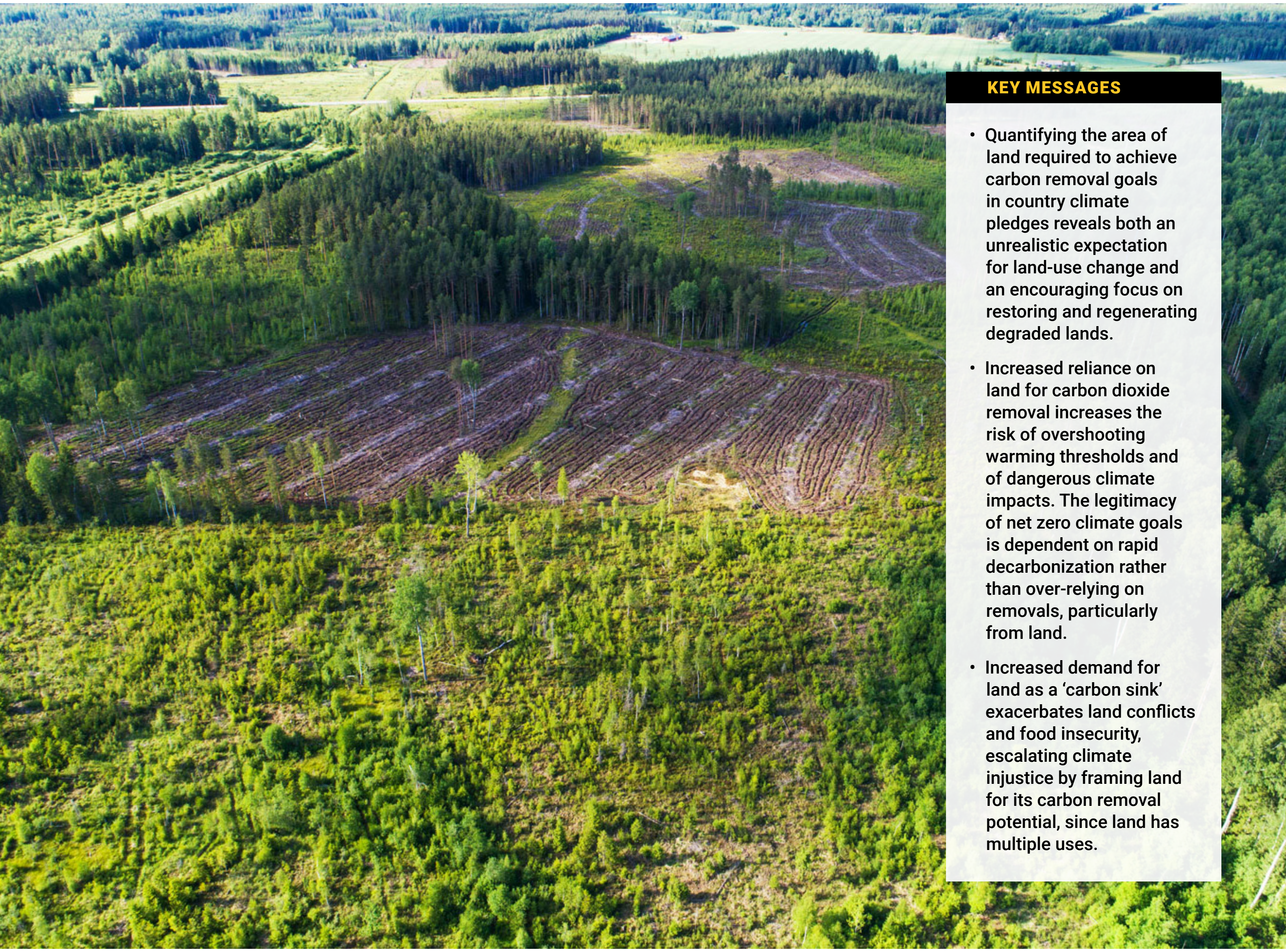
The Land Gap Report

2022

Governments' over-reliance on carbon removals could push ecosystems, land rights and food security to the brink with new land area equivalent to 50 percent of the world's croplands currently being required to meet targets. Climate pledges should focus on protecting and restoring existing ecosystems with carbon benefits.

Chapter 2: The land gap



KEY MESSAGES

- Quantifying the area of land required to achieve carbon removal goals in country climate pledges reveals both an unrealistic expectation for land-use change and an encouraging focus on restoring and regenerating degraded lands.
- Increased reliance on land for carbon dioxide removal increases the risk of overshooting warming thresholds and of dangerous climate impacts. The legitimacy of net zero climate goals is dependent on rapid decarbonization rather than over-relying on removals, particularly from land.
- Increased demand for land as a 'carbon sink' exacerbates land conflicts and food insecurity, escalating climate injustice by framing land for its carbon removal potential, since land has multiple uses.

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This chapter provides an assessment of the implied reliance on land for carbon removal in country climate pledges. This report finds that approximately 1.2 billion ha of land are included for CDR in countries' climate pledges. They span activities ranging from large-scale forest plantations to reforestation and restoration of degraded forests, wetlands and rangelands. The pledges envision land-use change (from other land uses to forests) for more than half of this land area (some 633 million ha), equivalent to half of the area of global cropland. These findings point to an unrealistic expectation for land to meet climate mitigation goals. The scale of land-based removals in country climate pledges calls into question the validity of net zero targets as contributions to the 1.5 °C threshold, in contrast with pledges that rely primarily on rapid decarbonization with limited CDR.

2.1 Land area in country climate pledges

Calculation of the land gap relies on two elements. The first is the scale of land-use change assumed in country climate pledges. The second is land available for climate mitigation, which is limited by the multiple demands on land, for food production, ecosystem protection and other needs, limiting the availability of land for climate mitigation.

To assess the reliance on land in country climate pledges, we reviewed all existing net zero and mid-century targets. For countries without long-term pledges, we reviewed near-term climate pledges in countries' Nationally Determined Contributions (NDCs). Our review focused on mitigation pledges. We did not review countries' National Adaptation Plans or land restoration commitments made outside of climate pledges. We identified both land-based CDR (reforestation, restoration and plantations) and technological CDR (BECCS and DACS). We did not assess bioenergy demand separate from CDR pledges, as bioenergy tends to be embedded within the energy sector of climate mitigation pledges. This means that our assessment of land demand for climate mitigation is likely to be conservative.

2.1.1 Methods

Climate pledges were reviewed for all countries.[1] The European Union (EU) was assessed as a bloc, meaning that 166 countries plus the EU were assessed.[2] For countries with long-term strategies (LTS) or net zero pledges, near-term pledges in NDCs were not reviewed. That is, we assessed the longest-term pledge that was available, assuming that any land-based CDR in near-term pledges is encompassed in longer-term pledges. Given that approximately half of our results are based on pledges for 2030, we can therefore expect these results to represent just a portion of the future land demand for climate mitigation, if countries' climate actions follow modelled mitigation scenarios, where reliance on CDR scales up after 2050. Our quantitative assessment could be regarded as reflecting a case where countries without an LTS do not rely on CDR beyond their NDCs (and implement the Paris Agreement goal through emission reductions only).

From this review of 167 mitigation pledges (including the EU as a bloc), It was possible to quantify the land area requirements for 112 pledges that relied on carbon dioxide removal, including land and forest restoration, reforestation, and for a very small number of countries, BECCS (See **Table 2.1** for CDR typology). We reviewed all climate pledges that were submitted until the end of September 2022, including new and updated NDCs.

Country climate strategies and pledges express commitments in a range of different metrics and qualitative ambitions. Therefore, a number of assumptions were made to identify the scale of CDR commitments.[3] The commitments were then combined with data from publicly available datasets on land cover and land use, such as from the Food and Agriculture Organization of the United Nations (FAO), and national GHG emissions profiles such as the Climate Analysis Indicators Tool, to calculate the implied land area when not directly stated.

The various approaches to land management activity types in national climate strategies were categorized into seven activity types, based on their carbon sequestration potential (using IPCC removal factors). **Table 2.1** shows the seven land-use categories we used, in relation to ecosystem condition. 'Primary forests' are intact natural forests with minimal disturbance. 'Old secondary forests' were selected to represent regeneration of degraded natural forests, while 'Young secondary forests' were selected when pledges referred to reforestation or forest expansion. Agricultural landscapes were classified into two broad categories – 'Agroforestry', for pledges that referred to regeneration or integrating trees into agricultural landscapes, and 'Silvopasture', for pledges that referred to restoring degraded rangelands. The activity type 'Mangroves' was used to quantify the removals

1 The list of countries is defined according to UN Member States.

2 The European Union and its 27 member States communicated one joint NDC and one Long-term Climate Strategy, hence we have analysed the climate pledges of the EU as a bloc, rather than individual Member States.

3 The range of land-based actions for carbon removal were presented in climate pledges as emissions reductions required to achieve net zero or interim (2030) targets compared with total emissions (presented in Mt CO_2e or percent of total emissions); references to residual or remaining emissions at the time of net zero; reference to removals/sequestration/CDR (presented in Mt CO_2e or proportion of total emissions); direct references to land area (in hectares, acres or km^2) or proportion of land area (of country, or of a land cover type, i.e.: proportion of forest cover to be maintained extended).

potential of restoring or expanding mangroves. The activity type 'Plantations' was used when countries referred to establishing commercial forests or plantations. This categorization represents a simplification of the range of land management activities and practices that countries have referenced in their climate strategies.

Default removal factors from the IPCC were applied based on the activity type and climate domain of the country (or implementation area, if this was identified as being outside the pledging country).[4] For agricultural activities, removal factors were sourced from the IPCC (Table 5.1 IPCC, 2019b). For forestry activities, Harris *et al*. (2021) was used (see **Table 2.2** for removal factors). The inclusion of technology-based CDR in national climate pledges was rare, but a handful of countries referred to BECCS and /or DACS. References to BECCS or bioenergy were categorized as plantations. This is not because it is assumed that forest plantations would primarily be used as the feedstock for bioenergy or BECCS, but because the emissions removal factor for plantations is the closest to energy crops, and so approximates the relevant area of land that would be required.

Table 2.2 characterizes the land management categories based on whether the primary intervention involves protection, resto-

4 A more accurate representation of the variety of land management activities would entail considerably more work, but would not greatly change the results, given that the range of emissions removal factors that can be applied is limited

Table 2.1 **Land management activities found in country pledges and IPCC removal factor (RF) categories**

Ecosystem condition	IPCC category	Land management activity
Less disturbed	Primary forest	Protecting existing intact forest
	Mangroves	Mangrove restoration or expansion
	Old secondary forest	Restoring or regenerating existing degraded forest
	Young secondary forest	Mixed plantings, mixed reforestation, reforestation
More disturbed	Silvopasture	Trees in grazing lands, restoring rangelands
	Agroforestry	Trees in croplands (including commercial trees), regenerative agriculture
	Plantation	Commercial planting for harvest, monoculture (no ref. to mixed species)

Table 2.2 **Land activity type categorization**

Approach	Land management	Activity	Removal factor ($Mg\ CO_2$ per ha per year)
Non-anthropogenic	Protection	Primary forest	1.55
Anthropogenic	Restoration	Old secondary forest	3.39
		Mangroves	15.40
		Silvopasture	2.62
		Agroforestry	1.49
	Replanting	Young secondary forest	8.50
		Plantation	14.40
Technology options	BECCS	Biomass feedstock identified as plantations	14.40
	DACS	No identified land footprint	

Note: Numbers in the table are shown for global average. Biome averages were used to calculate land area.

ration or replanting. It is important to understand the gains and losses, in terms of both physical and social resources, from each of these land management options. Pledges for avoided emissions and the protection of existing forests were noted, but not quantified in the context of our aim to assess the land area required for carbon dioxide removal in national climate pledges. The critical role that maintaining primary forests intact plays in stabilizing global temperatures, and the way that some climate policies incentivize creating new forests over protecting existing ones, is discussed in **Chapter 3**.

2.1.2 Results

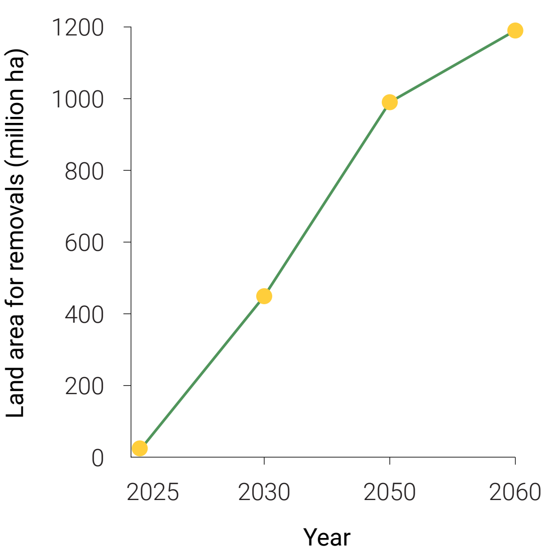
In total, we identified that 1,184 million ha of land would be required to meet the CDR commitments in country climate pledges to 2060 (see **Figure 2.1**). This land area is larger than the United States of America, at 983 million ha, or almost four times the size of India, at 329 million ha. More than half of this pledged land area – 633 million ha – is for planting new forests, requiring a land-use change from existing activities. The rest of the land area is pledged for the restoration of degraded forests, other natural ecosystems, or agricultural lands.

Most of the land area is in 2030 pledges. Fewer countries have submitted 2050 pledges and these are generally less detailed, making it harder to quantify land area. Many of the country pledges for 2030 (mostly in NDCs) focus on extensive land restoration, and climate pledges overlap with land restoration commitments.

Around one third (391 million ha) of the land needed for CDR pledges is based on direct area pledges in country climate commitments, as opposed to pledges expressed in terms of tree planting or emissions reductions through land use. 126 million ha result from indirect area pledges – that is, governments have pledged a proportion of land area, such as a percentage of forest cover increase, meaning that the calculation is based on existing land or existing forest area. Some 667 million ha of the land area in our results are calculated from an emissions pledge, which requires assumptions to be made about the type of activity in order to calculate the removal factor. The reliability of the land area estimates can be discussed by conducting a sensitivity analysis. When all emissions removal factors are based on global average values (meaning that no assumptions are made regarding activity type or biome), the land area in pledges changes the total results by less than 2 percent, showing that results are not strongly driven by our activity or biome assumptions. Another assumption affecting our results is that removals through increasing soil carbon stocks and below-ground biomass are not accounted for. We only use emissions removal factors based on above-ground absorption, even though many countries refer to soil carbon as part of their mitigation strategies. This affects the removals amount and could lead to an overestimation of the land area needed to achieve CDR pledges by approximately 20 percent (IPCC, 2019a) for the 667 million ha where calculations are based on emissions pledges (rather than direct or indirect area pledges).

Figure 2.1 **Carbon dioxide removal in national climate pledges**

Countries' climate pledges rely on 451 million ha of land for carbon removals by 2030, another 533 million hectares by 2050, and another 200 million ha is pledged from one country for 2060. This reliance on land can be expected to increase as more countries make longer-term pledges.



2.1.3 Discussion

Our results speak to the risks created by net zero targets that are over-reliant on land-based CDR, where future removals can undermine near-term emissions reductions. Land-based climate mitigation can also lead to the displacement of other land uses and users, infringing on the rights of indigenous peoples and local communities. Here, we highlight three risks and one hopeful and promising trend coming out of our analysis, as well as how it points to a need for more clarity and transparency across governments' climate and land restoration pledges.

First, a critical risk in framing climate targets as net zero is to undermine mitigation action by allowing an ill-defined trade-off, where land removals are pledged to make up for the lack of direct emissions reductions. The inclusion of almost 1.2 billion ha of land in climate pledges for removals alone (not counting land being relied on for avoided emissions) indicates an extensive reliance on removals, particularly for 2030 targets. Recent research has shown that emissions reductions in the next decade are the only way to limit warming to 1.5 °C, and that scaling up land-based removals cannot reduce peak temperatures (Dooley *et al*., 2022).

The second risk relates to displacing climate action to other countries. Very few countries make explicit commitments to using forest-based offsets to count towards their national mitigation commitments. Currently, the majority of forest-based offset projects are located in the global South. If historical trends persist, this would mean that pressure on land due to land-based CDR will be mainly concentrated in the poorest parts of the world. In other words, land-based CDR and its impacts are likely to be unevenly distributed, raising important climate justice concerns (Carton *et al*., 2020).

The third risk relates to land-based climate mitigation increasing overall demand for land. Land scarcity is already a critical issue, with global agricultural use threatening to push several planetary boundaries to their limits, including that for land-system change (Steffen *et al*., 2015; Campbell *et al*., 2017). Land-use change is the leading driver of biodiversity loss (IPBES 2019). Of the 1.2 billion ha of land that this report identified in climate pledges, over half relied on land-use change. This is particularly significant given that we categorized land into seven activities (see **Table 2.1**), only two of which involved a change in land use. This indicates that governments are over-reliant on plantations or new forests to achieve carbon dioxide removals.

There are also more promising and hopeful trends across governments' pledges. These consist of the approximately 551 million ha included in climate pledges for land restoration, while maintaining existing land uses to a greater or lesser extent. This highlights a growing awareness of and commitment by governments to the land restoration agenda. Many of the countries' climate pledges that we reviewed detail promising approaches to land management. Agroforestry, mangrove restoration and the restoration of degraded rangelands are all activities included in country climate pledges that can improve the contributions of land to multiple sustainability objectives, if implemented with respect to IPs' and LCs' rights to land and self-determination.

Our analysis also highlights the need for greater clarity in governments' pledges. This is important to avoid the risk of making unrealistic and overlapping claims on land to support various sustainability objectives. Current climate pledges from national and subnational governments have been criticized for failing to transparently elucidate their intended use of offset credits and carbon dioxide removal to meet their net zero targets (Hale *et al*., 2022). The same can be said about lack of transparency regarding the extent to which land is included in efforts to meet climate mitigation targets. While many governments include direct land areas in climate pledges, some make obscure assumptions or unquantifiable statements regarding the scale of land-based removals. Therefore, governments' climate pledges must present more clarity about the amount of land and land-use change planned to meet climate objectives. There is also a need for greater clarity about government pledges across United Nations conventions to avoid overlapping claims. Research shows that worldwide, governments (of at least 115 countries) have committed a total of close to 1 billion ha for land restoration (van der Esch *et al*., 2022). This is close to the land area for carbon removals that we found committed in climate pledges, but the restoration pledges in van der Esch *et al*., 2022 are found under a wider range of United Nations conventions (including the United Nations Convention to Combat Desertification (UNCCD) and the Convention on Biological Diversity (CBD) and the Bonn Challenge). It is not clear if these various pledges concern similar, overlapping or different areas of land. Again, more clarity is needed.

2.2 Global demand for land

Humans have already transformed more than 70 percent of the Earth's land area from its natural state, causing unparalleled environmental degradation and contributing significantly to global warming. An estimated 20 percent of global land is degraded to some extent, an area the size of the African continent (UNCCD, 2022). With food production using up half of the Earth's habitable land, and food systems creating one-third of all human-caused emissions, the United Nations is calling for a crisis footing when it comes to conserving, restoring and using the planet's land resources sustainably (UNCCD, 2022).

Avoiding conflict over land resources requires doing things differently. Increased resource extraction and land competition have already been shown to drive sustainability challenges and human rights conflicts. At the same time, strict conservation approaches such as protected areas (PAs) have been shown to dispossess local people. Expecting that land can be used for climate mitigation at the expense of other land demands will only exacerbate existing challenges. The impacts of climate change, competing demands on land, conflicts with food sovereignty and livelihoods, and the complexity of land ownership and management systems are all noted as key trade-offs and barriers to implementing land restoration (IPCC, 2022a).

The international community has pledged to restore 1 billion ha of degraded land by 2030 under the UN Decade of Ecosystem Restoration (UNCCD, 2022). Land restoration is critical for combating both climate change and the biodiversity loss crisis and provides unique entry points to apply human rights-based approaches that improve natural resource use and management. But what is sometimes ignored is the crucial question of how land restoration is carried out and whose lands are restored. Most importantly, trade-offs between different land uses need to be evaluated, to ensure that carbon sequestration goals do not undermine other uses of land. This section looks at projections of future demand for land across three areas: agriculture, climate mitigation and land restoration, and compares these with our findings – that governments have so far committed almost 1.2 billion ha of land in their climate mitigation pledges.

2.2.1 Demand for land – Projections for climate mitigation

Decarbonization of the energy sector and a transition to widespread renewable energy generation will carry a land footprint, but land availability is not considered a hard technical constraint for 1.5 °C mitigation pathways (Matthews and Wynes, 2022; Teske, 2019). Non-carbon renewable energy sources represent more efficient use of land to produce energy than does bioenergy. For example, solar panels are 100 times more efficient per unit land area than bioenergy for energy production (Searchinger *et al*., 2018). The projected extent of land-use change for climate mitigation, whether for bioenergy or CDR does represent a hard technical constraint to relying on land-based removals as a mitigation option (Dooley *et al*., 2018).

The most commonly included form of CDR in modelled climate scenarios continues to be BECCS and tree planting (referred to as afforestation/reforestation), although more recent research highlights the removal potential of less land-intensive technologies such as direct air capture or ocean-based forms of CDR (Riahi *et al*., 2022). In country climate pledges there is still very little inclusion of BECCS, with a direct reference made by only seven countries, corresponding to a land demand of 80 million ha. Yet widespread expectation for BECCS and bioenergy, as modelled in future climate mitigation pathways, would have substantial implications for land demand and therefore warrants attention in this section.

Estimates for land demand from bioenergy, including BECCS, vary widely across the mitigation scenarios represented in IPCC reports. In the pathways assessed for the *IPCC Special report on global warming of 1.5°C* (2018), land demand for bioenergy will range from 100 to 800 million ha by 2050, with a few outlying scenarios modelling a need for up to 1,500 million ha (Rogelj *et al*., 2018). More recent scenarios give a slightly more modest median land demand of 199 million ha (with a range of 56 to 482 million ha) for 1.5 °C scenarios, with limited or no overshoot (Riahi *et al*., 2022). In contrast, our finding of 80 million ha in land demand for BECCS from only seven countries would imply that this median is likely to be an underestimate, if BECCS to achieve CDR becomes as widespread as in modelled pathways.

Efforts for land-based climate mitigation would be more effective and successful if focused on achieving multiple sustainability objectives, rather than a singular focus on carbon dioxide removal.

Such ambitious expectations for land to meet bioenergy needs for CDR via BECCS raises a number of significant problems. First, modelled mitigation scenarios tend to be unconstrained by concerns for food sovereignty, biodiversity, respect for land rights, or other sustainability thresholds (Heck *et al*., 2018), allowing for substantial trade-offs with any of these. These pathways tend to build on assumptions of 'empty land' which ignore land-use practices that are not easily captured in globally aggregated datasets, such as nomadic lifestyles (Creutzig *et al*., 2021). They frequently rely on the conversion of (tropical) forests to cropland. In addition, they tend to underestimate the emissions from converting land to bioenergy plantations, as well as the potential for carbon storage when land is not used for agricultural production (Harper *et al*., 2018; Searchinger *et al*., 2018). One estimate surmises that taking these factors into account would require land for bioenergy production to be capped at its current level, roughly 50 million ha, in order to prevent undesirable impacts on biodiversity and livelihoods (Creutzig *et al*., 2021). The extreme assumptions being made about BECCS illustrate how easily climate mitigation approaches come into conflict with the finite productive capacity and multiple existing uses of land (Dooley and Kartha, 2018).

The allure of bioenergy (with or without CCS) in mitigation scenarios, and the consequent potential land-use demands for mitigation, is in part a construct of the way that carbon is accounted for in such models. BECCS, for instance, is particularly attractive in low-temperature scenarios that allow for overshoot – first exceeding temperature targets and then using CDR to bring temperatures back down again. A stronger focus on early mitigation action reduces the land demand for BECCS. The idea that bioenergy is carbon neutral across its lifecycle also leads to over-reliance on this approach as a mitigation option. After carbon dioxide is released at the point when biomass is first harvested and combusted, it will take time before the same amount of CO_2 is sequestered again on that land area (see section 3.2.1). For dedicated bioenergy crops, this time lag might be a matter of one or two years, but if forest biomass is used, it can easily take multiple decades before the carbon debt is repaid.

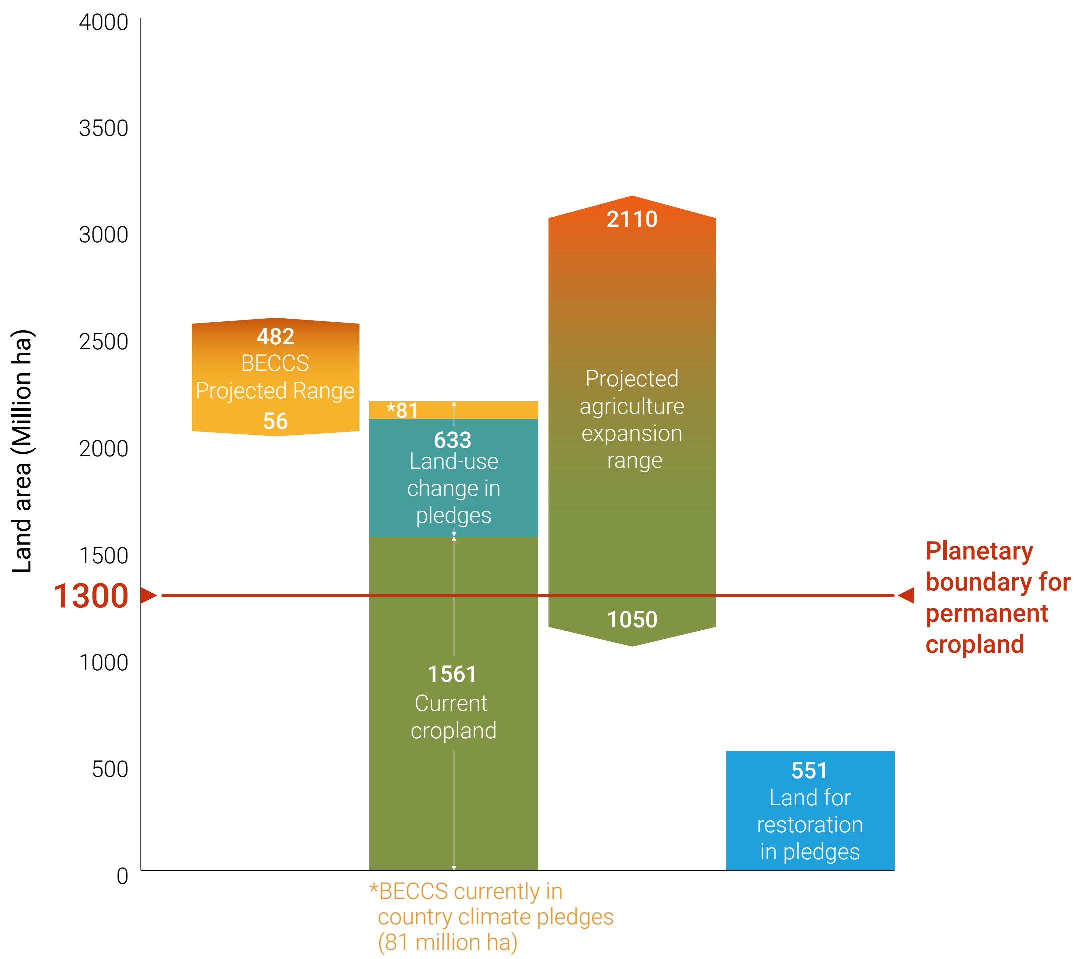
2.2.2 Demand for land – projections for agricultural needs

Modern agriculture has altered the face of the planet more than any other human activity, and now occupies approximately 40 percent of global land. Global food systems are responsible for 80 percent of deforestation and 70 percent of freshwater use, and are the leading driver of terrestrial biodiversity loss (UNCCD, 2022).

Projections of future demand for land for agricultural production vary considerably, based on their underlying assumptions, such as shifts in diets, handling of food waste, population projections and technological innovation to improve yields and/or production processes (Stehfest *et al*., 2019; Willett *et al*., 2019). For example, in the recent report *Food in the Anthropocene*, Willett *et al*. (2019) explores a range of scenarios for food production in 2050, which varies according to three parameters related to production process, food waste and dietary preferences. The resulting scenarios project global cropland area to range between 1,050 million ha and 2,110 million ha in 2050, compared with a baseline of 1,260 million ha in 2010 (see Figure 6 in Willett *et al*. 2019).

Figure 2.2 **Land for mitigation crosses planetary boundary thresholds**

The 633 million ha requiring land-use change found in country climate pledges (including 81million ha for BECCS), adds to demand for land, potentially crossing planetary boundaries if this adds to increased cropland areas. Land for restoration (551 million ha) does not increase demand for land, and can improve biodiversity and socioecological resilience.



Sources for projected ranges and planetary boundary: FAOSTAT 2022, Riahi et al., 2022, Willett et al., 2019.

* BECCS = bioenergy with carbon capture and storage

Projections for future agricultural land use under various shared socioeconomic pathways (SSPs) similarly model different assumptions and policy options, resulting in a range of projections for land use. Cropland change projections from 2010 to 2050 range from a decrease in cropland use of 210 million ha at the lower end to an increase in cropland use of 250 million ha compared with 2010 in the *IPCC Special report on climate change and land (SRCCL)* (IPCC, 2019a). The lower-end scenario features a decrease in pasture of 440 million ha and an increase in bioenergy cropland of 480 million ha, while the higher-end scenario shows an increase in pasture of 240 million ha and an increase in bioenergy cropland of 100 million ha. Other research similarly finds that cropland may either expand or shrink towards 2050, depending on the scenario and assumptions applied, (see, for example, van der Esch *et al*., 2017 and Stehfest *et al*., 2019), with Stehfest *et al*. (2019) projecting the greatest potential expansion to 1,800 million ha of total cropland in 2050.

Increasing land for agricultural use presents problems other than just the risk of increasing competition for land. Willett *et al*. (2019), in *Food in the Anthropocene*, suggest that a threshold for sustainable global cropland use is likely to be around 1,300 million ha (with a range from 1,100 to 1,500 million ha). Springmann *et al*. (2018) suggest a similar level for a sustainable boundary level of global cropland use (1,260 million ha, with a range of between 1,060 and 1,460 million ha). With cropland in 2022 reported by the FAO to be 1 561 million ha (FAOSTAT, 2020), this implies that we cannot expand global cropland further if we wish to stay within a safe boundary for land-use change (Steffen *et al*., 2015; Campbell *et al*., 2017). In **Figure 2.2**, we compare our results against other projected demands for land.

As agricultural land expands, it risks destabilizing vital ecosystems. While the total area of agricultural land has remained stable for some time (and by some projections may continue to remain stable), a shift has taken place over past decades, where less land is cultivated in the global North, as expansion takes place in the global South (Winkler, 2018). This in part reflects increases in export-oriented crop production, indicating that some of the agricultural expansion in the global South is satisfying demand in the global North (Henderson *et al*., 2015; Winkler, 2018). The reduction in agricultural land in the global North has resulted in abandoned, often degraded land, rather than functioning ecosystems and so is not comparable to the loss of ecosystems due to agricultural expansion in the global South in terms of impacts on biodiversity.

Expansion of cropland in the global South poses risks to indigenous peoples and local communities who may face encroachment on their land (especially from large-scale, commercial agriculture or feedlots), as well as biodiversity risks. A business-as-usual scenario for cropland suggests expansion of 89 million ha onto vital biodiversity hotspots towards 2050 (Molotoks *et al*., 2018). Maintaining or increasing terrestrial carbon stocks while meeting growing food demands will require increasing global land-use efficiency in terms of both storing carbon and producing food in a finite global land area (Searchinger *et al*., 2018). How humanity manages the global food system will be decisive to the challenge of feeding a growing global population, while addressing the biodiversity and climate crises in an equitable and just manner. The various projections for the future land footprint of the global food system illustrate that at the lower end there are possibilities for the interrelated nature of food, climate and biodiversity. Importantly, the wide-ranging projections for expansion of agricultural lands also illustrate the possibilities for shifting the global food system towards one that supplies healthy diets for a growing population, in ways that present opportunities for addressing the climate and biodiversity crises. These issues will be the focus of **Chapter 4**.

2.2.3 **Land restoration commitments**

Many countries have made commitments to restoration under a range of schemes, such as the land degradation neutrality commitments by 122 countries (UNCCD, 2019).[5] Collectively, global commitments to restoration based on national plans for 115 countries under the UNCCD, CBD, UNFCCC and Bonn Challenge total nearly 1 billion ha (van der Esch *et al*., 2022). The commitments include ecological restoration and protection of natural areas and improved land management and rehabilitation of degraded land. The areas include about 20 percent of cropland, 10 percent of forest land and a small proportion of pastures (van der Esch *et al*., 2022).

Little information is available to assess the success of these schemes, as most are based on pledges rather than actions on the ground. For example, of the Aichi Biodiversity Targets, 14 were not met, including targets for the elimination of biodiversity loss and halving the rate of loss of natural habitats. By 2020, less than 3 percent of the estimated potential land area was under active restoration (some 27 million ha) (CDB, 2020). Reporting on progress towards the Bonn Challenge targets is limited and assessment of land areas shows a 54 percent deficit in area committed to meeting country goals (Fagan *et al*., 2020).

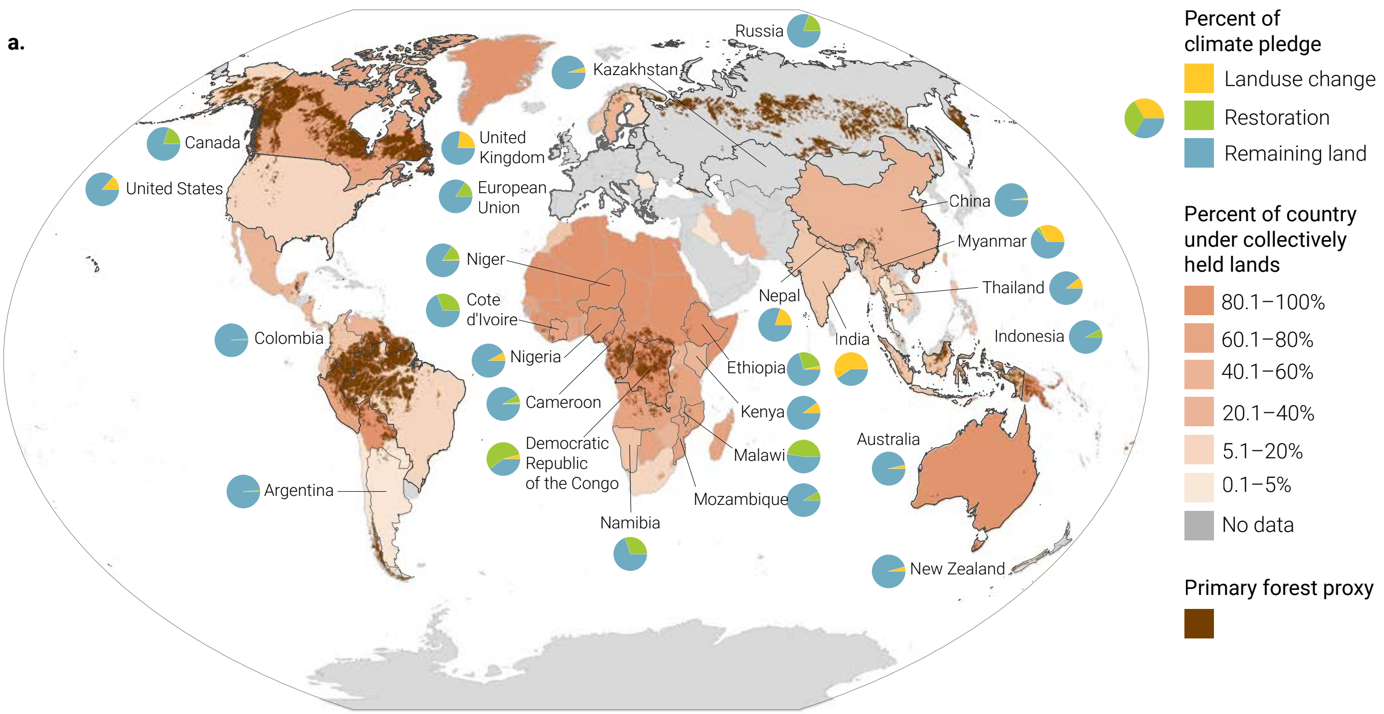
The potential for restoration has been modelled by the Netherlands Environmental Assessment Agency (PBL) (van der Esch

5 Restoration targets include the Latin American Initiative (20 million ha by 2020), African Forest Landscape Restoration Initiative (100 million ha by 2030), Agadir Commitment for the Mediterranean (8 million ha by 2030), ECCA30 including Europe, Caucasus and Central Asia (30 million ha by 2030), Great Green Wall for the Sahara and the Sahel (100 million ha by 2030), the Sustainable Development Goals (SDG) Target 15.3 (land degradation neutrality by 2030), Aichi Target 15 (restore at least 15 percent of degraded ecosystems by 2020), and The Bonn Challenge/New York Declaration on Forests Goal 5 (restore 350 million ha of degraded landscapes and forest lands by 2030).

Figure 2.3 **Intersection of the area of primary forest, collectively held lands, and the proportion of land area pledged for CDR in country climate pledges**

a. Shading for each country represents the proportion of the country area that is under collectively held lands that combines collectively held land. The area of extant primary forest is a proxy using the combined Intact Forest Landscapes and Hinterland Forest (see **Figure 3.2**). Percent climate pledge is the percent of country land area that is included in climate pledges that involves land use change by replanting or restoration of existing vegetation (see **Table 2.2**), with the remaining land representing existing dedicated land uses. Selection of countries shown include the top 10 forested countries (see **Figure 3.2**) plus other countries with large areas dedicated to climate pledges. **b)** Top 10 forested countries (in order of forest area, see **Table 3.2**) and global total showing primary forest areas in relation to the total country land area, the percent of primary forest that is within protected areas, collectively held lands at a country level, and the percentages of land area in countries' climate pledges that requires land use change (reforestation) or restoration.

a.



b.

Country	Primary forest as a % of country area	% of Primary forest in Protected areas	Community held lands as a % of country area	Reforestation in pledges as a % of country area	Restoration in pledges as a % of country area
Russian Federation	10	16			21
Brazil	28	72	19	Not quantifiable	Not quantifiable
Canada	21	17	62		20
USA	3.4	39	6	14	
China	0.1	22	50	2	
Australia	0.3	87	82	4	
DRC	29	23	86	4	56
Indonesia	19	26	23		8
Peru	36	34	66	Not quantifiable	Not quantifiable
India	0.7	2	21	59	
Global	7.6	37			

Source: Dubertret and Alden Wily 2015. UNEP-WCMC and IUCN (2022).

et al., 2022). Three scenarios to 2050 consist of: (i) baseline or business-as-usual, where land degradation and emissions from land-use change and degradation are projected to continue; (ii) restoration of 5 billion ha (35 percent of global land area) through conservation agriculture, agroforestry, silvopasture, grazing management, plantations and assisted natural regeneration; and (iii) restoration and protection, which combines restoration with protection of natural areas important for specific ecosystem functions, covering approximately half the land surface. Across the range of restoration activities, forest management and passive regeneration have the lowest cost per hectare. A major conclusion is that land restoration has the potential to deliver multiple benefits simultaneously, making it a highly integrated solution for sustainable development that supports the United Nations Conventions on land degradation and desertification, climate change and biodiversity and the SDGs (van der Esch *et al*., 2022).

The work by PBL suggests that the area of 1.2 billion ha of land that we found in climate mitigation pledges falls within the estimated 5 billion ha of restoration potential. However, only 551 million ha of land in mitigation pledges can be categorized as restoration, while 663 million ha requires a land-use change. A study that estimated 1.7–1.8 billion ha of land that could support increase in forest cover based on biophysical potential (Bastin *et al*., 2019) has been criticised for not accounting for existing ecosystems or land tenure rights. Local knowledge is needed to better assess suitable areas for restoration. Further work has been developed by FAO on mapping tree restoration potential to assist countries in identifying areas that are suitable for restoration (FAO and UNEP, 2020) and in developing guidelines to incorporate biodiversity into landscape restoration (Beatty *et al*., 2018). Overall, the area suitable for expanding forest cover is uncertain and depends on principles of ecology and human rights, while the area of global cropland has already reached sustainability thresholds, indicating there is no available land for energy crop or monoculture plantation expansion.

2.3 Conclusions

Our analysis of country climate pledges finds that almost 1.2 billion ha of land are included to achieve carbon dioxide removal for mitigation purposes. The land management activities included in climate pledges range from large-scale forest plantations to reforestation and restoration of degraded forests, wetlands and rangelands. Approximately half of the area pledged for removals (633 million ha) require land-use change in the form of tree planting to establish new forests, reforestation, or plantations. This represents a major risk. It is very likely that governments will be unable to pull off such major land cover change, equivalent to half of the global cropland area. If this happens, countries will fail to make good on their climate pledges and we will see a worsening of global warming. In the unlikely event that governments' actually succeed, they will contribute massively to worsening the crises of food security, biodiversity loss, water scarcity and infringements of IPs and LCs rights, as overall land pressure will increase dramatically. The observed over-reliance on land for climate mitigation in governments' pledges is obscured beneath the banner of net zero climate targets. The balance between reducing emissions and increasing removals must instead focus on rapid decarbonization before 2030 for pathways to 1.5 °C.

Large areas of land are being pledged in NDCs for CDR activities in countries that may conflict with human rights in collectively held lands or protection of primary forests. Areas of remaining primary forest range from very small to moderate but in many countries are poorly protected in formal protected areas and the forests and community held lands may be vulnerable to changes in land use under the NDC pledges (see **Figure 2.3**).

A recent review of net zero targets concluded that the transparency and integrity of existing net zero pledges are "far from sufficient" to ensure a timely transition to global net zero greenhouse gas emissions by mid-century, and observed that an "alarming lack of credibility still pervades the entire landscape" (Hans *et al*., 2022). The authors conclude that the focus needs to be on better targets and identifying where targets are not credible. We would add to this that net zero targets must be transparent about the assumptions made regarding removals, particularly when these rely on land-use change. Countries should avoid using removals to disguise inaction on emissions reductions, and should seriously consider the impact that land-based removals will have on other land uses and users.

Current human use of land and natural ecosystems is already crossing or near to crossing sustainability thresholds. Any further expansion of global cropland would put us beyond a safe threshold for permanent agricultural land, meaning there is no 'spare' land for bioenergy crops, or for conversion of land to tree plantations. Restoration of existing forests and degraded agricultural lands can bring climate benefits, without creating additional demand for land. Hence efforts for land-based climate mitigation would be more effective and successful if focused on achieving multiple sustainability objectives, rather than a singular focus on carbon dioxide removal.

Improved governance and management of land and territories is sorely needed to achieve multiple interrelated objectives, including addressing the climate and biodiversity crises. Current approaches to forest and ecosystem protection, land rights and food systems are exacerbating these crises. The following chapters outline the problems in current approaches and point to transformative changes in each of these areas – changes that are central to land stewardship approaches in line with 1.5 °C mitigation pathways.