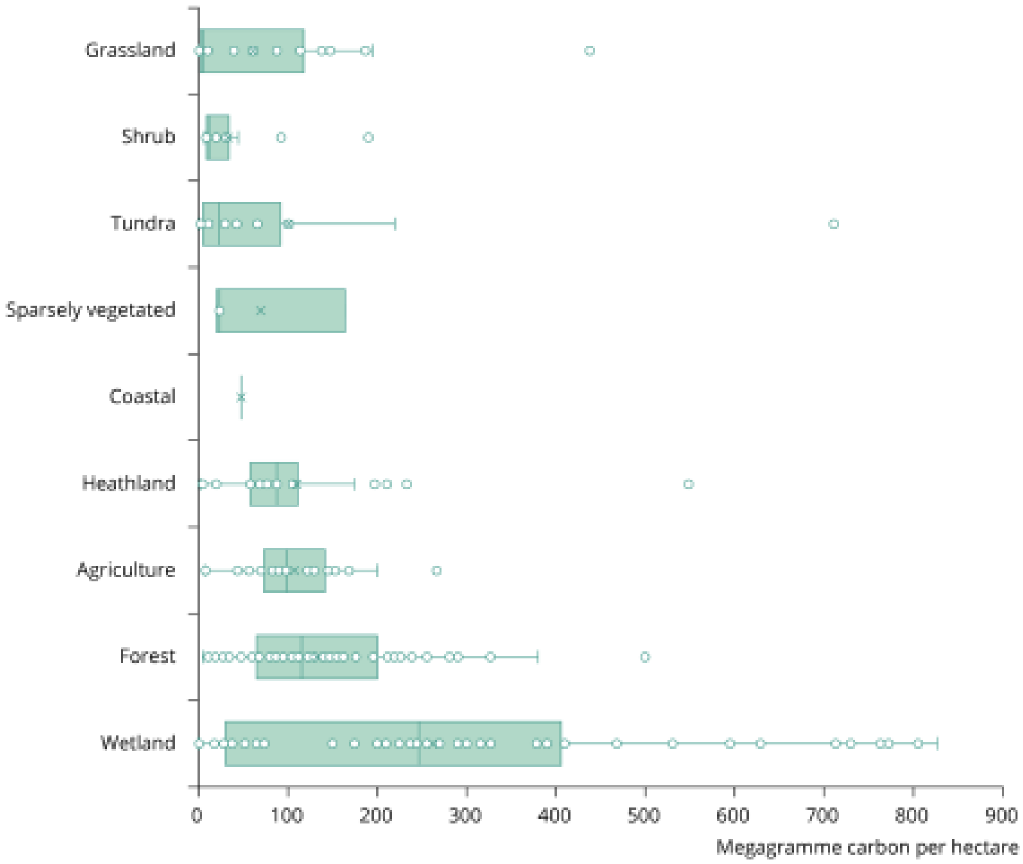


Figure 4: Carbon storage in terrestrial ecosystems. Source: The European Environmental Agency (2022)

Different latitudes play distinct roles in carbon storage and circulation. The tropical belt is a primary region for on-ground carbon circulation in forest vegetation (Crowther et al. 2019) and is also a key area for underground carbon storage. Nevertheless, the largest underground carbon storage areas are found in northern latitudes, characterized by wetlands, boreal forests, grazed fields, and tundra areas. Despite their pivotal role in climate strategies, these natural CO_2 sinks face substantial negative impacts from human activities, particularly through land-use changes and intensive forestry (Ellis 2021, IPCC et al. 2022).

Afforestation and tree plantations as climate strategies: Carbon sequestration initiatives, such as tree planting, have become pivotal in mitigating atmospheric CO_2 levels. This has led to a surge in commercial tree plantation projects, particularly in tropical regions rich in forests and grassy ecosystems. Ambitious afforestation plans, like those aiming for 1 million km^2 in Africa by 2030, primarily targeting grassy biomes, are underway (Bond et al. 2019). However, a potential drawback of such initiatives is their singular focus on carbon, potentially undermining biodiversity and essential ecosystem functions. For instance, in Brazil, a 40% increase in woody cover in a savanna area resulted in a 30% reduction in plant and ant biodiversity (Aguirre-Gutiérrez et al. 2023). Similarly, in Norway, forest fertilization for climate mitigation had negative consequences for biodiversity (Rusch et al. 2022). This raises concerns about the one-dimensional emphasis on carbon at the expense of broader ecological values. A more balanced approach is advocated, emphasizing ecosystem restoration to harmonize ecosystem services, biodiversity conservation, and carbon sequestration (Aguirre-Gutiérrez et al. 2023).

Last, biomass energy combined with Carbon Capture and Storage (BECCS) figures as a mitigation solution in many scenarios to meet the Paris Agreements temperature targets. Few BECCS operations exist today, and the scalability of BECCS to make a significant mitigation contribution is uncertain for two main reasons: land use and costs (Torvanger 2018). Scaling up BECCS would require a lot of biomass, and the land required for this biomass could also be used for food production, or for other ecosystem services and/or biodiversity conservation. Further, the land and water intensity of this biomass production is quite high, and additional water is needed for the CCS process, challenging the feasibility of BECCS as a much-used technology for negative emissions (Smith et al. 2016).

Conflicts and violations – forest farming, forest protection and rights to use of land: An emerging trend in developing countries is the acquisition of large tracts of land by private companies for forest carbon plantations. In Kachung, Uganda, a company secured a 50-year license to engage in plantation forestry within government-owned forest reserves. This disrupted the traditional access of local villagers to the land for grazing, food production, and cultural activities, resulting in what has been termed "carbon violence" (Mousseau and Biggs 2014). The term encapsulates the denial of land access to grow food, graze livestock, and collect forest resources, along with pollution from agrochemicals. However, reduced access to land due to climate strategies extends beyond commercial tree plantations. A literature review suggests that a carbon-centric focus in forest protection may conflict with the rights of communities living in and off the forest (Aamodt and Hermansen 2021). Understanding tropical forest primarily as a measurable carbon storage underplays indigenous people's holistic understanding of the values and services that the forest provides, and in addition camouflages underlying power structures (ibid.). As will be described in section 6 such "rendering technical" of a complex issue may have several pitfalls in relation to human rights.

An illustration of successful community involvement is the Ntakata Mountains Project in Tanzania. Before the project, undefined land use plans and boundaries hindered locals from protecting their forests, leading to a deforestation rate three times the national average[9]. The project, guided by the United Nations' REDD framework for carbon accounting, saved a substantial number of trees, benefiting biodiversity, the local community, and climate mitigation. The project's success rested on four pillars:

[9] Source: Network Nature: Ntakata Mountains Project | NetworkNature

education, job creation, community involvement, and carbon revenue. Village game scouts were trained and employed for forest conservation activities, complemented by environmental education programs and participatory land-use management. Carbon revenue, generated by forest preservation, funded diverse purposes, including health services and meals for students.

Brazil: Land of stark contrasts: Leading by example in law – struggling with implementation and enforcement

Country ranking when competing land uses are added: Number 16, score 2.06 of 5

Population growth rate: Low growth (0.5)

Potential for renewable energy investment: Score 2.25 of 5, ranks as number 25 in the global ranking

Important minerals for the green transition (% of world total):

- Production: Copper (1%), Nickel (3%), Lithium (2%), Rare earth elements (0.2%)
- Reserves: Nickel (16%), Lithium (1%), Rare earth elements (16%)

Land area formally recognised as held by Indigenous peoples or communities (% of total land area): 17.8%

Biodiversity:

- Aggregate threat of species extinction: Low (0.89)
- Change in total forest area, 2000 to 2020 (% of total land area): 10% decrease, from 66 to 60%
- Particular biodiversity hotspot: Brazil has two identified biodiversity hotspots – the Cerrado (almost entirely within Brazil) and the Atlantic Forests (parts extending into Paraguay, Uruguay and Argentina). The Cerrado is one of the world's largest biodiversity hotspots, but with one of the lowest levels of protection. The Atlantic Forests are home to thousands of species and a diverse mix of vegetation and forest types.

Although Brazil has strict regulations for land use change, indigenous peoples' rights and inclusive decision-making, the implementation of these regulations is often challenging. The long civil society engagement to reduce deforestation in the Amazon has experienced both strong political influence and severe setbacks the past two decades, rendering Brazil a country where one can find examples of both strong sustainability synergies, difficult trade-offs, and severe human rights violations (e.g. Hochstetler 2021).

A combined climate and nature conservation policy that has solid scientific backing is the establishment of protected areas, especially indigenous territories. Research from Brazil shows that there is very little "leakage" of deforestation to surrounding areas when protected areas are established and protection is intensified there (Barros et al 2022). Studies focusing both on the Amazon and other tropical forest areas find that areas controlled by indigenous peoples and local communities have less deforestation and more sustainable developments, thus combining carbon storage, biodiversity conservation, and human rights' compliance (Duchelle et al. 2018, Schleicher et al. 2017, Walker et al. 2020).

A downside of the massive national and international attention to reducing deforestation in the Brazilian Amazon is the lack of attention to other environmental conflicts in the country. The Brazilian environmental movement is strong, but dependent on funding from national and international donors. Such funding has been very difficult to attain for building competence and campaigns on other areas than forest protection, such as energy justice and water scarcity (Aamodt 2018). Deforestation and degradation in other biomes than the Amazon have also received relatively little attention.

In addition to cattle ranching, logging, and agriculture, mining is increasing as a source of deforestation and degradation of indigenous people's territories in Brazil (Souza-Filho et al. 2020). In addition to direct health and environmental consequences, the infrastructure around mining creates new opportunities for further deforestation. Gold and bauxite have long been mined in the Amazon, but other minerals are also abundant, and a surge in mineral demand is likely to increase the pressure on the forest from both legal (with concessions) and illegal mining (Souza-Filho et al. 2020, Vallejos et al. 2020). An example of this pressure is a bill recently passed by the Brazilian Congress to, among other things, open for commercial mining in indigenous territories. The parts of the bill most damaging to indigenous peoples and the environment were however vetoed by President da Silva in October 2023 (WWF Brazil 2023).

Canada: Combining indigenous reconciliation and transition to green energy

Country ranking when competing land uses are added: Number 71, score 1.39 of 5

Population growth rate: Low growth (0.5)

Potential for renewable energy investment: Score 2.1 of 5, ranks as number 37 in the global ranking

Important minerals for the green transition (% of world total):

- Production: Copper (2%), Cobalt (3%), Nickel (5%)
- Reserves: Copper (1%), Cobalt (3%), Nickel (2%), Lithium (3%), Rare earth elements (1%)

Land area formally recognised as held by Indigenous peoples or communities (% of total land area): 40%

Biodiversity:

- Aggregate threat of species extinction: Low (0.96)
- Change in total forest area, 2000 to 2020 (% of total land area): 0.2% decrease, from 38.79 to 38.69%
- Particular biodiversity hotspot: None

The fossil-energy economy of Canada has produced and strengthened structures of inequality by unjust distribution of benefits and burdens. One example is the oil sector employment where the 'good jobs' (e.g. permanent full-time positions) are preserved white men, while women and minority groups prevail in lower paid, part-time and less stable jobs (Lieu et al. 2020, MacArthur et al. 2020). Further, the indigenous population, which has been historically marginalized, often live near energy infrastructure that is detrimental to the berries, fish and caribou herds on which they depend (Lieu et al. 2020, MacArthur et al. 2020).

Canada's climate targets and NDC have paid little attention to the mentioned justice dimensions of transitioning to a low-carbon society (Lieu et al. 2020). However, following resistance from civil society the need of handling the reconciliation between indigenous population and historical settler-population[10] and the energy transition in

[10] In 2009 the Truth and Reconciliation Commission in Canada began a process of laying the foundations for reconciliation. This process endorses the UN Declaration on the Rights of Indigenous Peoples (UNDRIP) where a prominent theme is self-determination.

integration has been acknowledged (Hoicka et al. 2021, Lieu et al. 2020, McArthur et al. 2020).

The Pact for a Green New Deal, launched in 2019, exemplifies this. Being a broad grassroot coalition it sets a roadmap for an inclusive transition to cut emissions by 50% by 2030, create a million jobs, build inclusive communities and reconciliation with indigenous peoples. It argues that a broad support base for the transition requires inclusion of new actors in the energy system, e.g. citizens, civil society organizations and historically marginalized populations (MacArthur et al. 2020). Recent policies and economic incentives have played an important role in providing financing for energy projects integrating indigenous communities.[11] As a result, there has been a significant increase in renewable energy projects where indigenous communities have full or partly ownership or benefits from such projects (Hoicka et al 2021, MacArthur et al. 2020).

There are nevertheless challenges. First, policies and incentives that have supported this transition are being removed or face an uncertain future (Hoicka et al. 2021). Second, many indigenous communities lack capacity, financial resources and trust toward government or private developers hindering their participation, control and benefits from projects (ibid). Third, some indigenous populations and women are underrepresented in the projects (Lieu et al. 2020, Hoicka et al. 2021). Fourth, the increase of engagement often involved minority ownership that provide less benefits and decision-making power to indigenous communities.

A take-away message to strengthen the energy transition's opportunities for inclusiveness and reconciliation is to keep the focus on supporting policies more long-term, and heed particular attention to enabling community energy organizations that promote collective interests and democratic forms of ownership. Further, Canada's climate ambitions should connect to historical and present injustices and incorporate a wider base of knowledge (e.g. indigenous knowledge) to ensure diversity of perspectives and broad-based support).

5.7 A global map for showing overlapping land interests in the green transition

The low-emission transition is already causing land conflicts, as reflected in the case examples presented in this report. A spatial understanding of competing land-use interests relevant for the coming acceleration in climate change mitigation policies is therefore necessary. The map below takes a descriptive approach to illustrate locations where the potential for overlapping and conflicting land-use interests may be higher – giving a global overview. As discussed throughout the report, some important pressures for land areas in the green transition come from renewable energy expansion, mineral extraction and efforts to protect biodiversity. Pressures on land areas also come from growing populations and from indigenous peoples fighting for their collective rights to land and resources.

In the map, indicators for these land-interests are added together, as equal layers put on top of each other. A higher value indicates more overlapping and potentially conflicting land-use interests – given the categories we have included. However, this does not imply

[11] These include the First Nation Clean Energy Business Fund, Feed-in Tariffs schemes, Large Renewable Procurement Programs (including the Aboriginal Price adder), Purchase Power Agreements and the ecoEnergy program for Aboriginal and Northern Communities program (Hoicka et al. 2021).

that areas with high value are characterised by de facto high levels of conflict. The indicators[12] making up the index shown in the map are as follows:

- Areas with strong population growth, defined as positive population growth.
- Important minerals needed for the green transition, defined as the share of production and reserves of copper, cobalt, lithium, nickel, and REE of the world total.
- Areas with potential for renewable energy, shown as Climatescope 2022's assessment of the relative readiness of countries to put energy transition investment into work efficiently.
- Areas that are important for protecting biodiversity, shown by the Red List Index measuring aggregate threat of species extinction and by the change in total forest area since 2000.

The added index is unweighted[13], and the maximum value is 5. The map also has an overlay showing biodiversity hotspots, as defined by Conservation International, and countries where indigenous peoples and communities formally hold over 50 percent of the country's total land area are marked[14].

There are some limitations to this approach, and the map only gives an overview based on the indicators shown and assumptions of competing land-use as presented here. A limiting factor is the availability of appropriate and quality data, especially when applying a global perspective. In order to get a global overview, it is necessary to trade off some details. Contexts matter, and for example what is defined as *indigenous peoples* in one country does not mean that all countries apply the same definition. Coverage, reporting systems and data quality may also vary across countries. Further, marine areas are not covered here. A detailed description of the indicators, their data sources and disaggregated maps are presented in Appendix.

[12] All indicators were rescaled to a scale from 0 to 1 before added together. For example, the country with the highest population growth rate gets a score of 1, while countries with negative population growth rate get a score of 0.
[13] Because the index is a general descriptive overview, all indicators making up the index are given equal importance.
[14] We use data from LandMark, an ongoing work and therefore lacking data for several countries. Missing data either shows that they have not yet studied a country, or that there are not enough reliable data.

Map showing potential overlapping land use interests based on the following indicators:

- Mineral production,
- Markets' readiness to put energy transition investment to work
- Population growth
- Red list index
- Forest change.

Biodiversity hotspots are shown as yellow chatter. There are uncertainties in the data. Methodology described in chapter 5.7 in the report.

Data sources:
World Bank 2022a and 2022b; Teorell et al. 2023; ICUN 2022; World Mining Data 2023; The Energy Institute 2023; U.S. Geological Survey 2023; Dubertret and Wily 2021; Conservation International's "Biodiversity hotspots"; Bloomberg NEF, 2022

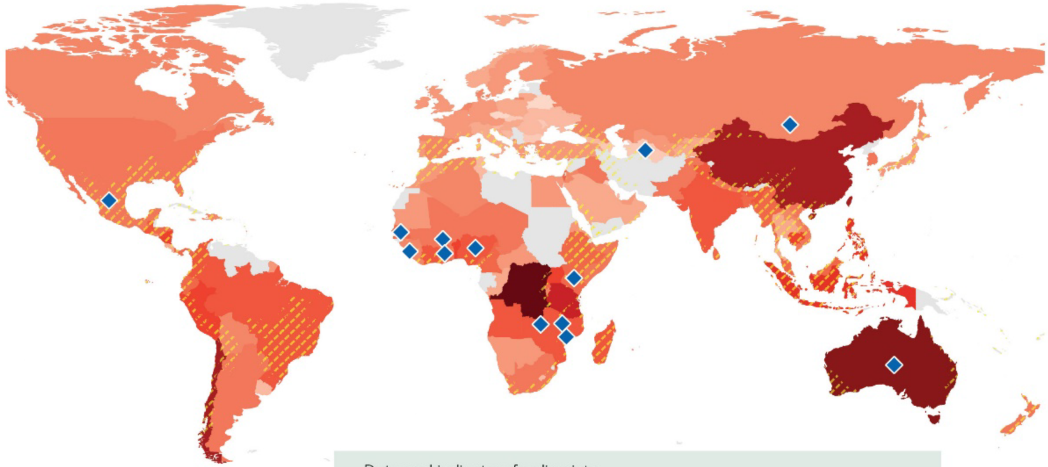
Potential for overlapping land-use interests

Low High

Countries with more than 50% of land area formally held by Indigenous peoples

Biodiversity hotspots

No data on one or more indicators



Potential for overlapping land-use interests in the green transition

Top 10

High score inidicate high potential

Country	Score	Rank of 131 countries
DR Congo	3,44	1
Australia	3,10	2
Chile	3,01	3
China	2,98	4
Tanzania	2,66	5
Indonesia	2,40	6
Malawi	2,35	7
Philippines	2,24	8
Uganda	2,72	9
Cambodia	2,70	10

Data and indicators feeding into index for potential overlapping land use interests

	Climatescope 2022 High score indicate markets' readiness to put energy transition investment to work		**Population growth** High ranking indicate high population growth		**Red list index** From high (0) to low (1) overall extinction risk. High ranking indicate high risk.		**Change in total forest area** High ranking indicate large negative change	
Country	Score (0-5)	Rank of 137 countries	Growth rate	Rank of 197 countries	Red list index (0-1)	Rank of 242 countries	Change in % since 2000	Rank of 189 countries
DR Congo	1,05	123	3,22	2	0,88	141	-12,33	34
Australia	2,24	27	0,12	151	0,81	93	1,53	123
Chile	2,58	9	0,99	95	0,75	62	15,13	173
China	2,44	14	0,08	155	0,73	47	24,28	181
Tanzania	2,23	28	3,00	8	0,69	28	-14,76	22
Indonesia	1,51	106	0,69	115	0,75	59	-9,03	40
Malawi	2,23	29	2,6	20	0,80	87	-27,25	6
Philippines	2,25	25	1,49	68	0,67	21	-1,65	74
Uganda	1,58	96	3,21	3	0,74	53	-26,34	7
Cambodia	1,98	46	1,16	86	0,78	72	-25,16	9

Mineral production and reserves in the top ten countries	Copper				Cobalt				Nickel				Lithium				Rare earth minerals			
	Production		Reserves		Production		Reserves		Production		Reserves		Production		Reserves		Production		Reserves	
	Kt	%	Kt	%	Kt	%	Kt	%	Kt	%	Kt	%	Kt	%	Kt	%	Kt	%	Kt	%
DR Congo	1924,3	9	31000	3,5	93	69	4000	48,2												
Australia	795	3,7	97000	10,9	5,2	3,9	1500	27	150,9	5,3	21000	21	113,6	49	6200	24	21,9	8	4200	3,2
Chile	5625	26	190000	21,4									65	28	9300	36				
China	1901	9	27000	3	2	1,5	140	1,7	104,6	3,7	2100	2,1	30,5	13,1	2000	7,7	168	62,4	44000	33,8
Tanzania	11,5	0,05															890	0,7		
Indonesia	731	3,4	24000	2,7	2,1	1,5	600	7,2	1173	41,7	21000	21								
Malawi																				
Philippines	51,6	0,3			3,2	2,4	260	3,1	386,3	13,7	4800	4,8								
Uganda																				
Cambodia																				

Global map main findings

Top 10 countries: The map shows that based on these indicators, countries with overlapping land-use interests in the green transition are not concentrated in one region of the world. Many of the countries, however, lie in the "belt" around the Equator, spanning from Chile, through the Amazon, through D.R. Congo in Africa and to Indonesia and Australia. Apart from Australia, many of the countries here also experience poor governance and strong structural inequalities. Because many of these countries also have a high score on human vulnerability to climate change, the geographical distribution of the double challenge where people and ecosystems are negatively affected by both climate change and climate change mitigation is striking. Yet, it shows that even in countries with developed economies and strongly rooted democratic systems, there are overlapping land-use interests that might be conflicting in the green transition.

The geographical distribution and values for each indicator, as shown in the tables below the map, further show that the scores are driven by different factors. For example, while there is a large pressure for land areas in D.R. Congo because of mining, high population growth and protecting important biodiversity areas, these are not the main challenges for other countries also facing potential issues with overlapping land-use interests. In contrast, the scores for Australia and China are mainly driven by the fact that they are two out of the three countries in the world producing all five important minerals for the green transition (the US being the last one). And Uganda does not have production of reserves of these minerals, but a high population growth, large potential for renewable energy and have lost a large portion of its forest area.

Population growth: A higher population growth rate increases the pressure on the natural environment as a larger population will have a higher demand for housing, agricultural land, and energy production. The countries with the highest population growth are found in Africa. For example, Niger is the country with the highest population growth in the world. On the other hand, several European countries, Russia and Venezuela experienced a decreasing growth rate in 2021. All the top 10 countries experienced population growth, but they represent the whole end of the scale – from a very low population growth rate in Australia, Chile, China and Indonesia, to some of the world's strongest growing populations in D.R. Congo, Tanzania and Uganda.

Biodiversity: Almost all countries that have a biodiversity hotspot, except for the Mediterranean basin, are in the Global South. This does not mean that there are not important areas for biodiversity in the Global North, which is to some degree shown by the Red List Index and the change in forest area. However, the areas that score highly on the Red List Index, i.e. have a high aggregate threat of species extinction, and areas that have experienced substantial loss of forest area often overlap, and can be found in a tropical "belt". Countries also differ in their ambitions and work to conserve and restore ecosystems, which is not shown in these overreaching indicators but is an additional land-use interest related to protecting biodiversity. Some of the countries on the top 10 list have experienced especially large loss of forest area the last decades, these are Uganda, Cambodia, Malawi, and Tanzania. This is also the case for Brazil and Paraguay, number 16 and 55 on ranking here.

Potential for renewable energy: As already discussed in this section, the most favourable structural conditions for expanding renewable energy production do not overlap with where the natural conditions are the most favourable. All of this is considered in Climatescope's ranking of the most attractive markets for renewable energy investment to be implemented efficiently. The highest scoring countries are therefore found in Europe, such as Denmark and the Netherlands. Some of the top 10 countries, however, have relatively high scores, such as Chile, Australia and China. India, as number 24 here, is also one of the emerging renewable energy markets assessed to have large potential for further investments to be used efficiently.

Important minerals for the green transition: Also discussed earlier, the geographical distribution of minerals that are important for the green transition is geopolitically important. Not surprisingly, D.R. Congo – the world's largest and one of few producers of cobalt – is number one on the list. Chile, similarly, the world's largest producer of copper and with the largest lithium reserves, scores highly. Indonesia as well, the largest producer of nickel, is in the top 10. The numbers here do not consider market concentration or the relative value of the different minerals, something which also adds tension to the large holders of these minerals.

Indigenous peoples and communities: Areas managed by Indigenous peoples and communities, which of course varies across countries and their laws, regulations and acknowledgement of these groups, are increasingly facing pressure for resource extraction, particularly mining. In the map, we use LandMark's data to show countries where indigenous peoples and communities formally hold over 50 percent of the total land area. These are: Senegal, Mexico, Gambia, Sierra Leone, Ghana, Burkina Faso, Nigeria, South Sudan, Kenya, Mozambique, Malawi, Zambia, Lesotho, Swaziland, Mongolia, Papua New Guinea, Australia and Fiji. LandMark is an ongoing work and these are among countries that have been studied thus far and have reliable data. This does not cover areas with indigenous peoples and communities without formally acknowledged managed land, which is also an important land-use interest that can be conflicting with other interests.

6. Human rights and climate aid

A successful transition to a low-emissions society will demand innovation in financial instruments, especially in countries rich on minerals. One example is the ten financial instruments proposed by the Intergovernmental Forum on Mining, Minerals, Metals and Sustainable Development (IGF) to enhance domestic resource mobilisation (DRM) in resource-rich developing countries (Redhead et al. 2023). Examples of such instruments range from introducing a minimum profit share for governments in resource-rich countries through production-sharing contracts for the mining sector, to variable royalties and measures to secure a fair share of benefits for local communities.

Climate aid is referred to as an important instrument for enabling sustainable transitions in the global South. "Climate aid" is not a defined concept, and it varies whether those using it refer to projects defined as official development assistance (ODA) or to foreign financing of climate-related projects in general. Further, there is political disagreement between the global North and South regarding what can be defined as "climate finance" (Sengupta 2023). A recent report that has reviewed all party positions before the Global Stocktake at the UNFCCC COP28 in 2023, finds that on average global South countries agree that climate finance should be mainly public, while the global North on average emphasise private financing (Sengupta 2023). Another clear division is that the global South emphasises that loans should not count as climate finance when assessing if global North countries have met their commitments, the global North on average disagrees with this view, and count loans as climate finance (Sengupta 2023). The OECD reports that two-thirds of "developed countries' public climate finance, provided bilaterally and through multilateral channels" in 2021 was loans (OECDa 2023, p. 9). According to the OECD (2023b) 27.6% of ODA pursued climate objectives in 2021. One fourth of the ODA to Africa and more than one third of the ODA to Latin America, Asia and Oceania were climate related (ibid.). In addition to the ODA comes various forms of climate-related investments, loans, and private financing through other mechanisms. Following this, climate aid is in this report considered to be ODA or other financing aimed at helping countries meet their climate targets (both climate-change mitigation and adaptation).

6.1 The Paris Agreement as a basis to integrate human rights in climate aid

In reviewing the literature on the Paris Agreement and human rights, the IPCC concludes that "there are differing views on the value and operational impact of the human rights recital in the Paris Agreement" (Patt and Rajamani et al. 2022, p. 1464), and the Paris Rulebook from 2018 has limited reference to human rights, leaving no clear operationalisation of the preamble (ibid.). All UNFCCC decisions need to be unanimous, and not all parties to the UNFCCC have the same understanding of human rights.

The Paris Agreement functions as a framework for a myriad of actions and initiatives by both state and non-state actors in a rather fragmented climate regime complex (Keohane and Victor 2011, Zelli and van Asselt 2013). In contrast to the Kyoto Protocol that had internationally legally binding mitigation targets for several countries, the Paris Agreement is primarily procedural, obliging parties to develop Nationally Determined Contributions (NDCs) to meet the overarching temperature targets, but there is no obligation to fulfil the NDCs or to meet national targets (Patt and Rajamani et al. 2022).

However, because the Paris Agreement's article 2 states that the response to climate change should be in the context of sustainable development, and the SDGs and human rights are inextricably linked, scholars have found that actions under the Paris Agreement, including climate finance and aid, should include social and environmental safeguards (Ferreira 2016, Webb and Wentz 2018). The legal basis for demanding to include safeguards in the specific frameworks for climate finance, for instance the frameworks under the Paris Agreements' Article 6 on market based and non-market-based cooperation, is however somewhat uncertain (Webb and Wentz 2018). States' legal obligation to adopt policies in line with the Paris Agreement has been tried in some national courts, with differing results, Brazil's supreme court has for instance defined the Paris Agreement as a human rights treaty and the government is therefore constitutionally obliged to mitigate climate change (see NIM (2020) for further elaboration of these court cases).

Nevertheless, in states' ratification of international agreements lies the acceptance of the obligation as duty-bearers, and one can argue that parties to the Paris Agreement are thus obliged to follow a human-rights based approach to climate. This would then also oblige states to fulfil their human rights obligations in situations of climate measures negatively impacting human rights, as discussed in part 2 of this report. In the literature on climate justice and the securitisation of climate change, a perceived tension between security and justice has been discussed (von Lucke et al. 2021, p. 58-59). This discussion pertains to situations where the state is aiming to fulfil its obligation to protect and secure the population through building for instance a hydropower dam, but where the rights of individuals living in the area are not fulfilled. Although there is some disagreement, especially in the literature on violent conflict, the literature mainly concludes that security and justice are interrelated, and need to be understood as interdependent (ibid.). Following this approach, states cannot prioritize energy security and climate change mitigation over human rights. Following this line, IPBES (2019), emphasises the need to reduce pressure on land managed by indigenous peoples and keep societal development within the boundaries of the ecosystem.

6.2 The impact of climate aid on human rights

Power inequalities: In the global North countries' understanding of the climate problem, the technical and economic hurdles to mitigation and adaptation have been at the forefront. Research and efforts to overcome these hurdles have resulted in several suggested climate solutions. The vital importance of preserving ecosystems and avoid increased inequality and stress for marginalised groups have often not been well integrated or understood in these solutions. As illustrated in the example from India below, a stated interest in improving gender equality may not be enough to ensure that this aim is actually implemented and attained. Much of the climate aid has been focused at assisting global South countries in adopting and implementing these solutions, guided by "theories of change" explaining expected causal relations between climate aid projects and climate outcomes. Although there has been a change in recent years of increased learning and using theories of change as ongoing frameworks, research finds that some standardised assumptions of vulnerability still often underpin these theories, and make them insufficiently able to ensure inclusion in different context (e.g. Forsyth 2018).

With new financing mechanisms emerging and an increasing focus on climate-related challenges in both donor countries, aid organisations and multilaterals, we here focus on some lessons learned from literature and knowledge summaries on climate-related aid and financing. Although climate aid has led to positive climate on-ground outcomes, a main critique from research on climate aid projects and programmes has been that existing power structures are often overlooked, causing a risk of cementing and strengthening existing inequalities (Eriksen et al. 2021, Standal and Aamodt 2022, Aamodt and Hermansen 2021). In reviewing literature on climate adaptation projects, Eriksen et al. (2021) conclude that there are several:

> *"underlying mechanisms through which adaptation efforts end up exacerbating vulnerability: the shallow understanding of the vulnerability context; the inequitable nature of stakeholder participation in the design and implementation of adaptation; the retrofitting of adaptation into existing development agendas; and lack of critical engagement with how 'adaptation success' is defined " (2021, p. 11).*

Climate aid projects may start out with good intentions of societal benefits beyond the technical or other solutions provided through the project. In project descriptions, and in bilateral agreements or agreements between project partners, adequate social and environmental safeguards may be included, and inclusive processes involving all relevant stakeholders and interest groups are often agreed on. However, these safeguards can be challenging to implement. Existing power structures and structures of inequality are difficult to change, and although a marginalised group is formally represented in decision-making processes, their voices may not be heard, or they may be alienated by the kind of language (technical/professional) used in the processes (Aamodt and Hermansen 2021). In some contexts such inclusive processes challenge existing holders of power, and the inclusion of relevant stakeholders may have unwanted and unintended consequences for the involved. The technical and political process to agree on a Just Energy Transition Partnership (JETP) between a number of global North donor countries and **Vietnam** exemplifies this. From the donors' side it was requested that the process was inclusive, and several Vietnamese climate and energy NGO representatives were included as experts in the negotiations. However, even before the JETP negotiations had been concluded, some of the NGO representatives had been arrested by the Vietnamese government, charged with allegedly politically motivated accusations of tax evasion (Pedroletti 2023, US Gov. 2023a).

Another aspect in relation to climate aid and existing power structures, is what Bee and Basnett (2017) refer to as Tania Li's concept 'rendering technical', and Campero et al. (2021) call 'depoliticization'. The concepts explain the process of finding specific solutions to specific problems, involving experts on those problems and solutions, but excluding existing socio-political structures from the equation (Bee and Basnett 2017). One example is the desalination technology mentioned in the Chile example case in this report. The desalination may provide a solution to acute water insecurity following draught and overuse of water in mining, but it does not address the causes to why water is unevenly distributed in the first place, or change the fact that mining companies have better access to fresh water than local inhabitants have (Campero et al. 2021).

Involvement: The process of involving already marginalized groups requires both local contextual knowledge and knowledge on good processes for such involvement. Few technical experts have such knowledge, and, as in the example below from India, it is often not prioritized spending extra resources to attain involvement in complex contexts. Such processes require time and resources that are often not budgeted into the projects. To keep the consultation process legitimate to the marginalized people affected by new development, the option of not continuing with the project must be kept as a possible outcome of the process. It is often the case that a lot has already been invested in projects when the involvement process starts, and there is a risk of it just becoming a box ticking or talking exercise, not a real consultation with open outcome. As Eriksen et al. (2021) find, often:

> *"[w]hen consultations do take place, the pressure to deliver quick results encourages a reliance on existing governance institutions and following established power relations, such that marginalized voices remain unheard and existing inequalities are reinforced, including on the basis of gender, literacy and caste" (p. 7).*

Because REDD+ is one of the climate aid initiatives that have been in function for some time, and that is also implemented in a range of global South countries, some lessons on involvement can be drawn. Research finds that particularly the most marginalized, such as indigenous peoples and other forest dwellers, are often inadequately included in REDD+ decision making and implementation, even when mechanisms to include these actors are formally in place. This lack of inclusion is more notable in African and Asian countries than in Latin America, probably due to stronger and more democratic civil society traditions in Latin American countries (Aamodt and Hermansen 2021). Although this may have changed as more attention has been drawn to the issue recent years, studies of REDD+ cooperation in African countries Satyal (2018) and Mbeche (2017) find that while indigenous peoples and local communities often are supposedly included in processes, the actors representing them are not actually selected/elected by those they allegedly represent.

Distinguishing involvement and box-ticking is not necessarily easy to see or understand without thorough contextual knowledge, also local NGOs participating in the projects may be blind to the existing structures that prevent actual involvement. The technicality of climate measures may also exclude representatives from marginalized groups from participating in project conversation, even if they are indeed included and sitting around the table (Aamodt and Hermansen 2021). Other studies have shown that when inclusion is attained it may reduce inequality, as in a case from Afghanistan where giving unskilled local women key roles in energy projects had a major impact on the recognition of women's abilities in the public spheres in local communities (Standal and Winther 2016).

<u>Climate aid example India: Providing electricity access to rural areas: Hard-learned lessons and missed opportunities for women</u>

In India a solar-based village electrification project was initiated in 2009 as part of the Clean Energy for Development Initiative (Norad) as a Public-Private People Partnership between Norway and India (Norad 2017). The aim was to increase electrification in rural areas through implementation of decentralized solar energy systems (PV microgrid) in rural North India. The partnership was a collaboration between the Norwegian and Indian authorities and a Norwegian solar energy company and the actual implementation in 28 villages was handled by well-known and experienced NGOs in the area. After the implementation, the project ensured the villages around-the-clock electricity supply, as well as piped water for the households that paid for connection. The electricity provided opportunities for socializing, entertainment, homework, cooking and other work in the evenings. The water supply also freed up much of the women's time and energy. Several women expressed that electricity at home gave them opportunities to be a better mother and do tasks at home better. They also highly valued entertainment from TV and opportunities for communication via mobile phone (Standal and Fenstra 2021, Standal 2018).

Despite the advantages, women had little opportunity to participate in the electrification process– both in the local community and at home. Due to the gender division of labour, very few women in the villages had their own income and they had little influence on purchases that could make their work more efficient at home (e.g. rice cookers, gas for cooking, irons, and hobs). Furthermore, women had little opportunity to participate or be actively involved in information meetings or decisions regarding the implementation of the microgrid. Women were given a quota in the electrification committees at the request of the project owners; however, they stopped participating as women could not speak freely according to current gender norms. The microgrids also provided local jobs for maintenance and security. This was lucrative work as it involved regular income and was not physically demanding, but women were considered "unsuitable" to work at the microgrid.
In the planning phase, the Norwegian authorities wanted the project to have a more explicit focus on the substantial inclusion of women at all levels, but the ambitions were adjusted down when the private company leading the project believed it was outside their expertise and core business. When the project was completed, the responsibility of the private company was ended, but the ownership and responsibility for continuation was not well-defined and external providers also withdrew. The microgrids had significant technical problems without any contractual party liable to address the issues. Further, the power tariffs were below operation and maintenance costs, but not adapted to the context of seasonal income. The project thus presents some hard-learnt lessons on the need to integrate contextual factors in planning and continuation of projects, as well as how opportunities for gender equality will only be realized when this is a clear requirement for the partnership.

7. Joint discussion and recommendations

A transition to a low-carbon society is deeply needed, as a combined response to both the nature- and climate crisis. Furthermore, it needs to be built on inclusion and fair distribution of burdens and benefits. To achieve a sustainable transition to a low carbon society - built on inclusion, equity, and protection of nature and human rights - these challenges need to be handled in integration. The challenges require a coordinated handling of climate, biodiversity and environment, as well as human rights in climate aid and finance.

A discussion on energy use and resource depletion is needed: We face significant climate-related challenges both as a result of climate change and in the transition to a low-emission society. The report shows how societies, population groups and nature are put under stress from occurring effects of climate change. Hence, policies to mitigate climate change are needed, hereunder a transition to renewable energy and extensive carbon sequestration in nature. However, such policies will also entail trade-offs between different needs and development goals. A broader understanding of these trade-offs needs to be pursued both at the policy level and in concrete projects. One step is to recognise that the transition to renewable sources does not remove the need for a critical discussion on the extensive and steeply increasing use of global energy. And as shown in this report, the low-carbon transition has a clear footprint on- and under ground through electricity producing units and mineral extraction. Hence, the discussion on the low-carbon society should also involve a discussion on resource depletion and how the world's energy is distributed between the different regions and countries of the world.

A socially just transition to the low-carbon society is needed: Both nature and climate challenges have been emphasised in the report as the two are inseparable, implying that they need to be solved in integration. Similarly, we see protecting human rights as not just a moral value in the green transition, but also as essential for it to happen quickly and with legitimacy. The examples of land conflicts in the report, regardless of whether they relate to onshore wind, hydropower, solar power, mineral extraction or carbon sequestration, involve many of the same elements, such as: deportation and loss of rights to use land, as well as low degrees of local involvement and little economic ripple effects.

When private companies get access to large land areas for forest carbon storage, local communities may lose their right to hunting, animal grazing and farming on the land and land use change may cause biodiversity loss and ecosystem degradation. So-called *green grabbing* - where people are disposed form their lands, justified by environmental objectives, breaches human rights. This breach can be avoided by strong frameworks combining local community involvement and a fair distribution of the benefits created by a project. Awareness is also needed regarding whether projects empower certain stakeholder over others and whether they create or sustain conflicts and inequalities.

Promising climate mitigation measures: The report presents a range of promising examples, which in different ways address climate mitigation. There are for example technical innovations, such as floating solar panels and panels integrated in transport infrastructure, potentially enabling power production in low-contested areas. And the report has illustrated how a transition to more micro hydropower in Nepal, not only had less impact on land compared to the large dam projects of the past, but that it also enabled electrification of new rural regions. Ultimately, the report has illustrated climate mitigation through forest restoration, where the projects also involve community building, among others through providing education and job opportunities. A focus should be kept on what can be termed land super-powers, typically rich in biodiversity, nature resources and with a high capacity to store carbon, but weak in institutional capacity. DRC is one such country and has vital role in mitigating and handling climate change.

Geopolitics and the geography of renewable energy: The transition to a low-carbon society also involves a shift in geopolitics. China is a dominant actor when it comes to the extraction and processing of green-technology minerals. China and Asia is also where renewable energy capacity is largest and increasing the most. Hence, the upscaling of renewable energy is not spread out evenly. In practice there is a range of regulatory, infrastructural, juridical, technical and financial factors influencing where new renewable energy is being installed. Africa may serve as an example of how potential for energy production until now has not been followed by investments. This also raises a concern for a continued geographically uneven access to energy as the world changes towards non-fossil sources. The uneven distribution of renewable energy will also put more pressure on land in some countries and regions.

A spatial understanding of conflicting interests and potential solutions: As illustrated in the global map of potential overlapping land-use interests, some countries and regions are particularly likely to experience challenging SDG trade-offs. Many of these countries lie in a "belt" around the Equator, spanning from Chile, through Africa and to Indonesia, rich in both tropical forests and minerals. Several of the countries highlighted are also among those experiencing poor governance and strong structural inequalities. The integration of social and environmental safeguards, and the implementation of these, in both climate aid and climate related investments in these countries, is of high importance, both to the population living there, and to ensure a just transition on a global scale. Following this, prioritization between acceptable and non-acceptable outcomes from trade-offs between the needed energy transition and development goals needs to be developed. Human rights have special status and should be safeguarded both in the encounter of climate change and the policies implemented for climate change mitigation. The rough spatial overview presented in this report presents one starting point for identifying areas with potentially conflicting land-use interests, but also potential synergies. However, the method, data availability and quality must be taken into consideration and further development of concepts and support for data collecting centres are important. In a similar vein, IPBES (2018) calls for a process where all uses of land are examined in an integrated manner in order to minimise conflicts, and to better link social, economic and environmental development.

Network cooperation and strong institutional frameworks: There is a need for public authorities and development-cooperation agencies to join existing or develop intranational or regional networks that address the challenging issues concerning preserving social and environmental sustainability in combination with a rapid transition to the low-carbon society. A way forward is also to work together with EU to develop conducive policies to enable 'onshoring' of value chains in Europe (extraction, processing and transport) to safeguard energy security and mitigate conflicts in 'hotspots' of human rights violations. If successful, this would enable a new energy geography where benefits, burdens and power are more evenly distributed.

There is also a need for working together with international partners to develop certification measures that safeguard human rights and environmental protection concerning extraction, production (working conditions included), and transport components in the upscaling of renewable energy. These measures must nevertheless be aware of the caveats of such certification schemes, as discussed earlier in this report. These are important steps to ensure not only a just and environmentally sound transition to the low-carbon society, but also to ensure the needed social acceptance to enable its realization. An important aspect here would be acknowledging that the same solutions do not fit everywhere, and involving local governments and civil society in creating schemes that ensure local ownership and contextual needs could provide more lasting and effective solutions. One example of certification measures with local ownership, are the schemes for tracing cattle from birth to final meat products that are currently under discussion in Colombia and the Brazilian state Para. These are too early-stage to be assessed in this report, but show that systems for integrating needs and responsibilities are under development in many sectors with land conflicts, and that local and national governments can be indispensable for scaling up initiatives to integrate different SGD concerns.

Intersectional understanding contextual vulnerability: There is a need to integrate an intersectional understanding of people's contextual vulnerability in the face of climate change. Most factors causing marginalisation are aggravated by climate change impacts, such as the increased impact of heat waves in poor neighbourhoods with few green areas. The people most affected by climate change are those least likely to be identified as experts, but their knowledge may be crucial to finding good solutions for both climate change adaptation and mitigation in those specific contexts. Enabling the organisation of local interest groups and capacity building may be important for identifying stakeholders that are not usually considered to be knowledge providers, and also to create solutions that do not increase already existing inequalities and human rights violations.

The global biodiversity framework guiding climate change mitigation: While initiated as a framework to address biodiversity loss the Kunming-Montréal Global Biodiversity Framework has a wider relevance. It transcends to discussions on land use, human rights and the transition to a low-carbon society. A main obligation in the agreement is to restore 30% of degraded ecosystems and to conserve 30% of the area on land, water and sea by 2030. These targets, in addition to the other goals and targets in the framework, set clear premises of how and where to upscale the production of renewable energy. However, the nature agreement will also be important to ensure the nature's capacity absorb and store carbon, among others in marshes, wetlands and forests, as well as to protect against the effects of climate change. Ultimately, the framework points out important pathways forward, emphasising that the sustainable use of land must be based on human rights, through inclusive processes, respecting the rights of indigenous peoples and local communities. What is needed, the nature agreement concludes, is a *whole-of-government and whole-of-society approach*. Contrasting this is the one-dimensional emphasis on carbon at the expense of broader ecological values, exemplified by carbon tree farms. Instead, a more balanced approach is needed, emphasizing ecosystem protection and restoration to harmonize ecosystem services, biodiversity conservation, human rights and carbon sequestration.

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Appendix

Indicator overview, global map

The data are cross-sectional country aggregates from the latest available year with the best country coverage, and ranges from 2020 to 2022. A detailed description of the indicators, limitations, data sources and illustrative map of the disaggregated indicators are presented here.

Population growth

Population growth (annual %), 2021

Definition: "Annual population growth rate for year t is the exponential rate of growth of midyear population from year t-1 to t, expressed as percentage. Population is based on the de facto definition of population, which counts all residents regardless of legal status or citizenship" (World Bank 2022a). Aggregation method is weighted average. *Recoded before summed into hotspot-index:* All negative population growth rate = 0, and then rescaled to a scale from 0 (no population growth) to 1 (the most population growth in the sample).

Data source: World Bank (2022a) *World Development Indicators.* Downloaded through The Quality of Government Standard Dataset (Teorell et al. 2023).

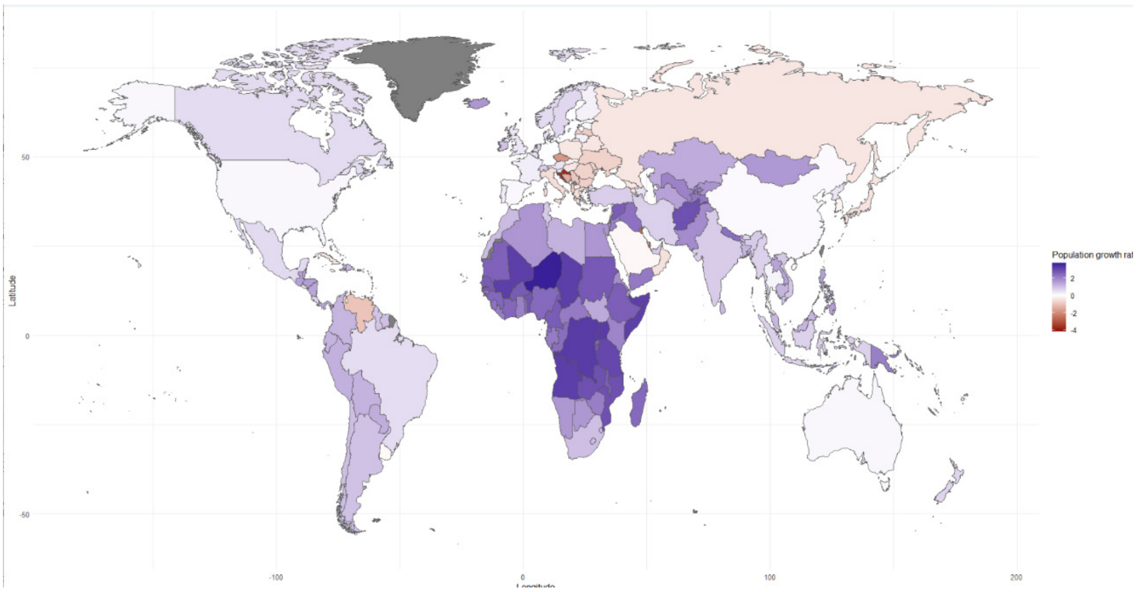

Figure A1: Map of population growth rate. Red - negative growth rate. Blue - positive growth rate. Grey - Missing data. N = 197.

Biodiversity

Red list index, 2021

Indicating the probability that a given species is vulnerable, at risk or close to extinction, and the Red List of Threatened Species has become the most used indicator for assigning species' threat status.

Definition: The index measures changes in extinction rate across groups of species. It is based on changes in the number of species in each category of extinction risk on the International Union for Conservation of Nature (ICUN) Red List of Threatened Species (ICUN 2022). It is expressed as an index from 0 to 1, where 1 equals the maximum contribution the country could make to global species survival, equating to all species being classified as Least Concern, and 0 equals minimum contribution that a country could make to global species survival, i.e., all species in the country having gone extinct. This minimum value is an extreme value as there are no countries in the world where all species are extinct, and the lowest value starts at 0.38. A downward trend therefore means that the rate of biodiversity loss is increasing, while an upwards trend means that the expected rate of biodiversity loss is decreasing.

Limitations: The coverage and reporting systems, therefore also the data quality, varies across countries. A direct comparison across countries should therefore be made cautiously.

Recoded before summed into hotspot-index: The scaling was turned around so that 1 = highest average extinction rate, and 0 = lowest average extinction rate.

Data source: ICUN 2022. Downloaded through the United Nations Sustainable Development Goals Indicator Database.

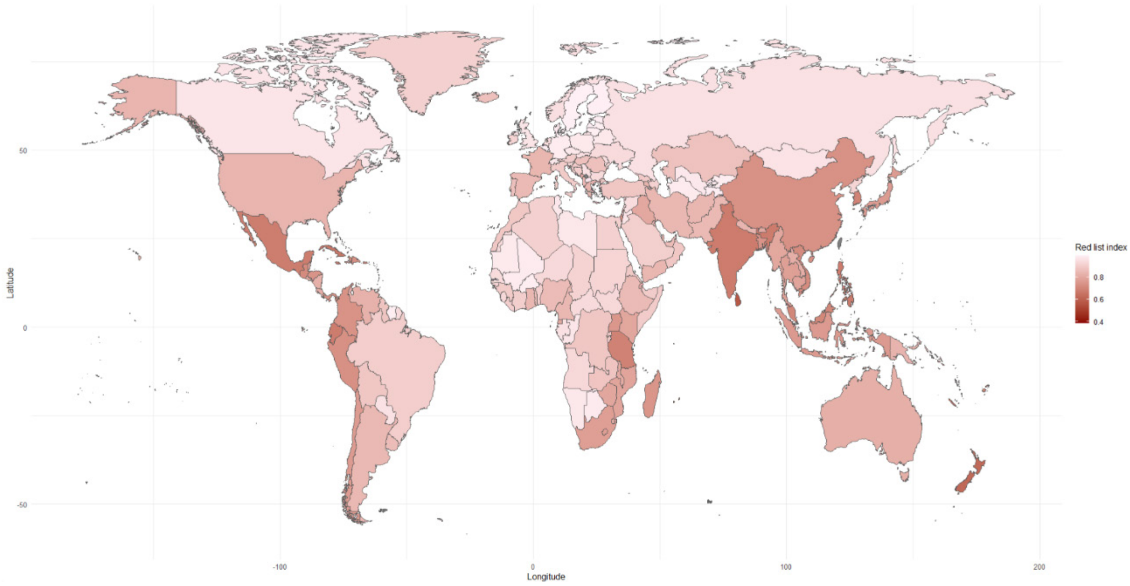

Figure A2: Map of Red List Index. Lower values = darker colour. N = 242

Change in total forest area (as % of total land area) from 2000 to 2020

Definition: Change in total forest area (in percentage) as a percentage of total land are from 2000 to 2020. Forest area is defined as "land under natural or planted strands of trees of at least 5 meters in situ, whether productive or not, and excludes tree stands in agricultural production systems (for example in fruit plantations and agroforestry systems) and trees in urban parks and gardens" (World Bank 2022b).

Limitations: This measure only shows the total change in forest area, i.e., the total forest area as percentage of total land area in 2020 minus the same in 2000, and does not differentiate different types of forest or causes of either loss or gain of forest area. A similar measure (*net tree cover change*) from the same time period but calculated with several accuracy measures is provided by Potapov et al. 2022 and can be accessed through Global Forest Watch. The values vary somewhat between the ones presented here and this alternative (e.g., Uruguay 48 percent gain vs. 54 percent), but the overall picture is the same.

Recoded before summed into hotspot-index: Rescaled to a scale from 0 (least) to 1 (most).

Data source: World Bank (2022b) *World Development Indicators*. Downloaded through The Quality of Government Standard Dataset (Teorell et al. 2023).

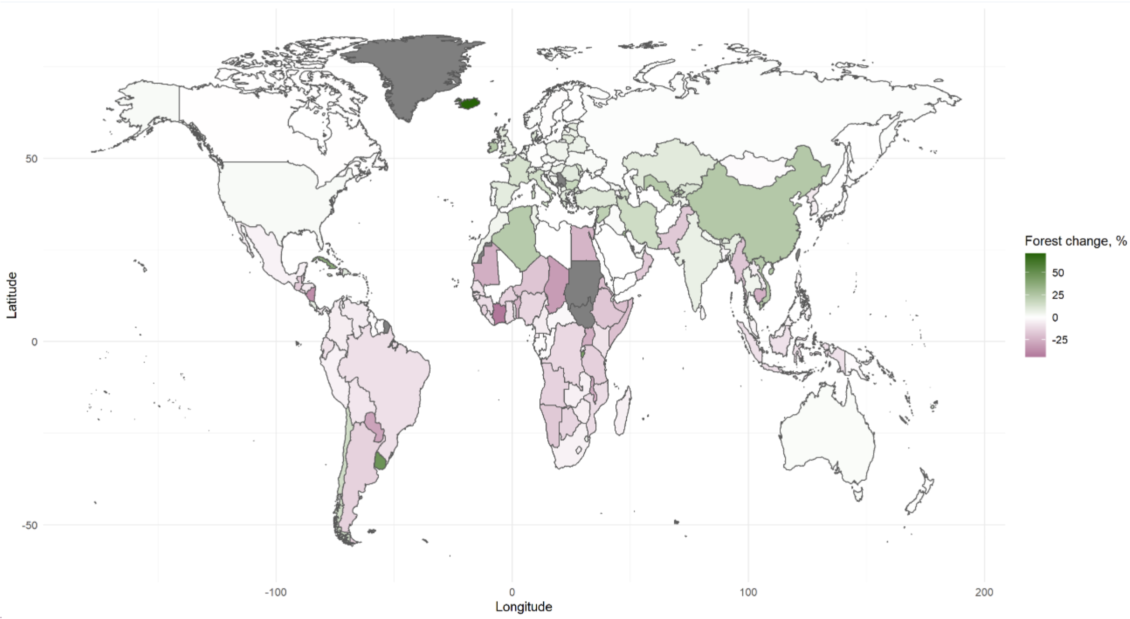

Figure A3: Map of forest change from 2000 to 2020. Green – forest gain. Purple – forest loss. Grey – missing data. N = 191.

Biodiversity hotspots

Definition: An area is identified as a biodiversity hotspot if 1) the region has at least 1500 vascular plants that are endemic to the region and 2) the region must have lost at least 70 percent of its ongoing original area.

Limitations: The definition of an area as a biodiversity hotspot is based on cut-off values, which means that there will be areas that are rich in biodiversity and highly threatened left outside this definition. For an overview of common critiques, see e.g., Marchese 2015.

In the global map: Because the areas either are or are not defined as a biodiversity hotspot this way and the 36 identified areas crosses national borders, the areas are shaded as a top layer in the map.

Data source: Conservation International, accessed through Global Forest Watch.

Minerals

Share of world mineral production, 2021

Definition: A country's share of the production of copper, cobalt, lithium, nickel and rare earth minerals summed and then recoded to a scale from 0 to 1. The production shares are weighed equally. Mineral production is defined as: "mineral constituents of the earth's crust which are of economic value. In the most comprehensive sense this includes the so-called 'mine-output' as well as output from processing at or near the mines" (World Mining Data 2023).

Limitations: Mineral production is measured in metric tons, which excludes smaller producing countries. The total world production here therefore do not in fact include the whole world, but around 90 percent of total world production.

Data source: World Mining Data 2023.

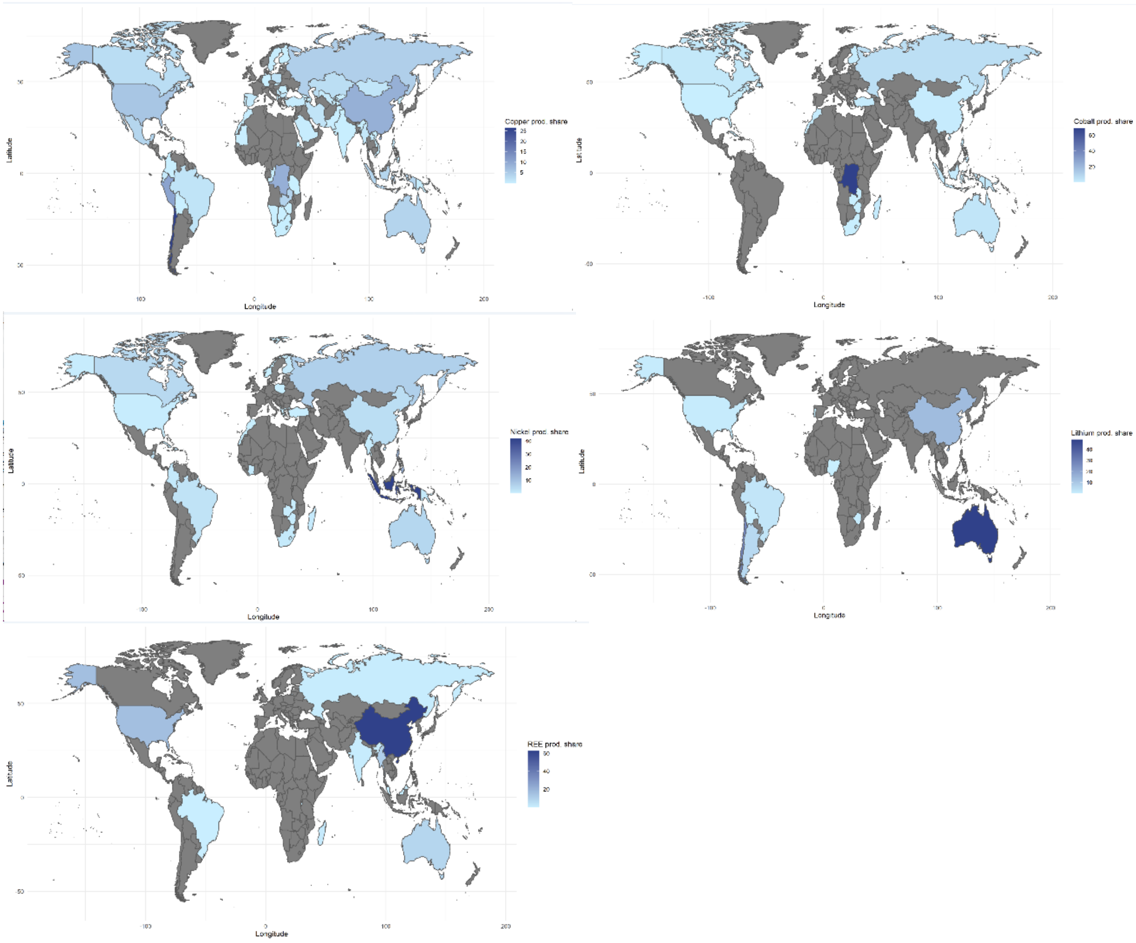

Figure A4: Map of mineral production shares of each mineral. From top left: Copper, cobalt, nickel, lithium, rare earth minerals. Grey – no production over one metric ton. N = 242.

Share of world mineral reserves, 2022

Definition: A country's share of the reserves of copper, cobalt, lithium, nickel and rare earth minerals summed and then recoded to a scale from 0 to 1. The reserves shares are weighed equally. Mineral reserves are defined as the part of the reserve that "could be economically extracted or produced at the time of determination. The term 'reserves' need not signify that extraction facilities are in place and operative. Reserves include only recoverable materials" (U.S. Geological Survey's *Mineral Commodity Summary 2023*).

Limitations: Mineral reserves are measured in kiloton, and therefore exclude countries with smaller reserves, or reserves that have not yet been identified or documented. Some reserves are estimated, and the reserves do not account for the whole world, but around 80 percent of the total world production. Reserves of rare earth minerals and cobalt are almost entirely covered here (97 and 98 percent respectively), while the numbers on copper reserves, on the other hand, only accounts for around 80 percent of the world's estimated copper reserves.

Data souces: U.S. Geological Survey's *Mineral Commodity Summaries 2023* and the Energy Institute 2023's *Statistical Review of World Energy* 2022.

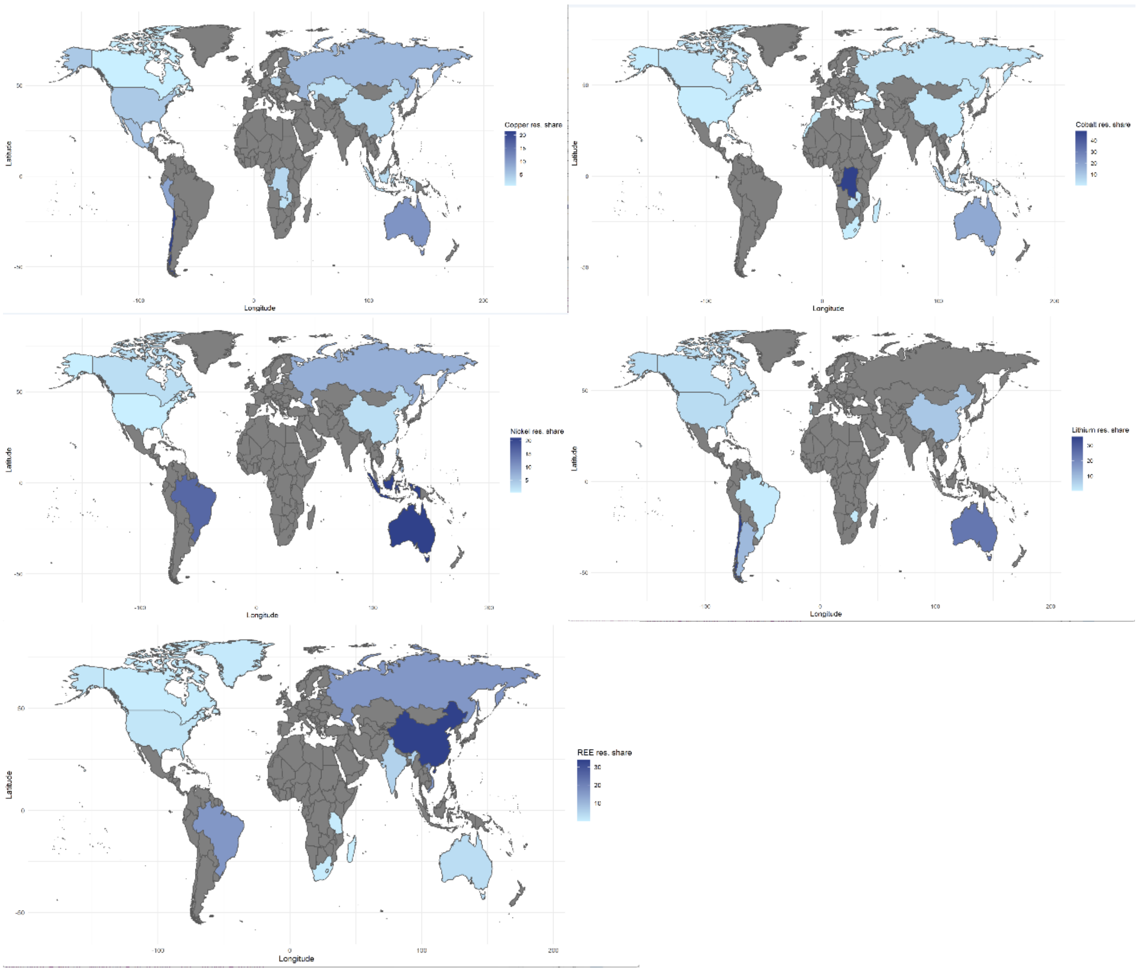

Figure A5: Map of mineral reserves shares of each mineral. From top left: Copper, cobalt, nickel, lithium, rare earth minerals. Grey – no reserves over one kiloton. N = 242.

Renewable energy

Attractive market for energy transition projects investment, power sector, 2022

Definition: Climatescope is an "online market assessment tool, report and index that evaluates the relative readiness of individual nations to put energy transition investment to work effectively. It provides snapshots of current clean energy policy and finance conditions that can lead to future capital deployment and project development" (BloombergNEF 2022). The indicator is composed of three subcategories consisting of several indicators: 1. Fundamentals – including indicators on key policies regarding energy, NDCs, market structures, infrastructure and economy; 2. Opportunities – including indicators on carbon emissions, and prices for greenhouse gas emitting energy sources, and interpreted as more opportunities where there are carbon intensive energy sources; and 3. Experience – including indicators that measures achievements to date within the renewable energy sector, such as clean energy investment and growth rate of investment, and installed capacity and growth of clean energy generation.

Recoded before summed into hotspot-index: Recoded to a scale from 0 (least attractive market) to 1 (most attractive).

Data source: BloombergNEF (2022).

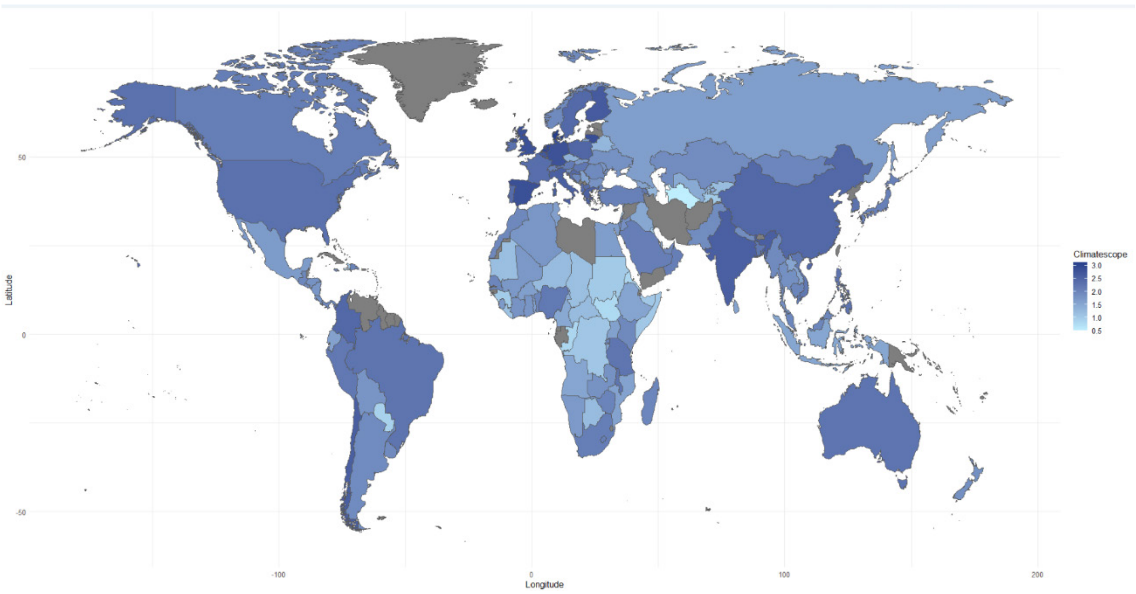

Figure A6: Map showing Climatescope 2022's ranking of attractive markets for renewable energy investments. Grey – no data. N = 136.

Indigenous peoples and communities

Percent of country held by indigenous peoples and communities, formally recognised/acknowledged by the government, various years. *Definition:* Estimated area of land "held or used by Indigenous Peoples and non-indigenous communities per country as a percentage of the country's total land area" (Dubertret and Wily 2021). The data here presents the land formally acknowledged by the government, i.e., recognised by the state.

Limitations: The methods or resources used to estimate the amount of land used vary for different countries and regions of the world. The data collection is based on information from published reports and websites of credible organisations, as well as literature by experts and land right organisations where no other information is published. All reported numbers have additional notes on LandMark's website or in the downloadable datafiles.

In the global map: Because data collection is ongoing, lack of data can both mean that the country has not yet been looked into or that there is not enough credible information. We therefore only include countries with where over 50 percent of the total land area is formally recognised as held by Indigenous peoples and communities, and among the countries so-far estimated with reliable data.

Data source: LandMark – Global Platform of Indigenous And Community Lands (Dubertret and Wily 2021).

CICERO was established in 1990 by the Norwegian government with a mandate to develop the knowledge base in national and international climate policy. Today, CICERO is an independent research foundation with approximately 100 employees and over 100 million NOK in annual turnover.

CICERO contributes to transformation through research, analysis, advice, and information on climate-related global environmental issues and international climate policy. The goal is to generate knowledge to help reduce the climate problem and strengthen international climate cooperation1.

CICERO is internationally recognised as one of the world's leading institutes for climate research. Six of the institute's researchers contributed to writing the sixth assessment report by the Intergovernmental Panel on Climate Change (IPCC), and more than 25 researchers have contributed to the panel's reports since 1992. CICERO leads and participates in large EU and national research projects with over 90 social actors participating.

CICERO was founded by Prime Minister Jan Syse in 1990 after initiative from his predecessor, Gro Harlem Brundtland. CICERO's Director is Kristin Halvorsen, former Finance Minister (2005–2009) and Education Minister (2009–2013). Jens Ulltveit–Moe, CEO of the industrial investment company UMOE is the chair of CICERO's Board of Directors. We are located in the Oslo Science Park, adjacent to the campus of the University of Oslo.