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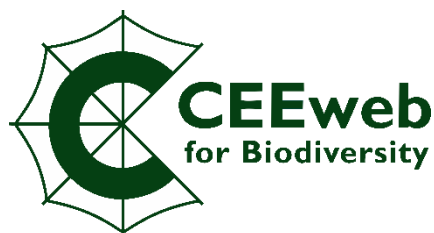
# Resilience of Forest Ecosystems to Climate Change

## **The Potential Impact of the EU Deforestation Law**

OCTOBER 2022

The potential impact of the 'EU  
Deforestation Law' on the  
resilience of forest ecosystems to  
climate change and their ability to  
adapt

Study on EU climate and ecosystem  
policies



## Acknowledgements

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## Executive summary

On 17 November 2021, the Commission adopted its proposal for a Regulation (hereafter: the Deforestation Regulation<sup>1</sup>) on the making available on the Union market as well as export from the Union of 6 commodities and products in order to minimise the contribution of the European Union to global deforestation and forest degradation. The aim of this study was to evaluate the Deforestation Regulation regarding the potential impact on the resilience of forest ecosystems to climate change to identify gaps and shortcomings in the proposal and recommend measures to increase its efficiency.

According to scientific evidence, forest ecosystems and climate change can have an effect on each other — forest ecosystems are carbon sinks that help to reduce and store GHG emissions from the atmosphere which mitigates the effect of climate change, while climate change poses a serious threat to the ecosystem services of the forests. Protecting forest areas and their ecosystems is the most cost-efficient and accessible way of balancing the unavoidable emissions in the future and increasing a region's adaptive capacity.

Deforestation is a quantity, while forest degradation is a quality loss of forest ecosystems that can be attributed to the production of certain commodities. The Deforestation Regulation has multiple purposes: from defining forest degradation and identifying the most deforestation affected (high-risk) countries, to the creation of a due diligence system that can cost- and effort effectively exclude products related to deforestation. Its final goal is to make sure every consumer in the EU could access products in the markets that have a minimum contribution to damaging global forest ecosystems. In order to reduce the administrative burden of operating the system, a classification of countries regarding the risk of deforestation is created, focusing on the most affected areas — where high-risk countries will be subject to enhanced scrutiny by the competent authorities. Products of coffee, cocoa, palm oil, soy, beef, and wood — mentioned in Annex I — will be covered by the Deforestation Regulation, while there is a future option to extend this list with additional commodities.

The Deforestation Regulation, as a legally binding act within the European Union, has to be coherent with EU strategies and long-term goals. In this study, the aims and measures of the Deforestation Regulation were analysed by their connections to the European Green Deal and key strategic documents on related areas, such as the Biodiversity Strategy, Farm to Fork Strategy, Forest Strategy, Strategy on Adaptation to Climate Change, and the national long-term energy and climate

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<sup>1</sup> Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the making available on the Union market as well as export from the Union of certain commodities and products associated with deforestation and forest degradation and repealing Regulation (EU) No 995/2010.

strategies. The strategies highlight the importance of forest ecosystems in the green economy, transition to renewable energy-based energy production and consumption, adaptation to climate change and maintaining biodiversity, and contributing to food security. The Deforestation Regulation is in line with these strategic goals, while it focuses on the external presence of the EU in global markets; therefore, it supplements the sectoral strategies which are limited to the territory of the Union.

By identifying gaps and proposing recommendations, this study aimed to increase the efficiency of the implementation of the Deforestation Regulation. The main findings were the following:

- The scope of the regulation is restricted to forest ecosystems despite the fact that **other biomes, such as wetlands, savannahs and peatlands, have also significant contribution to carbon sequencing / storing**, thus mitigating the effect of climate change;
- The involvement of **sugarcane, rubber and corn** should be considered in the revision of relevant commodities; and
- **Active cooperation and data-sharing** are needed with the partner countries to ensure the effectiveness of the due diligence system.

Not importing deforestation affected products alone does not solve the deforestation issue — a supporting mechanism is needed to help local farmers and organisations to find a more sustainable economic activity.

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## 1. Introduction

Forests are a key element of the biosphere on Earth, with multifunctional services participating in the carbon cycle, providing habitats for species, functioning as resources for various industries, and regulating local and global climate parameters. As a precious organism, it is a common global need to protect forests and maintain their functionality and ecosystems.

Humanity has always relied on forests in many ways throughout history, such as using wood materials for constructing homes, ships, and various tools, hunting and foraging their ecosystems, or plainly as recreational sites. Forests provide more than 86 million green jobs<sup>2</sup> and support the livelihoods of many more, especially people living in extreme poverty. Although forests are valuable resources for human populations, history shows that this conditionally renewable, multifunctional natural resource has been systemically exhausted as the global population has grown. While 10 000 years ago, 57 % of the habitable land was covered by forest, it has shrunk to 50 % by the 19<sup>th</sup> century and 31 % by 2020.<sup>2</sup>

Globally, EU consumption contributes to 10 % of deforestation, while it is estimated that between 1990 and 2020 an area larger than Europe was lost due to deforestation. In a major development, the European Commission has proposed a new regulation in 2021 to halt deforestation and minimise the EU's impact on forests worldwide.

Deforestation and forest degradation contribute to the global climate crisis in multiple ways. Most importantly, they increase greenhouse gas emissions through associated forest fires, permanently removing carbon sink capacities, decreasing climate change resilience of the affected area, and substantially reducing its biodiversity. Global deforestation alone accounts for more than 20 percent of the world's CO<sub>2</sub> emissions.<sup>3</sup>

The proposed regulation will require companies that sell products linked to deforestation and forest degradation — such as soy, palm oil and beef — to ensure they are 'deforestation-free' before placing them on the European market or exporting them from the EU. This proposal is a key part of the EU's Green Deal plans to protect ecosystems and biodiversity. Regulating the use of products that drive deforestation is a key part of achieving this. The draft of the Deforestation Regulation was published by the European Commission on 17 November 2021 and since then numerous reports, analyses and studies have been made on its expected effects or perceived shortcomings. The publication of the draft Deforestation Regulation was

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<sup>2</sup> FAO and UNEP. 2020. The State of the World's Forests 2020. Link: [www.fao.org/3/ca8642en/ca8642en.pdf](http://www.fao.org/3/ca8642en/ca8642en.pdf)

<sup>3</sup> UNFCCC. 2015. High Level Segment of the eleventh session of the United Nations Forum on Forests. Link: [https://unfccc.int/files/press/statements/application/pdf/201513-1405\\_unff11.pdf](https://unfccc.int/files/press/statements/application/pdf/201513-1405_unff11.pdf)

followed by an intensive discussion between stakeholder groups, scientists and experts.

This study focuses on the role of forest ecosystems and their mitigation potential in climate change and addresses the issue of deforestation from this perspective. The nature of the study is a 'literature review' or synthesis analysis rather than a primary research study. Based on scientific evidence, gaps are identified within the proposal of the Deforestation Regulation and recommendations will be made for enhancing the potential impact of the regulation.



## 2. General overview of forest ecosystems and climate change

Deforestation and forest degradation have complex drivers from direct effects, like agricultural use of forest areas, building infrastructures, or cutting trees for the use of wood materials, to indirect factors of economic demand and political demographic properties of the countries. These effects can be visualised by the following figure from a WWF report<sup>4</sup>.

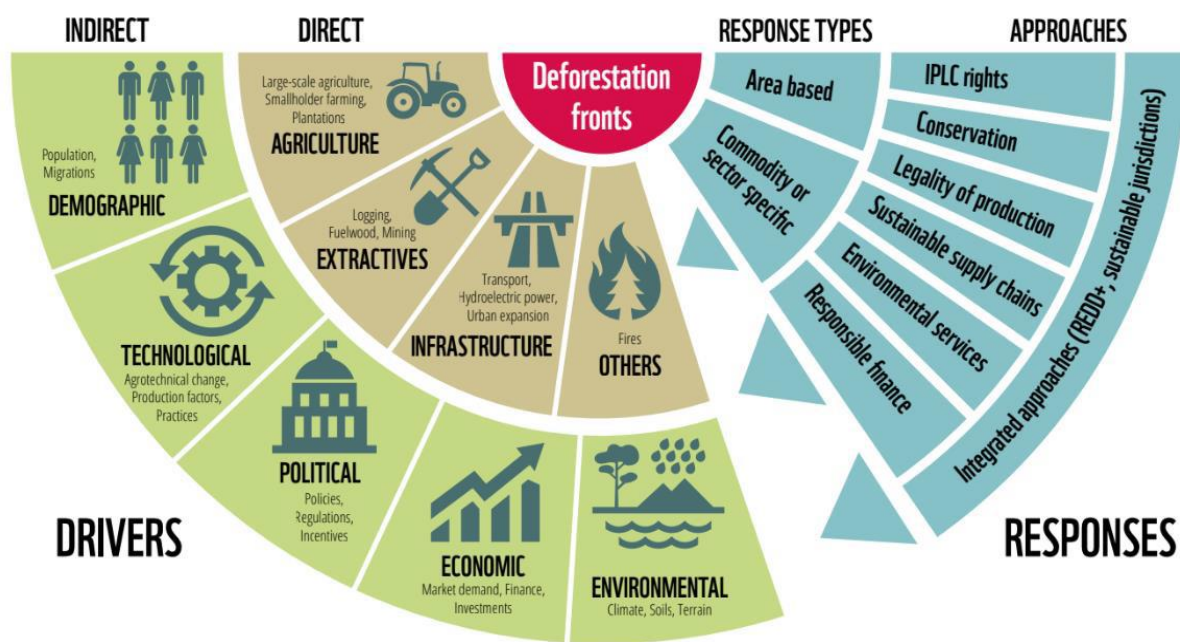


Figure 1. Analytical framework linking drivers of and responses to deforestation. *Source: Pacheco et al. 2021, pp. 7.*

Due to indirect drivers, an oscillation can be observed in deforestation affected countries, such as Brazil or Indonesia. There are 24 hotspots/fronts of deforestation in 30 countries:

Brazil – Amazon and Cerrado region	Columbia – Amazon region, Chocó-Darién region
Peru – Amazon region	Bolivia – Amazon region
Venezuela – Amazon region	Guyana – Amazon region
Paraguay – Gran Chaco region	Argentina – Gran Chaco region
Ecuador – Chaco-Darién region	Mexico – Maya Forests region

<sup>4</sup> WWF: Deforestation fronts: Drivers and responses in a changing world. Link: [https://files.worldwildlife.org/wwfmsprod/files/Publication/file/9bsfj8aq5v\\_deforestation\\_fronts\\_\\_\\_drivers\\_and\\_responses\\_in\\_a\\_changing\\_world\\_\\_\\_summary\\_english.pdf?\\_ga=2.79082973.835873498.1665166025-1349300517.1664970830](https://files.worldwildlife.org/wwfmsprod/files/Publication/file/9bsfj8aq5v_deforestation_fronts___drivers_and_responses_in_a_changing_world___summary_english.pdf?_ga=2.79082973.835873498.1665166025-1349300517.1664970830)

Guatemala – Maya Forests region	Liberia – West Africa region
Ivory Coast – West Africa region	Ghana – West Africa region
Cameroon – Central Africa region	Gabon – Central Africa region
Republic of Congo – Central Africa region	Democratic Republic of the Congo – Central Africa region
Central African Republic – Central Africa region	Angola – Central Africa region
Zambia – East Africa region	Mozambique – East Africa region
Madagascar – East Africa region	Cambodia – Mekong region
Laos – Mekong region	Myanmar – Mekong region
Indonesia – Sumatra region, Borneo region, New Guinea region	Malaysia – Borneo region
Papua New Guinea – New Guinea region	Australia – Eastern Australia region

The 24 deforestation fronts cover an area of 710 million ha, from which 256 million ha are primary/intact forests with rich biodiversity. The mentioned 28 countries would be subject to enhanced scrutiny by the due diligence system and classified as medium and high-risk countries by the Deforestation Regulation.

In order to create effective regulations and international cooperation, it is important to understand why forests are important in the mitigation of the effects of climate change.

Forests perform important and diverse functions; therefore, they are of outstanding importance among terrestrial ecosystems. Forests participate in regulating Earth's climate, sequestering a significant amount of carbon from the atmosphere and maintaining ecological stability. Currently, global climate change shows a general rise in temperature and atmospheric carbon dioxide levels, as well as changes in the amount and distribution of precipitation. Climate change fundamentally affects forests, as it affects the life processes of plant communities through the supply of heat, water and nutrients. It also modifies the structure of forest ecosystems and the disturbances that affect their natural functioning.

The changing climate, therefore, poses a significant threat to forest ecosystems. Although the rising CO<sub>2</sub> concentration stimulates the growth rate of young trees or saplings in the initial phase<sup>5</sup>, in the case of prolonged exposure to higher CO<sub>2</sub> concentrations photosynthesis and biomass accumulation will generally be lower — it is because the trees can adapt over time to the increased atmospheric CO<sub>2</sub> for development with concentration. Warming changes the timing of life cycle events (phenological phases): earlier bud break, leaf fall and flowering in trees. The gradual increase in temperature also changes the regeneration and growth of some species.

<sup>5</sup> Körner, C. 2006. Plant CO<sub>2</sub> responses: an issue of definition, time and resource supply. Link: <https://nph.onlinelibrary.wiley.com/doi/10.1111/j.1469-8137.2006.01886.x>

In parallel with the decreasing soil moisture due to drought, the rate of destruction can also increase in older forests since water is a basic requirement for photosynthesis. The water balance of the growing area is decisive for future forest growth and rising temperatures can lead to drought without an increase in precipitation or in the case of decreasing precipitation. If there is not enough water available for the vegetation, diseases and various damages can occur and, as a result, the distribution boundary can also change. Climate changes significantly affect the nutrient management of forest soils, the dynamics of the decomposition and transformation of organic matter, and the material transport processes.

Depending on their extent, forests can also influence the regional climate, so there is much feedback between climate and forests as a result of climate change. Climate change increases the spread of invasive species, the frequency of their appearance and the severity of their extent and promotes the movement towards invasion in the case of species that were not basically invasive (migration).

Forests are particularly sensitive to changes in climate due to the long lifespan of trees, which prevents their rapid adaptation and the structure of the ecosystem changes as the tree cover changes.<sup>6</sup> One of the most significant threats to forests and their biological diversity is, therefore, climate change — this threat is growing rapidly and also increases the negative effects resulting from other pressures, such as land use change.

## **2.1. The importance of healthy forest ecosystems for their resilience to climate change-related impacts**

Resilience is the ability of the ecosystem to resist external influences and return over time to the pre-disturbance state (a term introduced to describe non-linear dynamics affecting ecosystems).<sup>7</sup> However, in the scientific field of ecology, the definition of resilience is still not clear as there are several approaches. Multiple meanings of ecosystem resilience can lead to different management behaviours, so a definite and measurable definition would be essential. The resilience of forests should be defined in such a way that the ecosystem is able to preserve its “identity” in terms of its taxonomic composition, structure, and ecological functions. The resilience of a given forest ecosystem is significantly influenced by the extent of the community living in the forest, as well as the geographical location of the forest area. In forests, individual ecological communities can occur in a smaller area (several tens to hundreds of hectares), while forests can also occur in hundreds to thousands of square kilometres — therefore it is recommended to separate forest stands and

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<sup>6</sup> Lindner et al. 2010. Climate change impacts, adaptive capacity, and vulnerability of European forest ecosystems. Link: <http://sylvain-delzon.com/wp-content/uploads/2013/02/Lindner-et-al-2010-FEM.pdf>

<sup>7</sup> Holling, C. S. 1973. Resilience and Stability of Ecological Systems. Link: [www.annualreviews.org/doi/abs/10.1146/annurev.es.04.110173.000245](http://www.annualreviews.org/doi/abs/10.1146/annurev.es.04.110173.000245)

forest ecosystems in each case. Most of the available scientific evidence supports the conclusion that the resilience or recovery of forests after disturbance is significantly dependent on biodiversity.

The resistance of the forest ecosystem to changing environmental conditions is determined by its biological and ecological resources, while in the case of forests by the dominant floristic (tree) composition and stand structure. Most well-developed forests are to some extent, especially ancient forests, flexible and resistant to change (thus showing stability) — however, most younger forests are vulnerable. A stable ecosystem survives when it can absorb disturbances and remain largely unchanged (consistent species composition) for long periods of time. Different species play different roles in the ecosystem — their roles are not equally important. The difference in species composition affects the resilience of the ecosystem. At the same time, a specific succession is greatly influenced by local conditions: after a disturbing event, ecosystems return to habitats with favourable micro-conditions the fastest.

Habitat conditions affect ecosystem resilience in a number of ways. In the long term, the climate mainly affects the rate of photosynthesis, respiration, and other forest physiological processes through temperature, radiation, and available moisture. The resilience of the ecosystem at the local level depends significantly on the ability of the area to maintain the necessary infiltration, retain water storage capacity and operate nutrient cycles (which are significantly dependent on soil loss and structural changes). Resilience is also influenced by the size of forest ecosystems (generally, the larger and less fragmented, the better), as well as the state and nature of the surrounding landscape.

Human activities have changed the resilience of forest ecosystems as the cumulative effects of different activities can significantly transform the structure and dynamics of ecosystems. The impact of humans on the forest ecosystem can be observed, among other things, in the reduction of the forest area, the fragmentation of habitats, and the change in the species composition. It can also be said that:

- where population size and genetic diversity have decreased,
- or species mobility is limited by habitat fragmentation,
- or a natural lack of species mobility,

the likelihood of successful adaptation to climate change decreases. The spatial configuration and habitat quality of habitat fragments are changing in a negative direction through changes in the biophysical functions of the landscape, the composition of fauna and flora, and the loss of natural habitats.<sup>8</sup> Different fragmentation patterns (i.e., geometric, corridor, herringbone, diffuse, radial, and

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<sup>8</sup> Bennett, K.D. 1985. The spread of *Fagus grandifolia* across eastern North America during the last 18,000 years. Link: [www.jstor.org/stable/2844838](http://www.jstor.org/stable/2844838)

island) contributed to different survival and distribution rates of deforestation-induced species.

### 2.1.1. The impact of habitat fragmentation on resilience

Forests with different tree compositions react differently to the fragmentation of habitats. Species with large or heavy seeds have difficulty or cannot bridge the distances associated with habitat fragmentation, but also the reproduction of oaks and beeches in fragmented areas is significantly dependent on the presence of certain animal species.<sup>9</sup> By dispersing their seeds and pollen, forest plant species can preserve their genetic diversity — thus, their resistance to the effects of climate change. However, anthropogenic effects affecting the landscape and the gene pool (such as habitat fragmentation) reduce this capacity. The fragmentation of forest populations can have a detrimental effect on the genetic and reproductive status of the populations. The most significant anthropogenic factor, which increases the fragmentation of habitats in addition to the development of agricultural areas, is road construction and infrastructure expansion.

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*This has a very serious impact on the resilience to climate change, as it can cause changes in the species' composition and behaviour due to the reduction of the habitat area. It also leads to a deterioration of the quality of the remaining habitats and hydrological changes occur (the runoff changes, thus, the connection of the water systems), and the stress effect on the species increases because of this.*

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The stress resulting from habitat fragmentation typically begins when the first road construction begins in a contiguous natural area, and then the landscape is further “perforated” with related developments (this involves further road network development, energy infrastructure development, earthworks, etc.). The resistance of the shrinking habitat patches is decreasing in parallel. The environmental conditions of the larger habitat fragments are more diverse (soil, wetlands, geological and topographical differences), which are able to accommodate more species. On the other hand, it is also important to avoid excessive fragmentation of habitats. In areas connected at least by ecological corridors, animals and plants can more easily migrate from other patches to replace potentially struggling or declining species (the proximity and connection of similar habitat patches allow movement).

Although not perfect substitutes for large and contiguous areas of natural habitat, ecological corridors often allow many small populations to function effectively as

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<sup>9</sup> Scolozzi R., Geneletti D. 2012. A multi-scale qualitative approach to assess the impact of urbanization on natural habitats and their connectivity. Link: [www.researchgate.net/publication/257048663\\_A\\_multi-scale\\_qualitative\\_approach\\_to\\_assess\\_the\\_impact\\_of\\_urbanization\\_on\\_natural\\_habitats\\_and\\_their\\_connectivity](http://www.researchgate.net/publication/257048663_A_multi-scale_qualitative_approach_to_assess_the_impact_of_urbanization_on_natural_habitats_and_their_connectivity)

viable populations. Ecological corridors increase the connectivity of many species, including vertebrates, arthropods and plants. Good examples of ecological corridors that are still working effectively today include the corridors connecting the park network in Bhutan, the Terai Arc Landscape, which connects 14 different protected areas in:

- India
- Nepal
- the southwestern United States Lower Rio Grande Valley National Wildlife Refuge
- the European Green Belt, which stretches from the Finnish-Russian border all the way through the Balkans.

### 2.1.2. The health of the forest ecosystem

Forest ecosystems play a multifunctional role; ecosystem services, which cover the benefits provided by ecosystems to people, can be of different magnitudes for different forest areas. Although the concept of ecosystem services is human-centred (it focuses on why nature is useful for people), it also points out that the healthy functioning of ecosystems is the basis for this functioning.

Assessing the effects of environmental changes is particularly challenging in forest ecosystems, which are long-lived and often respond persistently to changes. However, multiple stress events can have a detrimental effect on the long-term health of trees. Different forest ecosystems respond differently to stress, and individuals, populations, communities, and ecosystem levels within the same ecosystem may respond differently. As a result of stress, the energy and nutrient circulation of a given ecosystem changes, as well as the ecological structure of the community (on a general level).

In a forest ecosystem, although trees are the defining elements of the forest, their relationship and interaction with other biotic and abiotic features are much more complex, which makes up a healthy forest ecosystem. The health of the ecosystem is a very complex concept, the importance of which was already emphasised in the 1940s. However, opinions and positions on a healthy ecosystem are not uniform from the point of view of ecologists. Certain definitions place human interests in the centre of the ecosystem — thus, at the centre of the health of forests (healthy ecosystems must be in line with human interest). Other views consider the natural role of the ecosystem to be important and within which humans are only a secondary factor (humans only benefit but play a secondary role to the structure and functions of the ecosystem).

The health of forests is relative and difficult to measure but there are parameters that can be used to measure the health of a forest ecosystem: the ability to react to negative stress conditions, respond to changes caused by a disaster, and/or recover from a disaster at the landscape level.

Examples of parameters for measuring the health of forests are:

- How self-sustaining is a given forest ecosystem; whether their physical environment and biological resources can support or not provide basic resources (water, nutrients, light, and growth space) in at least some stages of succession;
- What is the succession stage of the forest, the stand structure, and how diverse are all the ecosystem processes (it provides a habitat for many native species);
- Is it able to maintain the ecosystem function from the forest management side (from the human social and economic side).

According to the majority of scientific opinions,<sup>10</sup> there is no such thing as an absolutely healthy forest ecosystem, but health is a relative indicator of the state of the ecosystem.

The health of the forest includes the adequate supply of soil, water and air, as well as their interaction with the forest's entire fauna. A healthy forest ecosystem is, at the same time, a natural resource bank, a biological gene bank, and an energy storage bank. It plays a decisive role in improving the Earth's ecological environment and maintaining the ecological balance. Forests are also of great strategic importance from the point of view of the sustainable development of the human economy. For developing countries, they provide an opportunity to get rid of poverty; thus, protecting a healthy forest ecosystem in these countries is also a local interest. The integrity and sustainability of forest ecosystems and the balance between human society and ecosystem are therefore important because the world's poorest social groups are more dependent on forest biodiversity and ecosystem services than others — mainly, Africa and Asia, but also certain residents of Latin America).

## **2.2. How currently deforestation affects the resilience of forest ecosystems to climate change, how it contributes to emissions, and to forests' ability to adapt to climate change**

Forests currently cover 31 % of the world's land area. More than half of the world's forests are found in just five countries and two-thirds (66 %) in ten countries. There is also a significant number of areas that are — although they cannot be classified as forests by definition — at the same time areas covered with trees and similar to forests. According to estimates, around 420 million hectares of forest have been destroyed as a result of deforestation since 1990, although the rate has decreased in the last 5-6 years.<sup>11</sup> Deforestation is a major concern as the world's forests play a

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<sup>10</sup> J. A. Burger. 2004. SOILS BIOLOGY AND TREE GROWTH | Soil and its Relationship to Forest Productivity and Health. Link: [www.sciencedirect.com/science/article/pii/B0121451607002404](http://www.sciencedirect.com/science/article/pii/B0121451607002404)

<sup>11</sup> FAO and UNEP. 2020. The State of the World's Forests 2020. Link: [www.fao.org/3/ca8642en/ca8642en.pdf](http://www.fao.org/3/ca8642en/ca8642en.pdf)

significant role in the global carbon cycle (thereby having a major impact on climate change). Since the 1990s, the carbon stocks in forest biomass have decreased — mainly in Africa, Asia and South America. Although they have increased in other regions, a general decrease can be observed at the global level. The reduction of forest areas contributes to the unfavourable development of the global carbon balance, which in turn aggravates the disturbances affecting forest ecosystems (e.g., increase in the frequency of forest fires, intensification of drought, increase in the intensity of rain from storms, the proliferation of pests, colonisation of invasive species). Strong disturbances increase the degradation of forests.

Today, about 80 % of deforestation occurs due to agricultural reasons. The expansion of commercial agriculture (large-scale and small-scale land-use change) and various tree plantations are by far the biggest drivers of deforestation, and land speculation plays a significant role in many local contexts. However, in addition to agriculture, we can also find other activities responsible for deforestation, the most significant of which are, e.g., mining, infrastructure expansions, urban expansion, firewood production, and forest fires. The main causes of deforestation differ from continent to continent. In Latin America, mainly cattle breeding and, in parallel, the cultivation of soybeans for feed purposes, as well as the production of raw materials for the production of biofuels. Tree and oil palm plantations are a trend that is spreading in several regions in South Asia and Africa, as more and more small producers are growing products that are associated with deforestation, such as cocoa, oil palm, corn, and cattle — some of which are exported. In Europe, mainly infrastructure expansion or illegal logging contribute to the decline of forest health. Regardless of the continent, deforestation can also be observed where mining activities or the expansion of human settlements take place. Illegal large-scale logging, often to supply international timber markets, also leads to forest destruction, which is often followed by deforestation. However, in addition to large-scale logging, or instead of it, small-scale logging has been spreading in recent years, the purpose of which is to extract firewood and use it in the construction industry. More than a third of the total global deforestation in the last 20 years occurred in the tropics (approx. 35 %), another part was observed in the boreal forests (27 %), but temperate and subtropical forests were also affected in a similar proportion (approx. 20 %). The number of areas and locations affected by deforestation continued to increase worldwide in recent years (although the extent of deforestation decreased proportionally in certain areas, new locations appeared on the world map where the problem became identifiable).

### **2.2.1. Fragmentation of forest ecosystems**

It should be emphasised that the final deforestation in an area is often preceded by the fragmentation of the forest area. Habitats fragmented by anthropogenic effects, in combination with other stress factors, modify the reactivity, adaptability, and resistance of many species. As a result, forest ecosystems are already exposed to danger during the period of fragmentation. The rate of fragmentation that threatens



healthy forest ecosystems has increased worldwide in recent years. The main reason for fragmentation is, in addition to other activities (e.g., agricultural use), suburbanization and the gradual expansion of road networks, as well as the related energy and other infrastructure developments (expansion of utility corridors). In addition to being processes associated with earthworks (disturbing, disturbance), these also cause a fundamental change in its surface cover (natural vegetation is replaced by asphalt and concrete). Breaking down the groundwater management system leads to the mortality of the surrounding trees and other species.<sup>12</sup> It should also be mentioned that forests contain numerous wetlands (rivers, streams) and associated underground water networks and ecosystems. The fragmentation of terrestrial forest habitats often leads to the fragmentation of river and stream networks. The development of roads and related infrastructure changes the direction of surface and subsurface water flows. This effect further increases when the runoff is directed into drainage ditches and culverts. The destruction and extermination of trees and vegetation along the water significantly disturb the wetlands of the forest, as leaves and other plant remains that fall into the water often form the basis of the food network of small streams and rivers. The fragmentation of forest wetlands also has a negative impact on aquatic species, as it usually involves the loss of access to quality habitats for one or more life stages of certain species.

## 2.2.2. The relationship between fragmentation of forest areas and carbon dioxide emissions

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*Carbon dioxide storage in forest biomass is an important feature of healthy forest ecosystems and a key link in the global carbon cycle.*

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After carbon dioxide is converted into organic matter through photosynthesis, the carbon is stored in various forms in forests for a period of time before being released back into the atmosphere through decomposition or disturbance. Significant carbon stock is stored in woody biomass (roots, trunks and branches), while another part of the carbon stock is found as organic matter in the forest soil.

The fragmentation of forested areas leads to changes in the amount of carbon stored in forests. Fragmented habitats retain carbon in the biomass and soil — which would otherwise be released during complete deforestation. The amount of stored carbon also depends on the total extent of the given forest fragment, carbon density, and the ability of the forest structure and functions to retain it over time. The carbon storage capacity of the utilisation of the former forest area also depends on the carbon density of the alternative land use. Forest fragments retain a relatively small amount of the biomass carbon stored in the original forest. Where deforested areas

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<sup>12</sup> Laurence, W. F. et al. 2017. An Amazonian rainforest and its fragments as a laboratory of global change. Link: <https://onlinelibrary.wiley.com/doi/abs/10.1111/brv.12343>

have low-carbon pastures or annual crops, they can still store more biomass carbon than all other land uses combined (based on biomass estimates)<sup>13</sup>. Secondary forests can take more than 100-200 years to reach the biomass of primary forests.<sup>14</sup> Therefore, the continued loss of primary forests from fragmented landscapes can reduce carbon storage even where total forest cover is stable or increasing. Climate change will directly affect carbon emissions from forest fragments through plant growth and death. Soil carbon stocks are less sensitive to deforestation than carbon stored in biomass. The loss of carbon in the soil after deforestation occurs mostly in the first few years and soils in wetter areas lose more carbon than those in drier areas.

Protecting and restoring fragmented areas can help mitigate climate change by reducing emissions and increasing sinks. On the other hand, when larger, non-fragmented forest areas are nearby, protecting them (when prioritising) is often more effective — unless the forest fragments have a higher carbon density.

Almost three-quarters of European forests have an even age distribution, of which about 64 % are already beyond the renewal phase but have not yet reached the mature phase (Forest Europe 2020). Although the forest population is increasing in Europe thanks to forest plantations (since the 1990s, the extent of forest areas has increased by 25 %), the condition of the forests shows a worsening trend, mainly due to deciduous individuals. Regarding the disturbances, a clear regional pattern emerges: forest fires are more significant in the Mediterranean regions, while storm damage is more significant in the central and north-western areas. Nevertheless, in recent years a kind of shift can be observed due to the increase in heat waves and drought: forest fires have become more and more frequent in Central European areas as well. The damage caused by various pathogens and insects varies on the continent (at the same time, they may become more frequent due to increasing stress effects).

In terms of the distribution of the entire European continent, the area of Central Europe has the least amount of forest area, — even in the eastern areas of Central Europe (27.3 %), slightly less than in the West (27.9 %). The proportion of areas classified as other forests, covered with trees but which cannot officially be called forests, is also the lowest in the Central European region (in the eastern region, in the Czech Republic and Poland, this ratio is zero percent). The proportion of forests available for wood supply in the eastern areas of Central Europe is less than 80 %. The average stocking density in European forests is 169.1 m<sup>3</sup>/ha, of which the highest

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<sup>13</sup> Fearnside, P. et al. 2015. Biomass and greenhouse-gas emissions from land-use change in Brazil's Amazonian "arc of deforestation": The states of Mato Grosso and Rondônia. Link: [www.researchgate.net/publication/267711768\\_Biomass\\_and\\_greenhouse-gas\\_emissions\\_from\\_land-use\\_change\\_in\\_Brazil's\\_Amazonian\\_'arc\\_of\\_deforestation'\\_The\\_states\\_of\\_Mato\\_Grosso\\_and\\_Rondonia](http://www.researchgate.net/publication/267711768_Biomass_and_greenhouse-gas_emissions_from_land-use_change_in_Brazil's_Amazonian_'arc_of_deforestation'_The_states_of_Mato_Grosso_and_Rondonia)

<sup>14</sup> Mascaro, J. et al. 2012. Novel forests maintain ecosystem processes after the decline of native tree species. Link: [www.researchgate.net/publication/262090236\\_Novel\\_forests\\_maintain\\_ecosystem\\_processes\\_after\\_the\\_decline\\_of\\_native\\_tree\\_species](http://www.researchgate.net/publication/262090236_Novel_forests_maintain_ecosystem_processes_after_the_decline_of_native_tree_species)

values can be measured in the forests of the eastern areas of the Central European region (254.6 m<sup>3</sup>/ha). The annual growth of the production stock intended for the production of wood has stagnated in all regions of Europe but shows a smaller growth trend in the eastern part of Central Europe (this is due to the significant growth experienced in Romanian areas). In other parts of Europe, the reason for the slowdown in the trend of population growth is partly the slowdown in the expansion of forest areas, as well as the increasingly significant stress effects that cause forest degradation.

The amount of carbon stored in biomass per hectare is the highest in the forest areas of Central Europe — on the other hand, only half of this amount can be found in the southern and northern areas. In recent years, the stress effects caused by climate change, especially drought stress, have strongly affected deciduous beeches, which are also found in large numbers in the eastern areas of Central Europe. The effects caused by climate stress, therefore, affect this particularly sensitive region, and the invasive pests and pathogens that multiply as a result further increase the risk to the health and vitality of the trees. The stress effect of these forests in the eastern areas of Central Europe is exacerbated by the fact that, similarly to Northern Europe, the number of forest patches (the proportion of fragments) has increased here in the last 20 years, the most significant reason being the expansion of the infrastructure and the utility corridors connected to it.

### **2.2.3. Adaptation of forest ecosystems to climate change-regeneration**

Wherever possible, the natural regeneration of forests should be increased because this favours the effective defence of the forest population against climate change as it helps the evolutionary processes taking place in the forest (natural regeneration in a changing environment enables natural selection).

With appropriate forest management practices, we can significantly contribute to improving the adaptation capacity of forests to climate change; however, each type of forest (according to zonality) can be protected with different adaptation strategies. In boreal and mountainous areas, we can help adapt to climate change by increasing the intensity and frequency of thinning (high stand density can increase the sensitivity of forests to biotic and abiotic disturbances) — because, here, the growth rate of tree stands accelerates due to the warming climate. While in the case of forests located in moderate bioclimatic conditions, such as in the majority of forests in Central Europe, it is important that, in addition to the reform of care and thinning practices, the focus is on increasing stock density and species diversity (the goal here is to increase stock stability and mitigate drought situations). In the warmer, Mediterranean areas, the biggest challenge is the lack of water; there, similarly to forest management practices in temperate areas, the priority is to maintain stock density and biodiversity (greater water retention).

Exploring the synergies of climate change is vital for the protection of forest ecosystems. In natural or near-natural systems, the multiple effects of different

stresses are greater than the simple sum of the individual effects; with the continuous decrease in biodiversity, those social groups whose livelihoods are closely linked to forests are in danger. This increases the number of climate refugees, which further threatens the integrity of forest ecosystems in some regions. Deforestation and forest destruction is a global problem, but it unfolds differently at the regional level.

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*In addition to ensuring the long-term livelihood of communities, the practice of sustainable forest management can reduce the rate of conversion of forests to non-forest uses. Reducing the rate of deforestation and forest destruction reduces GHG emissions: based on IPCC estimates, the inherent potential is about 0.4–5.8 Gt CO<sub>2</sub> per year (IPCC 2022).*

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### 3. The EU Deforestation Law from the perspective of climate mitigation and adaptation

#### 3.1. General summary of the Deforestation Regulation

Despite the fact that in Europe the net forest area has been increasing since the end of the 20<sup>th</sup> century, by importing and consuming specific products the EU has a significant share in the global ongoing deforestation and forest degradation. The EU was among the first to identify the problem which led to the birth of EU forest policies. The formulation of forest policies is the competence of the Member States within a clearly defined framework of established ownership rights and with a long history of national and regional laws and regulations based on long-term planning.

The EU Forestry Strategy was adopted in 1998. Its main goal was to promote sustainable forest management and the multifunctional role of forests. The next great step for forest policies was the publication of the European Green Deal in 2019 —a growth strategy that “*aims to transform the EU into a fair and prosperous society, with modern, resource-efficient and competitive economy where there are no net emissions of greenhouse gases in 2050 and where economic growth is decoupled from resource use*”<sup>15</sup>. Forests are involved in various forthcoming strategies which contribute to the implementation of the European Green Deal, but the most significant are the EU 2030 Biodiversity Strategy and the Farm to Fork Strategy. Both strategies’ overall objective is to lay down the basic principles for peaceful coexistence between humanity and natural ecosystems within the European Union.

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*Even though, within the territory of the European Union, the existing policies and regulations have led to an **increase in the net forest area** (despite showing a substantial reduction in the rate of gain since 2010), **other continents are still facing severe deforestation and forest degradation** — in South America and Africa it is 2.5-5 million hectares per year.*

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The EU is a relevant consumer of commodities associated with deforestation in other countries; therefore, it has important responsibility to take steps for decoupling its import — and export — from global forest area reduction and degradation.

The policy for minimising the trade and consumption of commodities and products associated with deforestation was first concretised by publishing the proposal of the

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<sup>15</sup> European Commission. 2019. The European Green Deal. Link: [https://eur-lex.europa.eu/resource.html?uri=cellar:b828d165-1c22-11ea-8c1f-01aa75ed71a1.0002.02/DOC\\_1&format=PDF](https://eur-lex.europa.eu/resource.html?uri=cellar:b828d165-1c22-11ea-8c1f-01aa75ed71a1.0002.02/DOC_1&format=PDF)

“Commission Communication on Stepping up EU Action to Protect and Restore the World’s Forests”<sup>16</sup> in 2019. There, the Commission committed to

*“assess additional demand side regulatory and non-regulatory measures to ensure a level playing field and a common understanding of deforestation free supply chains. It aims to increase supply chain transparency and minimise the risk of deforestation and forest degradation associated with commodity imports in the EU.”*

The main goal of this proposal is to halt global forest cover loss by 2030, thus improving people’s health and livelihoods, and ensuring a healthy planet for the upcoming generations. The proposal is an integral part of, and coherent with, the overall objectives of the European Green Deal.

The evolution of forest policies has led to the creation of the *Proposal for a Regulation of the European Parliament and of the Council on the making available on the Union market as well as export from the Union of certain commodities and products associated with deforestation and forest degradation and repealing Regulation (EU) No 995/2010*.

General features of the Deforestation Regulation by topics are examined below.

### 3.1.1. Relevant commodities

- It covers over 50 products related to coffee, cocoa, palm oil, soy, beef, and wood commodities which are, based on scientific research, **the most responsible for deforestation and forest degradation**. The scope of the regulation could be extended within two years to other commodities and ecosystems.
- It is important to ensure that **feed used for livestock falling under the scope of this Regulation does not lead to deforestation**. Therefore, operators placing on or exporting from the Union market relevant products that contain or have been made using cattle — which have been fed with relevant products that contain or have been made using other relevant commodities — should ensure, as part of their due diligence process, that the feed originates from deforestation-free supply chains.
- Used commodities and **products that have completed their lifecycle** — and would otherwise be disposed of as **waste** — should be **excluded** from the scope of this Regulation.

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<sup>16</sup> European Commission. 2019. *Stepping up EU Action to Protect and Restore the World’s Forests*. Link: [https://ec.europa.eu/info/sites/default/files/communication-eu-action-protect-restore-forests\\_en.pdf](https://ec.europa.eu/info/sites/default/files/communication-eu-action-protect-restore-forests_en.pdf)

### 3.1.2. Definitions

- The definition of forest degradation should be created based on internationally agreed notions while ensuring that the associated obligations can be easily implemented by operators and competent authorities.

### 3.1.3. Expected result

- Relevant products from supply chains related to deforestation and forest degradation are not placed on the Union market, nor exported from the Union market, unless they are deforestation-free and have been produced in accordance with the relevant legislation of the country of production.

### 3.1.4. Obligated parties

- Operators should take the appropriate steps in order to ascertain that the relevant products that they intend to place on the Union market comply with the deforestation-free and legality requirements of this Regulation.
- Operators should establish and implement due diligence procedures, which include two elements:
  - information requirements — provide access to information about the sources and suppliers of the commodities and products being placed on the Union market, including information demonstrating that the absence of deforestation and forest degradation; and
  - risk assessment — based on the information of the aforementioned item, the operators should carry out a risk assessment. Where a risk is identified, operators should mitigate such risk to achieve no or negligible risk.
- Operators should formally assume responsibility for the compliance of the relevant products that they intend to place on the Union market or to export by making available due diligence statements.
- In order to foster transparency and facilitate enforcement, operators which do not fall under the categories of SMEs, microenterprises, or natural persons should, on an annual basis, publicly report on their due diligence system, including on the steps taken to implement their obligations.
- Competent authorities should carry out checks at regular intervals on operators and traders to verify that they effectively fulfil the obligations laid down in this Regulation.
- Competent authorities should cooperate with each other, with customs authorities of the Member States, and with the Commission, as well as with the administrative authorities of third countries.

### 3.1.5. Differentiate by the country of origin

- Operators sourcing commodities and products from countries or subnational jurisdictions thereof that present a low risk of growing, harvesting, or producing relevant commodities in violation of this Regulation should be subject to fewer obligations (simplified due diligence), thereby reducing compliance costs and administrative burden.

- Commodities and products from high-risk countries or subnational jurisdictions thereof should be subject to enhanced scrutiny by the competent authorities.

### 3.1.6. Supporting mechanisms

- The Commission should set up and manage an information system to support the operators and the competent authorities in presenting and accessing the necessary information on relevant products placed on the market.
- It is necessary to set up electronic interfaces that allow automatic data transfer between customs systems and the Information System of competent authorities.

## 3.2. Coherence with EU policies

Climate and forest policies have always had close connections in the European Union. In policy measures, forests have key roles: **carbon sinks**, **storage** and **substitution** contribute to the reduction of greenhouse gases in the atmosphere, while forest restorations ensure that forests continue to grow and provide many other services. Forests — along with agriculture and the land use sector — as carbon sinks play an essential role in the transition to **climate neutrality** in the Union.

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*Global forest areas are not only providing essential services but, when affected by climate change, they could pose a serious threat to local communities with forest fires. Recent extreme events have already had substantial impacts on ecosystems, affecting carbon sequestration and storage capacities of forest and agricultural land.*

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These factors highlight the importance of forests in favour of reaching any climate goals. This chapter analyses the coherence of the EU deforestation law with the recent climate related strategies.

### 3.2.1. Green Deal and the European Climate Law

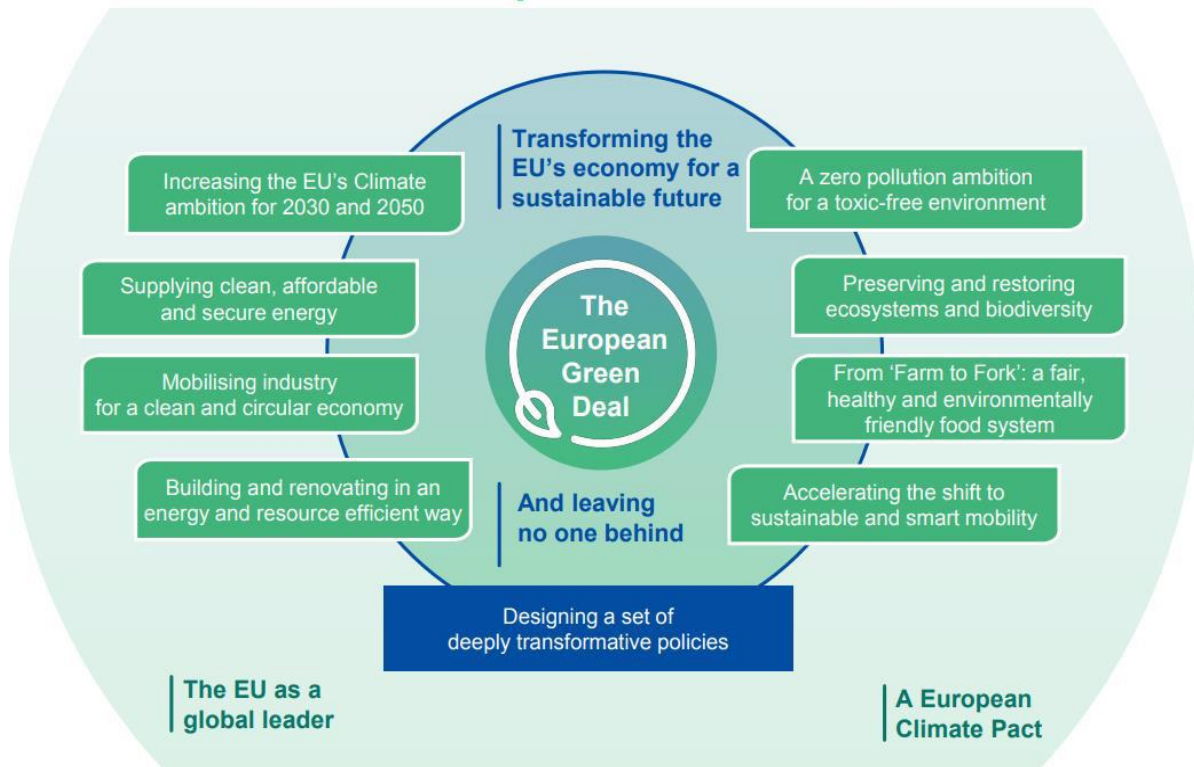
The publishing of the proposal of the European Green Deal was one of the first acts of the newly appointed European Commission in 2019.<sup>17</sup> Its core goal is to make Europe the first climate-neutral continent in the world. The proposal aims to make all sectors of the EU's economy fit to meet this challenge. They set the EU on a path to reach its climate targets by 2030 in a fair, cost-effective and competitive way. As *Figure 2* shows, the European Green Deal and the forthcoming strategies, and acts covering all main sectors of the EU.

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<sup>17</sup> European Commission. 2019. The European Green Deal. Link: [https://eur-lex.europa.eu/resource.html?uri=cellar:b828d165-1c22-11ea-8c1f-01aa75ed71a1.0002.02/DOC\\_1&format=PDF](https://eur-lex.europa.eu/resource.html?uri=cellar:b828d165-1c22-11ea-8c1f-01aa75ed71a1.0002.02/DOC_1&format=PDF)



# The European Green Deal



The European Green Deal is not only a commitment to reach climate neutrality, but it is functioning as an agenda for renewing or creating strategies for reaching its goals. Regarding climate and forest policies the following documents were published:

December 2019	European Green Deal
May 2020	EU Biodiversity Strategy for 2030
May 2020	Farm to Fork Strategy
June 2021	European Climate Law
July 2021	new EU Forest Strategy for 2030
February 2021	EU Strategy on Adaptation to Climate Change
December 2019–ongoing	EU and the national long-term strategies

Figure 3. Publication of forest policy related documents. Source: [ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal](https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal).

The European Climate Law writes into law the goal set out in the European Green Deal for Europe's economy and society to become climate-neutral by 2050. The law also sets the intermediate target of reducing net greenhouse gas emissions by at

least 55 % by 2030, compared to 1990 levels. The law aims to ensure that all EU policies contribute to this goal and that all sectors of the economy and society play their part. The European Climate Law sets a **legally binding target of net zero greenhouse gas emissions by 2050**. The EU Institutions and the Member States are **bound to take the necessary measures** at the EU and national level to meet the target, taking into account the importance of promoting fairness and solidarity among the Member States.

Combating deforestation and forest degradation constitutes an important part of the **package of measures** needed to **reduce greenhouse gas emissions** and to comply with the Union's commitment under the European Green Deal, as well as with the 2015 Paris Agreement on Climate Change and with the legally binding commitment under the EU Climate Law to reach climate neutrality by 2050 and reduce greenhouse gas emissions by at least 55 % below 1990 levels by 2030.

### 3.2.2. EU Biodiversity Strategy for 2030<sup>18</sup>

The EU's Biodiversity Strategy for 2030 is a comprehensive, ambitious, and long-term **plan to protect nature and reverse the degradation of ecosystems**. The strategy aims to put Europe's biodiversity on a path to recovery by 2030 and contains specific actions and commitments. In order to reach its aims, the strategy defines specific measures:

- Creation of a coherent network of protected areas – At least 30 % of the land and 30 % of the sea should be protected in the EU.
- Define, map, monitor, and strictly protect all the EU's remaining primary and old-growth forests.
- Creation of a new EU Nature Restoration Plan – The plan aims to help improve the health of existing and new protected areas and bring diverse and resilient nature back to all landscapes and ecosystems.
- The Commission will put in place a new European biodiversity governance framework with a monitoring and review mechanism – This will include a clear set of agreed indicators and will enable regular progress assessment and set out corrective action if necessary.
- Building on an integrated and whole-of-society approach – The Commission will help to build a European Business for Biodiversity movement, taking inspiration from recent initiatives and making this movement an integral part of the European Climate Pact. Particular attention will be paid to measures to incentivise and eliminate barriers to the take-up of nature-based solutions, as these can lead to significant business and employment opportunities in various sectors and are the key to innovation for economic or societal needs that rely on nature.
- The EU prioritises biodiversity in internal and external actions – The Union is ready to raise the level of ambition and commitment worldwide.

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<sup>18</sup> European Commission. 2020. *EU Biodiversity Strategy for 2030 Bringing nature back into our lives*. Link: [https://eur-lex.europa.eu/resource.html?uri=cellar:a3c806a6-9ab3-11ea-9d2d-01aa75ed71a1.0001.02/DOC\\_1&format=PDF](https://eur-lex.europa.eu/resource.html?uri=cellar:a3c806a6-9ab3-11ea-9d2d-01aa75ed71a1.0001.02/DOC_1&format=PDF)

Regarding the connection between forests and climate change, the strategy states that “the biodiversity crisis and the climate crisis are intrinsically linked. Climate change accelerates the destruction of the natural world through droughts, flooding, and wildfires, while the loss and unsustainable use of nature is in turn a key driver of climate change. But just as the crises are linked, so are the solutions. Nature is a vital ally in the fight against climate change.” Therefore, the EU must increase the quantity, quality and resilience of its forests (notably against fires, drought, pests, diseases, and other threats likely to increase with climate change).

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*The strategy is highlighting that **not only forests are important** for the mitigation of climate change, but so are peatlands, grasslands, wetlands, mangroves and seagrass meadow; thus, these areas should also be strictly protected.*

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### 3.2.3. Farm to Fork Strategy – For a fair, healthy and environmentally friendly food system<sup>19</sup>

The Farm to Fork Strategy is a new comprehensive approach to how Europeans value food sustainability while ensuring food security (quantity) and quality. The Strategy aims toward the following:

- Ensuring that the food chain — covering food production, transport, distribution, marketing and consumption — has a **neutral or positive environmental impact**, preserving and restoring the land, freshwater and sea-based resources on which the food system depends;
- Ensuring **food security, nutrition and public health** — making sure that everyone has access to sufficient, nutritious, sustainable food; and
- Generating fairer economic returns in the supply chain so that ultimately the most sustainable food also becomes the most affordable.

A new green financial business model and investments are needed to accelerate the implementation of the Strategy — in which the whole agribusiness sector has to be involved. The first main step forward was the adoption of the new Common Agricultural Policy (CAP) in 2021. New features of the CAP regarding forest and climate policy are:

- Eco-schemes as CAP's second pillar will support many types of voluntary actions going beyond conditionality and other relevant obligations — e.g., practices related to better nutrient management, agro-ecology, agroforestry, carbon farming or animal welfare (among many others).
- Farmers will also increase their contribution to biodiversity by, in principle, devoting at least 4 % of their arable land to non-productive features and areas,

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<sup>19</sup> European Commission. 2020. *A Farm to Fork Strategy for a fair, healthy and environmentally-friendly food system*. Link: [https://food.ec.europa.eu/system/files/2020-05/f2f\\_action-plan\\_2020\\_strategy-info\\_en.pdf](https://food.ec.europa.eu/system/files/2020-05/f2f_action-plan_2020_strategy-info_en.pdf)

including fallow land. The obligatory minimum for such non-productive features will be 3 % — where farmers “top up” that total to 7 % through an eco-scheme, or where farmers devote significant additional land to catch crops or nitrogen-fixing crops.

- To ensure that the contribution of the CAP to climate action is correctly measured and accounted for, the Commission will propose an improved methodology, to be in place as of 2026 at the latest.
- Member States will have to spend at least 35 % of their respective rural development budgets on action on the environment, climate and animal welfare.

The Farm to Fork Strategy shows a close connection with the proposal of the Deforestation Law focusing on promoting the global transition to reach a sustainable agri-food system. The Strategy, which was published in May 2020, mentions the creation of the legislative proposal to reduce the EU’s contribution to global deforestation and forest degradation in 2021.

Appropriate EU policies, including trade policy, will be used to support and be part of the EU’s ecological transition. The EU will seek to ensure that there is an ambitious sustainability chapter in all EU bilateral trade agreements. It will ensure full implementation and enforcement of the trade and sustainable development provisions in all trade agreements.

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*The EU will engage actively with trading partners, especially with developing countries, to accompany the transition towards the more sustainable use of pesticides to avoid disruptions in trade and promote alternative plant protection products and methods.*

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### 3.2.4. EU Strategy on Adaptation to Climate Change<sup>20</sup>

Halting all greenhouse gas emissions would still not prevent the climate impacts that are already occurring. These will continue for decades, even if global and European efforts to cut greenhouse gas emissions prove effective. The key to maintain functional economic, social and environmental structures and processes, their resilience, and adaptive capacity has to be improved.

The new strategy sets out how the European Union can **adapt to the unavoidable impacts of climate change and become climate resilient by 2050**. The Strategy has four main objectives:

- Smarter adaptation – improving knowledge and managing uncertainty; develop effective and inclusive governance mechanisms that ensure

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<sup>20</sup> European Commission. 2021. Forging a climate-resilient Europe - the new EU Strategy on Adaptation to Climate Change. Link: <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52021DC0082&from=EN>

dialogue between policymakers and scientists; gathering data on climate-related risk and losses.

- Faster adaptation – speeding up adaptation across the board: the EU increased the spending target for climate action to 30 % in its long-term budget for 2021-2027, with adaptation as a key component; climate resilience decision support systems and technical advice must become more accessible and rapid to foster their take-up.
- More systematic adaptation – support policy development at all levels and sectors: improving adaptation strategies and plans; support the local uptake of data, digital and smart solutions related to climate adaptation tailored to local and regional specificities; integrating climate resilience in national fiscal frameworks; implementing nature-based solutions on a larger scale.
- Stepping up international action for climate resilience: The EU will promote sub-national, national and regional approaches to adaptation, with a specific focus on adaptation in Africa, Small Island Developing States (SIDS), and Least Developed Countries (LDCs); additional international finance for climate change adaptation, both from public and private sources; the EU will provide targeted support to partner countries to help unlock existing and new financial resources towards climate adaptation.

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*The Strategy on Adaptation to Climate Change highlights the importance of promoting nature-based solutions — in which protecting and restoring wetlands, peatlands, coastal and marine ecosystems; developing urban green spaces and installing green roofs and walls; and promoting and sustainably managing forests and farmland will help adapt to climate change in a cost-effective way.*

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The Commission will facilitate the broadening of the supply of suitable high-quality plant reproductive material to support adaptation in agriculture, forestry, and land ecosystem management.

### 3.2.5. EU Forest Strategy for 2030<sup>21</sup>

Forests and other wooded land cover over 43.52 % of the EU's land space and this number has been constantly increasing since the end of the 20<sup>th</sup> century. While the forest area has become bigger in the last decades thanks to natural processes, afforestation, sustainable management and active restoration, and while this has resulted in several trends moving upwards, the forest conservation status should be considerably improved, including in the 27 % of the EU forest area that is protected.

Climate change continues to negatively affect European forests, particularly but not only in areas with mono-specific and even-aged forest stands. Climate change has also brought to light previously hidden vulnerabilities aggravating other destructive

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<sup>21</sup> European Commission. 2021. *Forging a climate-resilient Europe - New EU Forest Strategy for 2030*. Link: [https://eur-lex.europa.eu/resource.html?uri=cellar:0d918e07-e610-11eb-a1a5-01aa75ed71a1.0001.02/DOC\\_1&format=PDF](https://eur-lex.europa.eu/resource.html?uri=cellar:0d918e07-e610-11eb-a1a5-01aa75ed71a1.0001.02/DOC_1&format=PDF)

pressures, such as **pests, pollution, and diseases**, and it affects forest fire regimes, leading to conditions under which the **extent and intensity of forest fires** in the EU will increase in the next few years. Tree cover loss has accelerated in the last decade because of extreme weather events and an increase in harvesting for different economic purposes. These are the challenges that the new EU Forest Strategy aims to overcome.

According to the EU Climate Law, in order to reach the 2030 target and the climate-neutrality objective, the relevant EU institutions and the Member States shall prioritise swift and predictable emission reductions and, at the same time, enhance removals by natural sinks. Greenhouse gas emissions and removals by **forests and forest products will play a crucial role** in reaching the ambitious net removal target for the Union of **310 million tonnes of carbon dioxide-equivalents**, as set out in the proposal for a revised Deforestation Regulation on Land Use, Land Use Change and Forestry.

### 3.2.6. EU and the national long-term strategies<sup>22</sup>

In accordance with the Paris Agreement, all Parties should strive to formulate and communicate long-term low greenhouse gas emission development strategies, taking into account their common but differentiated responsibilities and respective capabilities, in the light of different national circumstances. Currently, 53 nations submitted their strategies, including the European Union as a community.

Regarding the Central Eastern European region, Austria, the Czech Republic, Germany, Hungary, Slovakia and Slovenia created their own pathways and milestones to reach climate neutrality until 2050. Based on the guidelines of the UNFCCC secretariat (UN Climate Change), each country covered the following topics:

- Creation of a long-term greenhouse gas reduction target.
- Describing transformative pathways for all areas, such as energy, buildings, transport, industry, agriculture and forestry.
- Milestones and targets as a framework for all sectors up to 2030,
- Strategic measures for every area of action,
- Establishment of a learning process that enables the progressive raising of ambition envisaged in the Paris Agreement.

All strategies point out that the climate neutrality target in 2050 can be reached through a large-scale structural change in the functioning of the economy, society and environment. Net zero carbon emission has two components:

- **Reduction of greenhouse gas emissions** by 80 to 95 percent — 100 % cannot be reached because in some sectors there is no known technology that can completely eliminate emissions (e.g., chemical fertiliser in food production or

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<sup>22</sup> The strategies are available: <https://unfccc.int/process/the-paris-agreement/long-term-strategies>.

natural gas ensuring flexibility in energy production). Key solutions for emission reduction are focusing on renewable energy use, promoting electromobility, energy efficiency in building stock, accelerating the uptake of innovation.

- **Increase the capacity of carbon sinks** (natural and artificial reservoirs that absorb and store carbon) which balance the unavoidable GHG emissions. Although there are some experimental technologies for storing and using CO<sub>2</sub> artificially, most strategies emphasise the importance of land use and forestry as the most accessible solution for creating carbon sinks — where healthy forest ecosystems have the highest carbon storage capacity.

Forest areas have multiple purposes, such as functioning as carbon sinks, habitat for an ecosystem, natural energy source (e.g., solid bioenergy fuel in the heat sector) and other ecosystem services. Only with sustainable forest management can these functions be further developed.

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*In the long-term strategy of Germany, it is also stated that the “German government considers the reinforcement of international cooperation in the areas of conserving, restoring and sustainably managing forests to be a primary instrument for counteracting continued global deforestation and for maintaining the diverse functions of forests in the interest of people and nature, such as climate action and species protection, and as a vital supplier of raw materials over the long term.*

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### 3.2.7. Summary

The climate and forest policies of the European Union show many interconnections and synergic effects. These connections are summarised in the following table.

Table 1. Documents of implementation of the European Green Deal and their connection with forest policies and climate change.

Name	Connection to climate change	Connection with the Deforestation Law	Shortcomings
<p>EU Biodiversity Strategy for 2030</p>	<p>Mitigation – Forests are rich ecosystems that remove carbon from the atmosphere, while storing significant carbon stocks.</p> <p>Adaptation – Forest ecosystems are vulnerable to climate change; thus, protection and restoration measures are needed to maintain their functionality.</p>	<p>The aim of the Deforestation Law is that products from supply chains related to deforestation and forest degradation are not placed on the Union market, nor exported from the Union market. Protecting forest ecosystems also contribute to the restoration of biodiversity — the two documents show positive synergies.</p>	<p>The Deforestation Law at the moment is suitable only to reduce the EU contribution to deforestation and forest degradation but restoring forest ecosystems is not targeted. The EU Biodiversity Strategy has various measures for protecting the biosphere in Europe, but it has less impact in non-EU countries.</p>
<p>Farm to Fork Strategy</p>	<p>Agriculture is one of the key sectors which has to face a serious transition in order to reach climate neutrality in 2050. The existing agribusiness sector has to change to be sustainable and ensure food security and quality at the same time.</p>	<p>The Deforestation Law is targeting agricultural and forestry products in connection with deforestation; therefore, both exported and imported commodities are affected within the EU market — a sector where the Farm to Fork Strategy aims to promote sustainability while ensuring the quality and quantity of products.</p>	<p>The Strategy highlights the importance of reducing carbon leakage through imports, and to avoid that the EU will examine rules to reduce the dependency on commodities related to deforestation and promote alternative materials. The Strategy (and the Common Agriculture Policy) has not described a concrete measure on how it can alter trade policy focusing on areas that are affected by deforestation the most — measures that help farmers meet sustainability standards rather than penalise them.</p>



Name	Connection to climate change	Connection with the Deforestation Law	Shortcomings
<p><b>EU Strategy on Adaptation to Climate Change</b></p>	<p>The Strategy is focusing on various measures for the adaptation to unavoidable climate change effects.</p>	<p>Improving forest ecosystems is an important nature-based solution for promoting climate resilience. Utilising and prioritising green and blue infrastructure helps mitigate the negative outcomes of climate effects within the European Union.</p>	<p>Protecting primary forests and other forest areas that have been threatened by deforestation globally is an important climate adaptation measure. The Strategy should also focus on the promotion (and transfer to developing countries) of practices where investments not only create financial values but, at the same time, increase the region's adaptive capacity (e.g., sustainable forestry techniques, green roofs and walls to newly built houses).</p>
<p><b>EU Forest Strategy for 2030</b></p>	<p>Forests are important carbon sinks which will play a crucial role in reaching the ambitious net removal target for the Union. This role of the forest ecosystems is threatened by different climate effects — a problem which the Strategy has to face with.</p>	<p>The Strategy aims to create a new business model that rewards more climate-friendly land management, that helps increase forest areas, and that improves forest ecosystems within the European Union.</p>	<p>As forests not only create value through forest products, but increasing the carbon capacity has climate benefits, the created new business model for land management should be extended to global trade partners that are most affected by deforestation.</p>
<p><b>EU and the national long-term strategies</b></p>	<p>In the Paris Agreement, the Parties legally bind themselves to limit global warming to well below 2° C — preferably, to 1.5° C — compared to pre-industrial levels. In order to meet their commitment, all Parties have to create their own long-term strategy for 2050. The strategies are describing the efforts for reaching climate neutrality.</p>	<p>Reaching climate neutrality needs to involve large-scale afforestation and improvement of forest ecosystems for balancing the unavoidable GHG emissions of different sectors. Most of the EU members are aligned with the 2050 climate neutrality goal — for which promoting sustainable forestry within the Community is crucial.</p>	<p>In order to limit global warming below two degrees, global efforts are needed in cooperation with all Parties — therefore, each EU member state should not only invest on improving forest ecosystems within their country but join forces with countries with the most deforestation.</p>

The analysed documents highlight the options of the EU as a Community and global political actor to cause changes in climate and forest policies within its territory and globally:

- Set up an example within the Community for creating and implementing strategies and roadmaps for important topics, such as reaching climate neutrality, forest and biodiversity protection.
- Regulate, map, and revise processes within the Community to change existing practices to promote sustainability and just transition.
- Allocate subsidies and create financial mechanisms within the Community for supporting the green transition of the economies of member states — thus, find and reach an eco-economic equilibrium.
- Improve international cooperation and partnership building in various topics — research and development, innovation, climate change adaptation and mitigation, agro-ecology; sustainable landscape management and land governance; conservation and sustainable use of biodiversity; and inclusive and fair value chains.
- Alter the EU trade policy to enhance cooperation with and to obtain ambitious commitments from third countries in key areas of climate and forest policy.
- Allocate direct financial support for international projects focusing on key issues.

## 4. Gap analysis of the regulation and recommendations

The previous chapters of this study highlighted the connection between healthy forest ecosystems and climate resilience and how the Deforestation Law can be approached from the perspective of the EU strategic framework. To enhance the effectiveness of the Deforestation Regulation gaps should be identified based on the available literature, scientific experience, and logic. With describing each gap, our goal is to highlight those areas where the Deforestation Regulation can be further enhanced and, within this chapter, recommendations will be given for consideration.

### 3.3. Involving forest ecosystems only

The draft Law focuses exclusively on forest ecosystems, but, at the same time, the products currently produced in connection with the destruction of forested areas can easily be diverted to other natural ecosystems as well (e.g., soybean cultivation on grasslands, drainage of peatlands). And this, through the reduction of biodiversity, worsens the resilience of other natural ecosystems to climate change; even by significantly degrading the soil over time, they can become carbon emitters — thus, other ecosystems can easily become victims of the Deforestation Regulation. According to the general approach to the Deforestation Regulation, *“Ecosystems such as wetlands, savannahs and peatlands are highly significant to global efforts to combat climate change, as well as other sustainable development goals and their conversion or degradation require particular urgent attention. To address this, the Commission should assess the need and feasibility of extending the scope (or creation of a new regulation) to other ecosystems and to further commodities two years after the entry into force.”* It is recommended to create an assessment of these ecosystems as well in order to identify the production of which commodities affects them most.

### 3.4. Clarification of definitions

The Deforestation Regulation does not distinguish between primary or secondary forests, natural forest or plantation under the definition of forest. In this case, the main problem is that although the utilised forest area (e.g., logging) is not registered, it may still be a degraded area whose resistance to climate change has decreased and, in addition to continuous use, the regeneration processes cannot take place sufficiently and can make it a net carbon emitter. Unlike ‘deforestation’, which is clearly defined and easily identifiable, the definition and detection of ‘forest degradation’ requires predetermined, objective thresholds based on quantitative references. Due to the impreciseness of the definition, its regulation enables the support of wood products that come from improper forest management and degraded forests.

### 3.5. Differentiate within the commodities

To identify commodities which are related to EU-driven deforestation, an impact assessment was created for the Deforestation Law. Six commodities were identified with the share of contribution:

- palm oil (33.95 %)
- soy (32.83 %)
- wood (8.62 %)
- cocoa (7.54 %)
- coffee (7.01 %)
- beef (5.01 %)

The Deforestation Regulation **prioritises its efforts** within countries with higher share of deforestation — which will be subject to enhanced scrutiny by competent authority. When efforts of the authorities are prioritised by a country classification, it is recommended to have a **stronger emphasis to the due diligence process related to palm oil and soy.**

### 3.6. Involving other commodities in the Deforestation Regulation

The scientific evidence-based impact assessment of the Deforestation Regulation pointed out six commodities as the main driver factor for deforestation. Although the proposal of the regulation has to focus on the most significant commodities, it is recommended to extend the list with products that have a significant and increasing importance in the topic. Reaching climate neutrality takes a huge amount of effort and financial support in each sector — where **energy production and mobility are relying even more on resources of biological origin.** Recent studies<sup>23</sup> highlighted that the increasing global demand for biofuels lead to the expansion of **sugarcane cultivated areas** in the most deforestation affected countries, like Brazil and Indonesia. To prevent further escalation of sugarcane related deforestation, it is recommended to **consider the involvement of sugar** in the due diligence system.

### 3.7. Measures for avoiding shifts in imported commodities related deforestation

Global trade is a fast-changing system where different players have to adapt to new consumer needs, changes in regulations, taxation parameters and many other factors. The Deforestation Regulation does not describe a mechanism that can help avoid changes in global trade when producers and operators shift to the production of commodities that are not covered by the current list of commodities listed in the Annex — thus maintaining the deforestation activities.

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<sup>23</sup> Tomas Jusys. 2017. A confirmation of the indirect impact of sugarcane on deforestation in the Amazon. Link: <https://www.tandfonline.com/doi/full/10.1080/1747423X.2017.1291766>

### 3.8. A balance between stick and carrot

Those products which do not meet the due diligence requirement of the Deforestation Regulation will be banned from the market of the EU. This provision may result in increasing poverty in the producing communities, which further aggravates social, economic and environmental issues. As global forest ecosystems are crucial in reaching climate neutrality and avoiding a global climate crisis, the EU should extend the financial resources for restoring forest ecosystems and reach their protection in cooperation with the relevant national governments.

### 3.9. Environmental against social issues

The measures in the Deforestation Regulation should not only consider the environmental perspective but also the ongoing energy crisis and the war in Ukraine that caused a food crisis which could challenge the implementation of the Law. For example, after the war in Ukraine ends, the country will need quick and large-scale support in rebuilding the infrastructure which needs large amount of building materials, inter alia wood.

### 3.10. Ban of imports does not mean the end of deforestation

Without international cooperation against placing deforestation related products in global markets there is a high chance that commodities that cannot be imported to the EU will be sold to other customers, thus maintaining the initial deforestation problem. Therefore, regulating the market processes alone would not be effective; initiating large-scale projects in order to create a more sustainable but profitable agriculture in the deforestation fronts is needed.

### 3.11. Circumvention of the legislation within the trade system

International trade processes are fast changing areas of the global economy where adaptation to new technology, existing legislations and taxation are key elements of market survival. Therefore, operators may try to circumvent the legislations by the following methods:

- trying to change the country of origin of the product (illegally) by giving false information.
- changing the form of the product to not be included in Annex I of the Deforestation Regulation (e.g., processing of the product).

One of the most fundamental elements of operating the due diligence is information from the product which is about to be placed on the EU market. A clear, simple, automated but effective data sharing system is needed with the global producers using the latest technology (for example, smartphone GPS based geolocating).

### 3.12. Measuring the outcomes of the Deforestation Regulation

The creation of the Deforestation Law was based on scientific evidence; certain commodities were evaluated based on their impact on global deforestation and forest degradation. With the creation of the scientific report, a **baseline scenario was created**, a current state which can be compared to a desired future state. Clear indicators should be created to evaluate the changes of the rate of deforestation/forest degradation in each category of countries, and the overall impact of the Deforestation Regulation in decreasing deforested areas.

### 3.13. Installation of multifunctional plantations

In terms of protection and reforestation of forest ecosystems, the installation of **multi-functional plantations** can act as a compromise solution, which in addition to ecological benefits also bring economic benefits (income for local farmers). In addition to cultivated crops (e.g., fruit trees), other indigenous tree species can also be planted, which, functioning as a forest, can once again provide shelter for the wild animals that once lived in the forest.

### 3.14. Combining legally binding measures with intensive communication to the public

According to the impact assessment for the legislation, “legally binding options would be more effective than voluntary measures like labelling or voluntary private certification.” Although deforestation-free requirements, mandatory due diligence and mandatory certification are needed measures for minimising the EU contribution to deforestation, **an extensive public-awareness campaign is needed to inform citizens** about the necessity of the Deforestation Regulation — and what additional voluntary actions could they initiate against rapid global deforestation.

## 5. Conclusions

Global forest areas are playing an important role in maintaining an ecosystem which has crucial services for human communities: from direct benefits through resource services to carbon sequencing and storing contributions to the mitigation of climate change, it has provided various benefits to humanity throughout history. Despite the dependence on forest ecosystems, human activity leads to deforestation. Forest degradation has reached an alarming rate: between 2004 and 2017 only, over 43 million hectares of forest areas were lost — an area roughly the size of Morocco.

The EU is combating global deforestation and forest degradation by three major tools:

- By strategies and action plans based on strategic measures, the Union tries to ensure the protection of forest areas within its territory and create a financial model which helps to maintain the sustainable coexistence of the human economy and natural environment.
- By the regulation of the EU trade processes to exclude the major deforestation associated products from the market without significantly interrupting its operation.
- By financing projects in the main deforestation fronts to help local governments and initiatives to change the existing practices to a more sustainable system.

The Deforestation Regulation is a legally binding tool for decreasing the contribution to global deforestation of the European Union by excluding agricultural and forestry products from the European Common Market. The proposal of the regulation is coherent with the existing climate and forest policies as it aims to protect global forest areas.

The working mechanism of the Deforestation Regulation is based on the creation of a due diligence system that obligates operators to make sure imported products listed in Annex I are not associated with deforestation and forest degradation. The system is based on the data provided by the producers. Therefore, the effective operation of the due diligence system will rely on communication and data sharing between the stakeholders.

By identifying gaps and proposing recommendations, this study would like to increase the efficiency of the implementation of the Deforestation Regulation. The proposed regulation was analysed by its scope, which is restricted to forest ecosystems despite the fact that other biomes have also significant contribution to carbon sequencing/storing — thus mitigating the effect of climate change.

Over 50 products related to coffee, cocoa, palm oil, soy, beef, and wood are covered by the list in Annex I of the Deforestation Regulation — with the option for future extension. The available scientific literature is highlighting other products which are less significant regarding deforestation compared to the original six commodities

but have an increasing contribution. The involvement of sugarcane, rubber and corn should be considered in the next years.

Regarding the implementation of the Deforestation Regulation, real-life experiences will decide its effectiveness, but some aspects can be anticipated beforehand. The global trade system is fast changing and adapting to the existing regulatory framework and global needs; producers can change the grown product to an alternative that is not involved in Annex I while continuing deforestation activities. The classification of countries by the risk of deforestation is a tool for lessening the administrative burden for operators in less affected countries. This can be used as a loophole in the Deforestation Regulation as false data will be given to authorities so for the import process to be initiated from a lower risk classified country.

The overall goal of the European Union with the regulation is to decrease the rate of global deforestation, for which the Deforestation Regulation is an important step, but without international cooperation and targeted aid schemes, deforestation activities may continue.



## 6. References

- Bennett, K.D. 1985. The spread of *Fagus grandifolia* across eastern North America during the last 18,000 years. *Jour. Biogeogr.* 12: 147-164.
- Burger, J. A. 2004. Soils biology and tree growth, Soil and its Relationship to Forest Productivity and Health. *Encyclopedia of Forest Sciences*. pp. 1189-1195
- Communication from the Commission to the European Parliament, the Council, the European, Economic and Social Committee and the Committee of the Regions, *Stepping up EU Action to Protect and Restore the World's Forests*, COM/2019/352 final.
- Communication from the Commission to the European Parliament, the Council, the European, Economic and Social Committee and the Committee of the Regions, *The European Green Deal*, COM/2019/640 final.
- Communication from the Commission to the European Parliament, the Council, the European, Economic and Social Committee and the Committee of the Regions, *EU Biodiversity Strategy for 2030 Bringing nature back into our lives*, COM/2020/380 final.
- Communication from the Commission to the European Parliament, the Council, the European, Economic and Social Committee and the Committee of the Regions, *A Farm to Fork Strategy for a fair, healthy and environmentally-friendly food system*, COM/2020/381 final
- Communication from the Commission to the European Parliament, the Council, the European, Economic and Social Committee and the Committee of the Regions, *Forging a climate-resilient Europe - the new EU Strategy on Adaptation to Climate Change*, COM/2021/82 final.
- Communication from the Commission to the European Parliament, the Council, the European, Economic and Social Committee and the Committee of the Regions, *Forging a climate-resilient Europe - New EU Forest Strategy for 2030*, COM/2021/572 final.
- FAO and UNEP. 2020. The State of the World's Forests 2020. Forests, biodiversity and people. Rome. <https://doi.org/10.4060/ca8642en>
- Ministerial Conference on the Protection of Forests in Europe. 2020. State of Europe's Forests 2020. Liaison Unit Bratislava. [www.foresteurope.org](http://www.foresteurope.org)
- Holling, C. S. 1973. Resilience and Stability of Ecological Systems. *Annual Review of Ecology and Systematics*, Vol. 4 (1973), p.
- IPCC 2022. Climate Change 2022, Mitigation of Climate Change. Summary for Policymakers. AR6 WG III
- Körner, C. 2006. Plant CO<sub>2</sub> responses: an issue of definition, time and resource supply. *New Phytologist* 172: 393-411
- Lindner M, Maroschek M, Netherer S, Kremer A, Barbati A, Garcia-Gonzalo J, Seidl R, Delzon S, Corona P, Kolström M, Lexer MJ, Marchetti M. 2010. Climate change impacts, adaptive capacity, and vulnerability of European forest ecosystems. *For Ecol Manag* 259:698–709. doi:10.1016/j.foreco.2009.09.023
- Mascaro. J., Hughs, R. F., Schnitzer, S. 2012. Novel forests maintain ecosystem processes after the decline of native tree species. *Ecological Monographs* 82(2):221-238. DOI:10.2307/41739366
- Mendelson Lima, Carlos Antonio da Silva Junior, Tatiane Deotti Pelissaria, Thaís Lourençoni, Iago Manuelson Santos Luz, Francis Junior Araujo Lopes. 2020. Sugarcane: Brazilian public policies threaten the Amazon and Pantanal biomes. *Perspectives in Ecology and Conservation*. Volume 18, Issue 3, July–September 2020, Pages 210-212
- UNFCCC. 2015. High Level Segment of the eleventh session of the United Nations Forum on Forests, Statement by Christiana Figueres, Executive Secretary, United Nations Framework Convention on Climate Change. New York

- Pacheco, P., Mo, K., Dudley, N., Shapiro, A., Aguilar-Amuchastegui, N., Ling, P.Y., Anderson, C. and Marx, A. 2021. Deforestation fronts: Drivers and responses in a changing world. WWF, Gland, Switzerland.
- Scolozzi R., Geneletti D. 2012. A multi-scale qualitative approach to assess the impact of urbanization on natural habitats and their connectivity. *Env Imp Assess* 36:9–22
- Tomas Jusys. 2017. A confirmation of the indirect impact of sugarcane on deforestation in the Amazon, *Journal of Land Use Science*, 12:2-3, 125-137, DOI: 10.1080/1747423X.2017.1291766
- William F. Laurance, José L. C. Camargo, Philip M. Fearnside, Thomas E. Lovejoy, G. Bruce Williamson, Rita C. G. Mesquita, Christoph F. J. Meyer, Paulo E. D. Bobrowiec, Susan G. W. Laurance. 2017. An Amazonian rainforest and its fragments as a laboratory of global change. *Biological review*, Volume93, Issue1.

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