Nature restoration: Contributions to tackling climate change

The climate mitigation and adaptation benefits of up-scaling terrestrial nature restoration in Europe

Nature restoration is central to our efforts to mitigate and adapt to climate change. Healthy ecosystems deliver a range of services which contribute to enhancing carbon capture and storage in natural sinks, increase the resilience of natural and human systems to climate change, and enhance our ability to adapt to its unavoidable impacts. This brief gives an overview of the key contributions that nature restoration can make in tackling climate change in the context of the proposal for an EU Regulation on Nature Restoration.

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The European Commission's proposal for an EU regulation on nature restoration is a unique opportunity to strengthen biodiversity and climate change action. Climate change and biodiversity loss are intrinsically linked challenges which are part of the same complex problem - and must be addressed together. We need an integrated approach to biodiversity conservation and climate mitigation and adaptation to maximise win-wins and minimise potential trade-offs.

The proposed EU nature restoration regulation identifies ecosystem-specific targets which must be met by Member States by 2030 and 2040, to reach the headline ambition of placing 20% of EU land and sea under restoration by 2030 and all areas in need of restoration by 2050. Acknowledging climate and biodiversity synergies, the proposal calls for restoring ecosystems with the most potential to remove and store carbon and prevent and reduce climate-related risks. We outline key evidence for the significant contribution that restoration can make to the EU's climate mitigation targets and to increase our resilience and adaptability to the unavoidable impacts of climate change.

1. Climate mitigation benefits

Nature restoration can significantly contribute to the EU's climate mitigation efforts by enhancing ecosystem's carbon sequestration and storage capacities while reducing some significant land-based carbon emissions (IPCC, 2019). However, this climate mitigation will only be achieved if there are also rapid greenhouse gas (GHG) emissions reductions in other sectors (Turner et al, 2020). As such, restoration can help compensate for unavoidable GHG emissions but should not be used to compensate for continued emissions from other sectors. Avoiding and reducing emissions from fossil fuels remains the most critical climate mitigation action (Cook-Patton et al, 2021).

Overall climate mitigation benefits of restoring EU terrestrial ecosystems

The first set of targets to be implemented under the EU Nature Restoration Regulation proposal cover habitats for which data, baselines, and monitoring methods are already available. For terrestrial ecosystems, these are the habitats listed under Annex I of the Habitats Directive as well as the habitats of species covered by the Birds and Habitats Directives (the EU Nature Directives) (Error! Reference source not found.).

Box 1: Article 4 of the Nature Restoration Regulation proposal

Member States shall put in place the restoration measures that are necessary to:

- Improve the condition and connectivity of Annex I habitats on 30% of the area, which is currently not in good condition, by 2030, 60% by 2040 and at least 90% by 2050.
- Re-establish Annex I habitats on 30% of the additional area needed to ensure their long-term viability by 2030, 60% by 2040 and at least 100% by 2050.
- Improve the quality and quantity of the habitats of species listed under the EU Nature Directives.

EU habitat types significantly differ in their natural carbon sequestration and storage capacities. Wetland, forests, and grasslands are particularly important:

- Healthy **wetlands** have the highest carbon stock per unit of any terrestrial habitat, around twice as high as that of forests (953 tCO_2/ha on average). Sequestration rates are around half those of forests (less than 5.5 tCO_2/ha/year on average)[1].

[1] Based on data from (Hendriks et al, 2020).

- European **forests** have been estimated to sequester around a tenth of Europe's gross CO_2 emissions (Forest Europe, 2020), but current reports indicate that much of Europe's forest area has become a net source instead of a sink (Booth, 2022)[2]. Sequestration rates of intact forests reported in the literature are the highest of any terrestrial habitat, ranging from 0.07 to 34 tCO_2/ha/year (with a median of around 10.6 tCO_2/ha/year)[3].

- Due to their large spatial coverage, **grasslands** have a large carbon stock (Kopsieker, Costa Domingo and Underwood, 2021).

Restoration measures can help re-establish some of the natural carbon sequestration and storage abilities of healthy ecosystems. Estimates for these GHG mitigation benefits vary widely and have high uncertainties due to the high context-dependency nature of restoration and differences in methodologies. This makes calculating the precise additional carbon benefits of restoration challenging (EEA, 2022b).

- Most studies focus on **wetland restoration**. GHG emission reductions after peatland restoration in Europe range from 1.19 to 22.8 tCO_2eq/ha/year[4]. Applying this range to the area of Annex I peatland habitat in need of restoration in the EU[5], shows that the additional carbon sequestration which could theoretically be achieved lies between 3.93 and 36.3 million tCO_2eq/year.

- On **grassland**, there is good evidence for win-win measures that restore biodiversity and reduce GHG emissions. Converting arable land to grassland delivers the largest carbon benefits of around 1.79 – 3.19 tCO_2eq/ha/year over 20 years (Conant et al, 2017). Preventing the conversion of grassland to arable land can also avoid significant additional emissions. Improving grassland management can increase soil carbon stores by around 1.72 tCO_2eq/ha/year (Conant et al, 2017). Creating more woody landscape features such as hedges can potentially deliver carbon benefits of around 3.3. tCO_2/ha/year (Black et al, 2014).

The **timeframe** to deliver carbon benefits after restoration varies considerably across habitats and habitat types ranging from as little as 2 years for some grassland (Anderson, 2021), 15-30 years for wetlands (Escobar, Belyazid and Manzoni, 2022), at least 10-30 years and up to a century for forests (Barredo Cano et al, 2021). Little information is available for alluvial and riparian habitats, steppe, heath, scrub habitats, and rocky habitats.

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[2] In Finland the net sink of forest land totalled -6.7 million tonnes of CO_2 eq. in 2021 (Statistics Finland, https://www.stat.fi/en/publication/cktlcpwag38sg0c5561iqop0y)

[3] Based on data from (Hendriks et al, 2020).

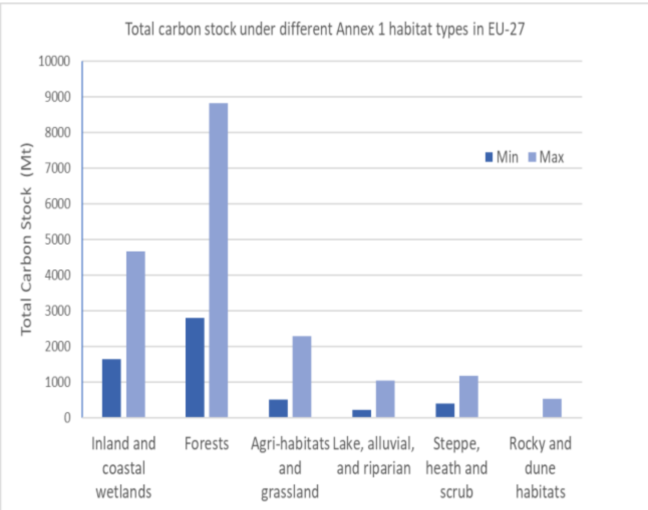
[4] European Commission (2022) COMMISSION STAFF WORKING DOCUMENT. IMPACT ASSESSMENT REPORT ANNEX VIII-a. Accompanying the proposal for a Regulation of the European Parliament and of the Council on nature restoration. (COM(2022) 304 final - SEC(2022) 256 final - SWD(2022) 168 final).

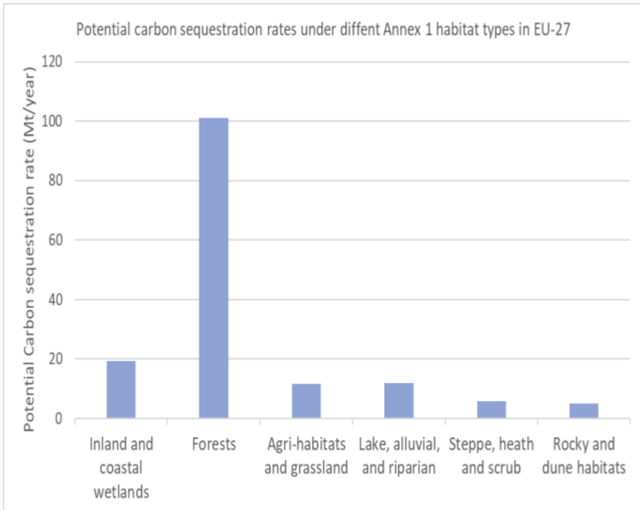
5 33 036 km2 – EU27 but excluding Romania due to poor data

The below estimate gives a ballpark indication of the **theoretical carbon storage and sequestration which could be achieved on the area to be restored under the Article 4 targets**.

If 90% of all terrestrial Annex I habitat which is currently in not good or unknown condition were to be restored to good condition, **the restored area would store a total carbon stock between 2 858 - 9 210 million tons of carbon in the EU**[6] (equivalent to 10 479 – 33 770 tCO_2eq) and would **sequester around 286 $MtCO_2eq$/year** (or 77. 89 million tC/year) **over an area of 381,786 km** (EEA, 2022b)[7]. This would however take many years to centuries of restoration time.

Figure 1 Estimated carbon stocks and sequestration rates in key terrestrial habitats in EU-27 if all Annex I habitats were in good condition





Several limitations must be considered. For example, restoration measures typically do not fully re-establish the natural carbon sequestration and storage capacities of ecosystems in good condition, and therefore restoration measures implemented may not lead to full restoration. Moreover, ecosystems take time to reach their natural carbon sequestration and storage potential, and there are limitations in the underlying carbon data and the approach used to extrapolate these (Kopsieker, Costa Domingo and Underwood, 2021).

This estimate does not reflect the additional carbon emissions mitigation benefits of implementing Article 4 of the proposed Regulation. This would require an assessment of the current stock and emissions on Annex I habitats (a baseline scenario) and estimates for the additional sequestration that can be achieved by restoration actions. Currently available evidence is insufficient to reliably calculate a quantitative estimate of the additional carbon mitigation potential of restoring EU Annex I habitats. Despite this, current evidence for the

6 EU27 but excluding Romania due to poor data

[7] Based on data from (Hendriks et al, 2020).

carbon stocks and sequestration rates of healthy ecosystems clearly shows natural ecosystems cycle and store a significant proportion of EU carbon. Protecting, enhancing, and increasing these natural carbon sinks through restoration is therefore key to climate mitigation.

Deeper dive into the evidence for climate mitigation benefits of peatland, agroecosystems, and managed forests

The targets under Articles 6-10 of the proposed Nature Restoration Regulation go beyond habitats listed under Annex I of the EU Habitats Directive (Error! Reference source not found.). Here, we focus on three key ecosystem types due to their large spatial coverage, their large potential carbon mitigation benefits, and the fact that stakeholders have voiced the most concerns over upscaling their restoration.

Box 2: Article 6-10 of the Nature Restoration Regulation proposal

Member States must achieve the following key targets:

- **Article 6** covers urban ecosystem restoration including a requirement for Member States to increase green space area by 3% by 2040 ad by 5% by 2050 and ensure a minimum tree cover in cities.
- **Article 7** covers floodplain and river restoration including a requirement for Member States to create an inventory of river barriers and remove them to achieve the EU Biodiversity Strategy target of restoring 25 500 km of free-flowing rivers by 2030.
- **Article 8** sets a target to reverse the decline of pollinators by 2030
- **Articles 9 and 10** cover agroecosystem and forest restoration beyond Annex I habitats. These include an obligation to achieve an increasing trend in existing indicators including for agroecosystems: the grassland butterfly index, organic carbon in cropland mineral soil, share of agricultural land with high diversity landscape features, for forests: standing and lying deadwood, share of forests with uneven-aged structure, forest connectivity, common forest bird index, and stock of organic carbon.
- Two additional targets for agroecosystems include increases in the **common farmland bird index** and putting in place restoration measures on peatland under agricultural use to reach 30% of the area by 2030 (with at least a quarter rewetted) and 70% by 2050 (with a least half being rewetted).

Peatlands

Peatlands cover around 3% of EU-27 agricultural area (with estimates ranging from 43 000-55 000 km^2) yet emit around 25% of the annual agricultural emissions (Greifswald Mire Centre, 2020). A large proportion of these peatlands are found in the north-western, northern, and eastern countries. In 2020, Member States reported emissions of 92.3 million tCO_2eq from drained peatland under agricultural land use under the LULUCF regulation. This is likely an underestimate with emissions estimated to be around 167 million tCO_2eq (Martin and Couwenberg, 2021). Europe is the second largest CO_2 emitter from drained peatland, including under other land uses such as forestry, making up around 15% of total global peatland CO2 emissions (around 220 million tCO_2/year) (Greifswald Mire Centre, 2020).

Restoring peatland under cropland and grassland use is recognised as a key GHG mitigation measure by the IPCC (Hiraishi et al, 2014). **To reach climate neutrality by 2050, virtually all drained peatlands should be restored.** If no rewetting takes place, emissions form peatland would take up 12-42% of the global emission budget needed to keep warming below 1.5-2 °C (Leifeld, Wüst-Galley and Page, 2019).

Rewetting alone can stop the disproportionate emissions from degraded peatland thereby avoiding the loss of their high carbon stocks and, under some circumstances, convert them into carbon sinks. The additional carbon sequestration rates of wetlands are relatively small and likely only compensate the increased methane emissions from rewetted peat soils (Mrotzek et al, 2020).

The huge mitigation benefits of rewetting mostly arise from avoided emissions from degraded peat. There is strong evidence showing that, when all GHGs are considered, rewetting reduces net GHG emissions (Wilson et al, 2016a). Rewetting delivers instant climate mitigation benefits as the effects of a spike in short-lived methane (CH_4) emissions (even when emitted at rates higher than in pristine wetlands), do not undermine the long-term climate mitigation benefits of avoiding long-lived CO_2 and N_2O emissions (Günther et al, 2020). Postponing rewetting has a high cost of inaction in terms of limiting global temperature increases.

To meet the peatland rewetting target under the Nature Restoration Regulation proposal, around **12 245 km^2 would have to be restored by 2030** (and at least 3 061 km^2 rewetted), and **29 038 km^2 restored by 2050** (with at least 14 519 km^2 rewetted).[8]

By applying the ranges of estimated climate mitigation values of restoring peatland reported in the literature (10-25 tCO_2/ha/year for rewetting grassland, 3.4-10 tCO_2/ha/year for restoring grassland (Wilson et al, 2016b), 25-30 tCO_2eq/ha/year for rewetting cropland and 3.4-25 tCO_2/ha/year for restoring cropland[9]) **the target could achieve additional net GHG mitigation benefits ranging from 7.8-22.8 million tCO_2eq/year to 2030 and 26.7-62.9 $MtCO_2eq$/year to 2050**.

[8] These figures are based on the area of organic soil under agriculture reported by Member States in their national GHG emission inventories which is likely an underestimate.

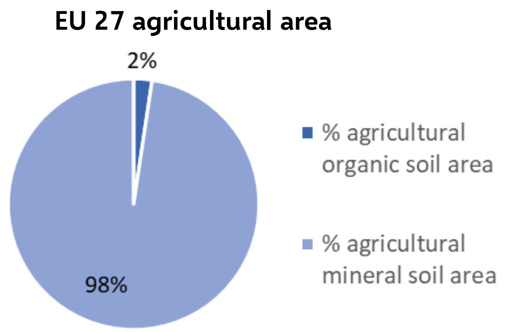
[9] European Commission (2022) COMMISSION STAFF WORKING DOCUMENT. IMPACT ASSESSMENT REPORT ANNEX VIII-a. Accompanying the proposal for a Regulation of the European Parliament and of the Council on nature restoration. (COM(2022) 304 final - SEC(2022) 256 final - SWD(2022) 168 final).

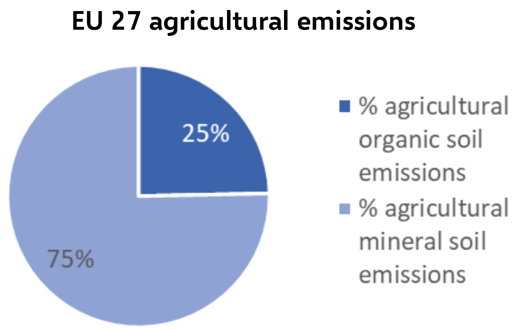
This gives a rough estimate of the range of the potential benefits based on currently available information. However, it is not a precise estimate of the climate benefits of reaching the Nature Restoration Regulation target as it makes several important assumptions, it does not consider site, region and habitat specific variations, and there are important uncertainties in the underlying data.

Table 1 Area of organic soil under agricultural land and emissions from this land in EU Member States where organic soils represent over 1.9% of agricultural land (larger than the EU average). The area data used is that reported by MS under their GHG inventories. The emissions data used has been corrected with updated emission factors (EFs) for organic soils (see Martin and Cowenberg, 2021[Error! Bookmark not defined.]).

MS	Total area of organic soil under agricultural land (km2)	Total emissions from organic soil under agricultural land (MtCO2eq)	Agricultural land on organic soil (%)	Agricultural emissions from organic soil (%)
NL	3382.04	9.69	14.76	35.64
FI	3294.24	9.19	12.05	57.92
DE	13126.20	38.42	6.76	39.67
IE	3329.33	5.73	6.74	25.04
LV	1583.15	5.05	6.33	71.78
EE	764.28	2.34	5.98	38.39
DK	1790.40	6.12	5.54	34.76
PL	9217.89	26.34	5.09	48.73
SE	1647.34	4.38	4.98	40.50
LT	1326.00	4.21	3.72	47.84
EU	41 484.20	118.17	1.92	19.30

Figure 2 Share of organic soils in the EU27 agriculture area; Share of emissions from organic soils in the EU27 agricultural emissions (cropland and grassland)





Agroecosystems

Reported emissions under the LULUCF regulation show that EU cropland (representing 125 Mha) emits 50.2 million tCO_2eq while grasslands (95.2 Mha) are a smaller source of 10.9 million tCO_2eq (EEA, 2022a). When taken together, agricultural land emits around 60 million tCO_2eq/year. Soils are a particularly important component as they store most carbon in agroecosystems. Mineral soils on cropland are a net carbon source (27 million tCO_2eq), while they are a net sink for grassland (41 million tCO_2eq).

Restoring agroecosystems can re-establish their natural carbon cycling and storage capacities thereby achieving climate mitigation benefits through avoiding some current emissions and enhancing carbon sinks. A range of measures can contribute to achieving the agroecosystem targets under article 9 while simultaneously enhancing carbon sinks. The measure with the highest potential, excluding peatland restoration, is the conversion of cropland to grassland which can achieve net gains in soil carbon stock of around 2.2 tCO_2eq/ha/year (ranging from round 1.4 tCO_2eq/ha/year to 3.2 tCO_2eq/ha/year) (Lugato et al, 2014). Other measures with good evidence for their carbon storage and sequestration potential include cover cropping, improved crop rotations, agroforestry, organic farming, improved grassland management, halting ploughing on grassland, increasing landscape features, and increasing crop residues (Pellerin et al, 2021).

Carbon benefits can be achieved from improved agroecosystem management. Although management changes needed to maximise carbon stocks are not always the same as those needed for restoration, many measures to enhance soil organic carbon can simultaneously enhance agroecosystem biodiversity (Laban, Metternicht and Davies, 2018). The potential for increasing SOC stocks on arable land in EU27 could achieve an additional sequestration of 50.48 million tCO_2eq /year (Lugato et al, 2014). Other estimates calculate a technical carbon sequestration potential of EU27 agricultural soils of up to 200 million Tco_2eq/year while the economically feasible potential is most likely closer to 20 million Tco_2eq/year (Smith, 2012).

Forestry

Forests are currently the main carbon sink of the EU, sequestering around 365 million tCO_2eq/year and offsetting around 7% of total GHG emissions (Grassi et al, 2019). The ten Member States with the highest contribution to the EU forest carbon sink account for around 90% of removals and include Germany, Sweden and France (EEA, 2022a). EU-27 +UK forests hold a carbon stock of around 99.8 Gt CO_2eq.

The EU forest's capacity to sequester and store carbon has been decreasing since 2013 (Forzieri et al, 2021). When they reach a certain tipping point, forests can become net sources of GHGs. This shift has already been recorded in Slovenia, Czechia, and Estonia (Böttcher, Reise and Hennenberg, 2021). In addition, according to preliminary data, even though Finland's forests remain a net carbon sink, a decline in stand growth and increased logging has reduced their sequestration to the point that the LULUCF sector is now a net source of 2.1 million tCO_2eq (Tuomainen, 2022).

Climate change related risks are also predicted to threaten the ability of EU forests to continue absorbing GHGs. It is estimated that the carbon storage potential of Europe's forests could be reduced by 180 million tCO_2eq annually from 2021-2030, reducing its sink by more than 50% (Seidl et al, 2014).

Restoration, recreation, and enhanced adaptability of forest habitat can significantly contribute to climate mitigation by increasing the forest carbon sink and avoiding emissions associated with deforestation, intensive forest management practices, and climate-related risks. Forest restoration is predicted have considerable implications for climate mitigation in Europe (Stanturf et al, 2015). Evidence exists for the climate mitigation benefits of specific measures including uneven-aged systems, reduced harvesting intensity, increase target diameters, increased dead wood, altering thinning regimes, rotation periods, and species composition management (Ruiz-Peinado et al, 2017). Measures to enhance SOC can also make important contributions to climate mitigation (Mayer et al, 2020).

Forest area can be increased through biodiversity-friendly afforestation and reforestation. Proposed increases in EU forest area in the literature range from 6 to 59% which would mitigate 77-210 million tCO_2eq/year (2.2-7.7 tCO_2/ha/year) (Böttcher, Reise and Hennenberg, 2021). Avoiding two thirds of the emissions associated with natural disasters and the draining of peat soils could reduce emissions by a further 35 million tCO_2/year. In total, improving forest management in the EU forests is estimated to have an additional mitigation potential in the order of 90 - 180 million tCO_2/year by 2040 (Nabuurs et al, 2017). Recent studies estimate significantly larger potentials of up to 440 million tCO_2eq/year which could double the climate mitigation potential of forest management by 2050 (European Commission, 2021).

There is an important time dimension with forest restoration. It can take 10-30 years for new woodland to deliver carbon sequestration benefits and decades for stocks to accumulate (Anderson, 2021). Although there is no explicit target under the proposed Nature Restoration Regulation, rewetting peatlands which have been drained for forestry can be a key restoration measure with important climate mitigation benefits. It is estimated that around 28% of European organic soils have been drained for forestry (78 024 km^2) and that organic soils under forestry in the EU27 emit around 67.6 million tCO_2eq/year (Stolte et al, 2015). Potential trade-offs between increasing the mitigation potential of forests and the conservation of biodiversity must be carefully considered.

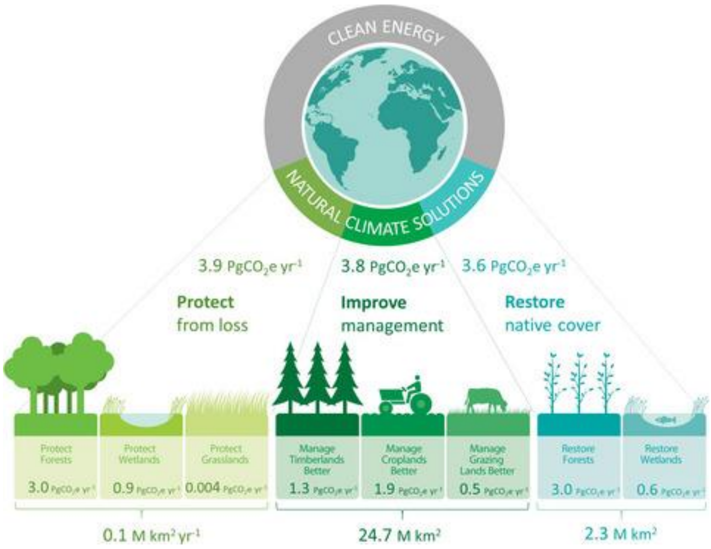
Potential contributions of the Nature Restoration Law to EU climate mitigation objectives

Nature restoration is a prerequisite to reach the global ambition of keeping global warming well below 2 °C. **Decreasing GHG emissions from degraded land and increasing natural GHG sinks is widely cited as having the potential to contribute up to 30% of the GHG mitigation needed to 2050 (Seddon et al, 2021)**. As highlighted by the IPCC, "*all scenarios that limit climate change to 1.5 °C rely heavily on land-use mitigation measures*".

Natural Climate Solutions, which cover a wide range of land management practices that conserve, restore, or sustainably manage natural ecosystems and lands and that increase carbon storage, could limit warming by an additional 0.3°C by the end of the century, but only if implemented alongside the rapid decarbonisation of other sectors needed to achieve the IPCC emission scenario which aligns with the Paris Agreement targets (Rockström et al, 2021).

Estimates for the potential global climate mitigation benefits of nature-based solutions (including protection, restoration, and improved management) across all ecosystems range from 5 $GtCO_2eq$/year to 11 $GtCO_2eq$/year by 2030 and 10 $GtCO_2eq$/year to 18 $GtCO_2eq$/year in 2050. This is an approximation as the studies on which it is based rely on different assumptions, methods, and scopes. Considering the time it will take to implement nature-based measures, the lower estimate (5 $GtCO_2eq$) is likely more realistic by 2030 (Miles et al, 2021). For the EU27 a recent study estimated the total cost-effective mitigation potential of land-based measures could be around 520 million tCO_2eq/year by 2050 (equivalent to 21% of total GHG emissions) (Roe et al, 2021).

Figure 2 Proportion of potential global emission reduction which can be delivered through land-based solutions by 2030 including protection, improved management, and restoration. 1 PgCO2eq = 1Gt CO2eq.



Source: (Griscom et al, 2019)

Proposed changes to the LULUCF Regulation establish a net carbon sink target for the sector of 310 million tCO_2eq by 2030. Most Annex I habitats are managed and therefore covered by the LULUCF regulation, and all agroecosystems and forestry are included. Therefore, the realisation of the LULUCF target will be linked to the implementation of restoration actions under the Nature Restoration Regulation.

The EU GHG inventory of LULUCF sector emissions under the UNFCC shows a net GHG sink of 249 million tCO_2eq in 2019. Integrated scenarios estimate that the sink could be increased to anywhere between 400 million tCO_2eq and 600 million tCO_2eq by 2050 (Böttcher, Reise and Hennenberg, 2021). However, most estimates include assumptions on higher levels of ambition, such as reducing current forest harvesting intensity levels. Importantly, the measures considered go beyond nature restoration measures and are not always synergistic with biodiversity objectives. The precise contribution of specific restoration actions to the LULUCF sink target cannot be made using existing evidence and models.

2. Climate change resilience and adaptation benefits

Nature restoration can contribute to reducing a range of climate change related risks by 1) reducing exposure to climate related hazards, 2) reducing the vulnerability of terrestrial and human systems to the impacts of these hazards, 3) building capacity to adapt to potential impacts, and, in some cases, 4) reducing their frequency and intensity (McVittie et al, 2018). Effectively designed and implemented nature restoration measures can often be more cost-effective at reducing climate related risks than alternative grey solutions (EEA, 2021).

Evidence exists for the potential of nature restoration to reduce key climate related risks including 1) risks of extreme weather and shifting rainfall, 2) risk to sustainable and reliable water supply, 3) climate-induced natural hazard risk (including flood, drought, forest fires, landslides, avalanches, and erosion), 4) risks to coastal areas, 5) risks to human health and well-being, and 5) to key sectors (such as agriculture, forestry, insurance, and tourism) (Chausson et al, 2020). Quantifying these benefits is more challenging than quantifying the benefits for climate risk mitigation as mitigation can be compared using the common indicator of changes in net GHG emissions (CO2eq). This is not the case for adaptation where no single measure can capture the wide range of multifaceted and interrelated climate-related risks which can be reduced though restoration measures (Morecroft et al, 2019).

Most research so far has focused on measuring wetland and forest restoration for flood risk mitigation, soil erosion reduction, and water quality and quantity regulation (Chausson et al, 2020). Some illustrative examples of the climate adaptation benefits of restoration action include:

- **Flood risk mitigation**: Wetlands and freshwater ecosystems are key to reduce flood risk by increasing the ability of nature to act as a sponge and increase water absorption and storage. In Europe, a study estimates that enhancing floodwater retention areas of rivers can decrease flood exposure by up to 70% (EEA, 2021). For example, the Dutch 'room for rivers' programme achieved lower flood levels and depths, thereby reducing flood frequency and exposure. These benefits were valued at around EUR 2 billion of avoided economic damage in case of breaching and around EUR 70,000 a year from reduced flood frequency (Asselman and Klijn, 2016). Urban restoration is also key to reduce flood risk of urban areas and agricultural restoration can also contribute to reducing flood risk to agriculture and downstream areas (Zölch et al, 2017).

- **Water quality and water quantity regulation**: Wetlands can play a key role in water supply and quality (Russi et al, 2013). Often, the water purification benefits of peatland are cheaper than the costs of drinking water treatment (Ferre and Martin-Ortega, 2019). In addition, restored wetlands have higher water holding and flow regulation capacities influencing groundwater and surface water supply. A study in the Elbe in Germany estimated that nutrient retention benefits after restoration are worth from EUR 440-1540/ha/year (Grossmann, 2012). River floodplain, forest, and agroecosystem restoration can also contribute to water management benefits.

Nature restoration can also deliver important benefits for human health, wellbeing, and employment.

- Access to good quality natural and semi-natural spaces has been linked to reduced climate-related health risks including **heat stress and mortality, risk of zoonotic disease outbreaks.** A global study, including European cities, found that well-watered trees can decrease air temperature by up to 3.1-5.8 °C during summer (Meili et al, 2021).

- Green spaces can reduce the vulnerability of people to the impacts of climate change by increasing physical health through promoting more **physical activity, reducing stress, and reducing heat, noise, and air pollution** (Ten Brink et al, 2016).

- Nature can also reduce the mental health impacts of climate change, such as ecoanxiety, as it has been linked to positive **mental health benefits** including reduced anxiety, depression, and loneliness, and reduced incidence of neurosis and childhood behavioural disorders (Gascon et al, 2015).

- Nature can also help adapt to some of the social impacts of climate change, such as reduced well-being and climate-related migration, as it can increase **well-being** associated with visiting attractive locations as well as increased **social cohesion, community-building, and a sense of local pride**[Error! Bookmark not defined.]**.**

- Restoration can help adapt to the inevitable impacts of climate change on job markets. It is estimated that **restoring 15% of degraded EU ecosystems could create between 20,000 and 70,000 jobs** (Dickie, 2017)[10].

More fragmented and mostly qualitative evidence exists measuring the contribution to adaptation of restoring other ecosystem types and to other key climate risks. Despite this, strong theoretical rationales exist for the vital role of restoring nature to reduce climate-related risk across all sectors of society. There is a need to strengthen the evidence base for these benefits. The lack of evidence should not be used as an excuse to delay action, as restoring nature is vital to help people and economic sectors adjust to the impacts of climate change.

Nature restoration is vital to enhance the resilience and adaptability of habitats and ecosystems to climate change (Biggs et al, 2020). In turn, this will protect some of the vital ecosystem services, on which societal well-being and prosperity depend, from the impacts of climate change including their important contributions to climate mitigation. Climate change mitigation and adaptation are intrinsically linked. As a result, measures with climate adaptation benefits can simultaneously reduce and avoid emissions and enhance carbon sinks. However, conflicts between these objectives can also arise. Since the primary objective of the proposed Nature Restoration Regulation is to enhance biodiversity, trade-offs should be identified and adequately mitigated through careful planning and implementation.

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[10] Jobs created to deliver Target 2 of the EU Biodiversity Strategy to 2020.

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