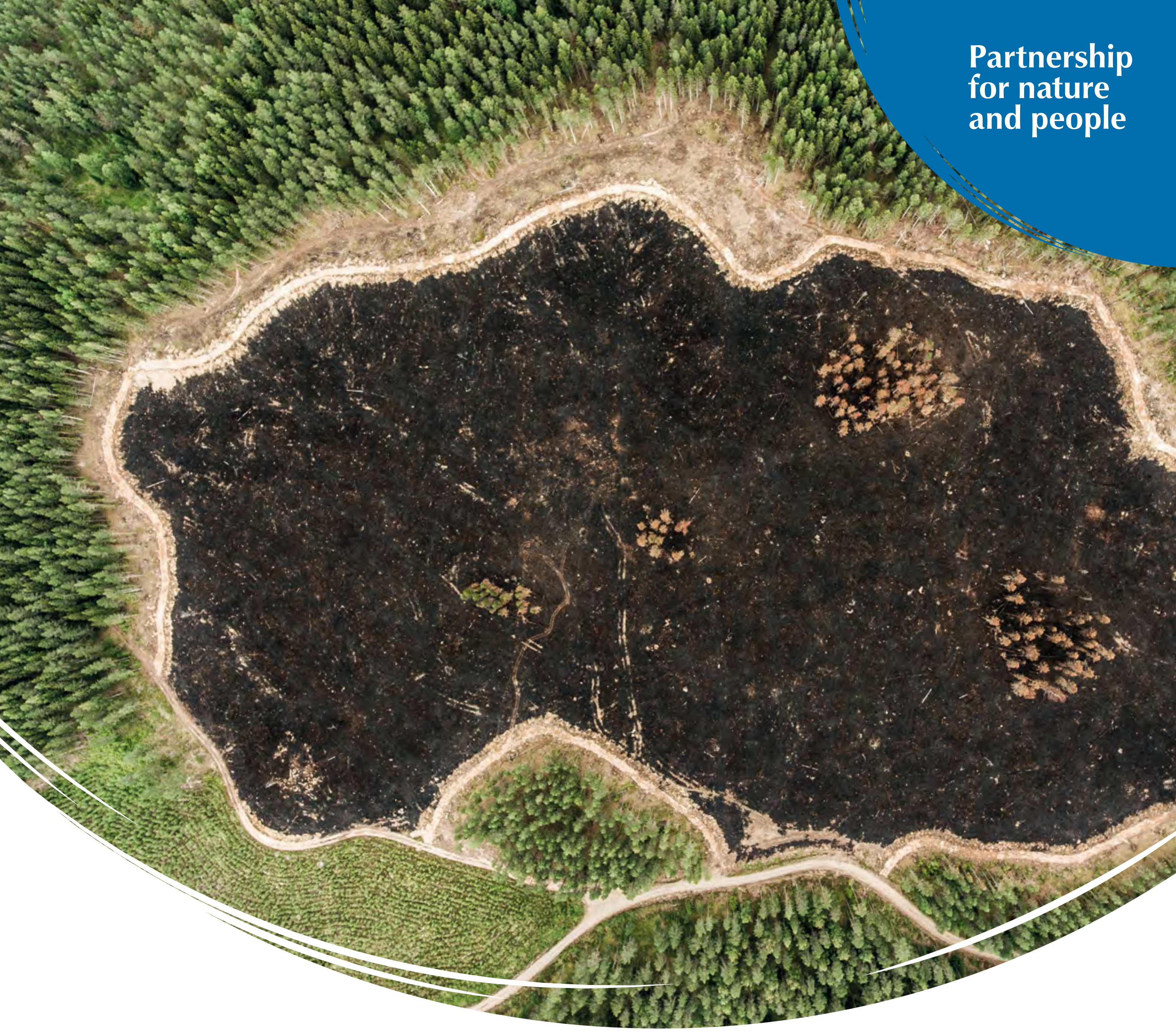

Partnership for nature and people

Burn or Restore

Meeting competing demands for land in the best way for nature, the climate, and human needs.

BirdLife INTERNATIONAL

EUROPE AND CENTRAL ASIA

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Section one

Executive Summary

Land is a finite resource. Yet growing demands are putting increasingly competing pressures on the world's land and ecosystems. The debate on how much land is available is often flawed as it is based on the question what land assets can be sacrificed.

More and more of the world's habitable land is taken up by agriculture, to feed a growing population. The vast majority of this land is taken up to feed livestock. In recent times renewable energy incentives have added new pressures on land, in particular through the large scale growing of bioenergy feedstocks.

But our current use of land is already unsustainable and in order to mitigate biodiversity loss and climate change we urgently need to set aside land for nature.

False climate solutions, like the large-scale use of land for bioenergy with carbon capture and storage (BECCS) and a limitless and rapid upscaling of a bioeconomy untied from circular resource use, would have the potential to add even more pressure on land while providing little benefit for climate and nature.

When estimating future land use, models must stop the simplistic framing of land as a resource that is either 'spare' or not and must recognize the vital role of land for nature. Such models must not extrapolate from an energy 'need' to a land 'need' via large scale bioenergy growing, but instead must prioritise demand reduction, both in the energy sector as well as the food sector through changing diets, as well as better reflect land use change implications and opportunity costs.

Furthermore, equity considerations must guide our future thinking on land, as Europe is already a net importer of agricultural land, primarily through feed imports, but increasingly also through bioenergy imports.

In this paper we propose a set of principles to guide EU policies affecting future land use, namely:

- Systematic management of land use
- Space for biodiversity
- Better land use assessment and modelling
- Decarbonisation before energy crops and offsetting
- Protect nature-based solutions
- End global land degradation by Europe
- Inclusive policies
- Nutritional food security
- Dietary shifts
- Agro-ecological farming
- Avoid agricultural expansion
- A circular economy

Section two

Introduction: finite land on a finite planet

"We are ultimately bound by and reliant upon the finite natural world about us," said David Attenborough in his latest documentary film.[1]

This finite natural world encompasses the resources and ecosystems that exist on the planet, including the land itself. Yet we already use more than 1.7 planet's worth of resources[2], and once we factor in all the competing uses for land now[3] and in the future, this unsustainable situation is set to intensify.

We need to reassess our relationship with land, and this is confirmed by two recent landmark compilations of the latest science by the IPCC[4] and the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES).[5] Globally, land use contributes about one-quarter of global greenhouse gas emissions (notably carbon dioxide (CO_2) emissions from deforestation, methane emissions from rice and ruminant livestock and nitrous oxide (N_2O) emissions from fertiliser use) and has wiped out untold number of species.

These reports also confirm that the loss of biodiversity both reduces the resilience of ecosystems and agricultural systems to climate change, and as the systems change, through processes such as desertification, they further contribute to climate change. A feedback loop needing far greater attention. The evidence has also led to action on land featuring several United Nations Sustainable Development Goals for 2030 (SDGs).[6]

Yet pressure is strong, from industry and governments, however to use more land for climate mitigation via crops and plantations for energy or materials and for carbon storage. Such land use change can have direct and indirect biodiversity, environmental and social impacts that are not adequately recognised. Is a major expansion in bioenergy consistent with other aims for land use, from agriculture to forestry and from nature protection to climate change mitigation?

If we want to protect and restore the planet and the natural ecosystems that we need to survive we need an integrated approach, focussing on all aspects of land use impact in policy decisions. And this must be tackled beyond national and regional borders. Huge increases in commodities traded to satisfy new demands – such as for cheaper meat and dairy – means that the EU is now a major net importer of land in the form of animal feed products.[7] Policy driven demand for biofuels to replace fossil fuels[8] has also greatly increased our land take overseas. Societies and policymakers must start addressing the drivers of unsustainable demand to reduce pressure everywhere.

We need to identify how much land we need to meet the essential needs of a growing world population for food, fibre and land-based materials in a sustainable and healthy way, whilst maximising the land available for nature and carbon storage. This means looking at how we can drive consumption in the right direction.

The EU has so far failed to introduce policies to address land use, consumption patterns and phase out harmful policy mandates and subsidies;[9] a key reason for its failure to meet its 2020 biodiversity objectives. The recent EU Land Use, Land Use Change and Forestry (LULUCF) Regulation has been criticised for weak ambition on forest emissions, failing to address imported biomass and doing nothing to reduce burning forest biomass for energy.[10] We need to do far better in order to meet a range of policy goals by 2030 – including the SDGs, the Paris Climate Agreement and the upcoming agreement between the parties to the UN Convention on Biological Diversity (CBD).

This paper looks at the primary drivers of demand for land, both current and projected, and the interlinkages and impacts of land use decisions and modelling when addressing global challenges such as climate change. It looks at flaws in current modelling and concludes with summary points and a set of principles on incorporating sustainable land use in future policy.

Section three

How we are using land today

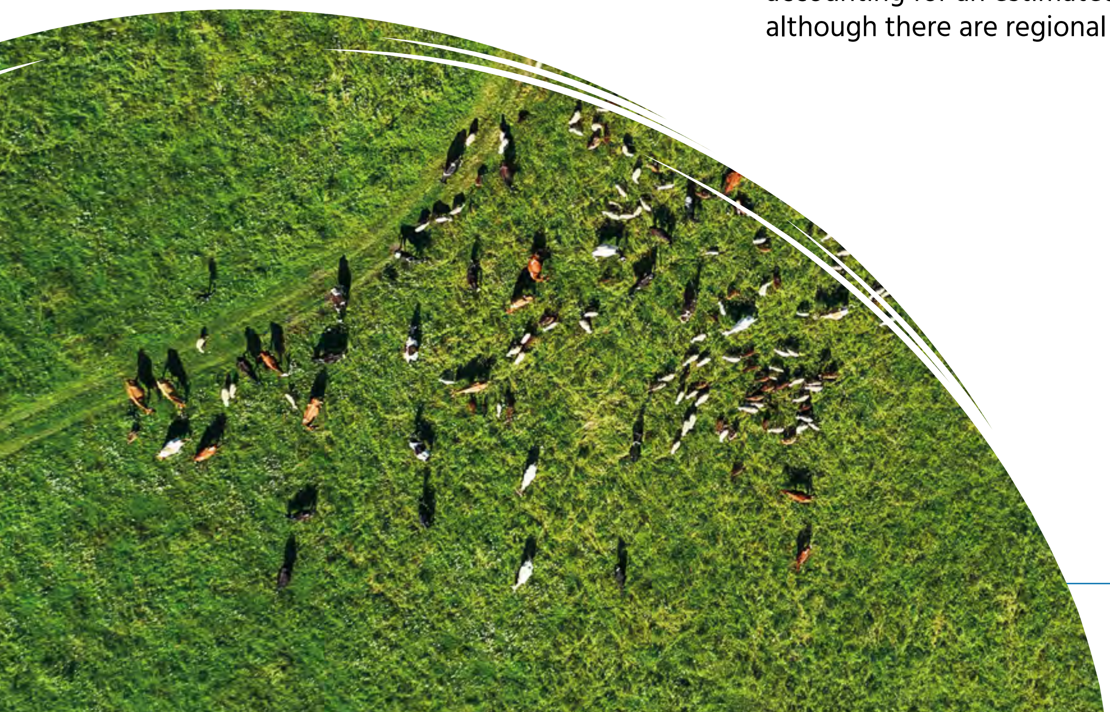
Coupled with extraction of fibres and other resources, human use affects about 60–85% of forests and 70–90% of other natural ecosystems (e.g., savannahs, natural grasslands).

Studies suggest that 58.4% of terrestrial Earth is estimated to be under ‘moderate or intense human pressure’, and that pressure on land is increasing: between 2000 and 2013, 1.9 million km^2 – an area approximately the size of Mexico – of land relatively free of human disturbance became highly modified.[11]

Agriculture and livestock

Half of the habitable land in the world today is used for agriculture (see **Figure 1**). This has steadily increased over previous centuries in response to population increase and dietary shifts. In 1700, pasture and cropland occupied roughly 2% of ice-free land or 3 million km^2. By 2000, cropland expanded to 11% or 15 million km^2, while pastureland increased to almost 25% of ice-free land area (34 million km^2).[12]

Of the land for food production, the greatest proportion is taken up by animal farming. The 2019 IPBES report highlighted that more than a third of the world’s land surface and nearly 75% of freshwater resources (as feed) are now devoted to crop or livestock production. Livestock, including crops grown for feed, account for 77% of agricultural land but make up only 17% of calorie supply and 33% of protein supply for global consumption.[i] In the EU, 48% of land is used for agriculture[13], with livestock production, including feed production, accounting for an estimated 71% of this[14] although there are regional variations.[15]



Global surface area allocation for food production

The breakdown of Earth surface area by functional and allocated land uses, down to agricultural land allocation for livestock and food crop production, measured in millions of square kilometres. Area for livestock farming includes grazing land for animals, and arable land used for animal feed production. The relative production of food calories and protein for final consumption from livestock versus plant-based commodities is also shown.

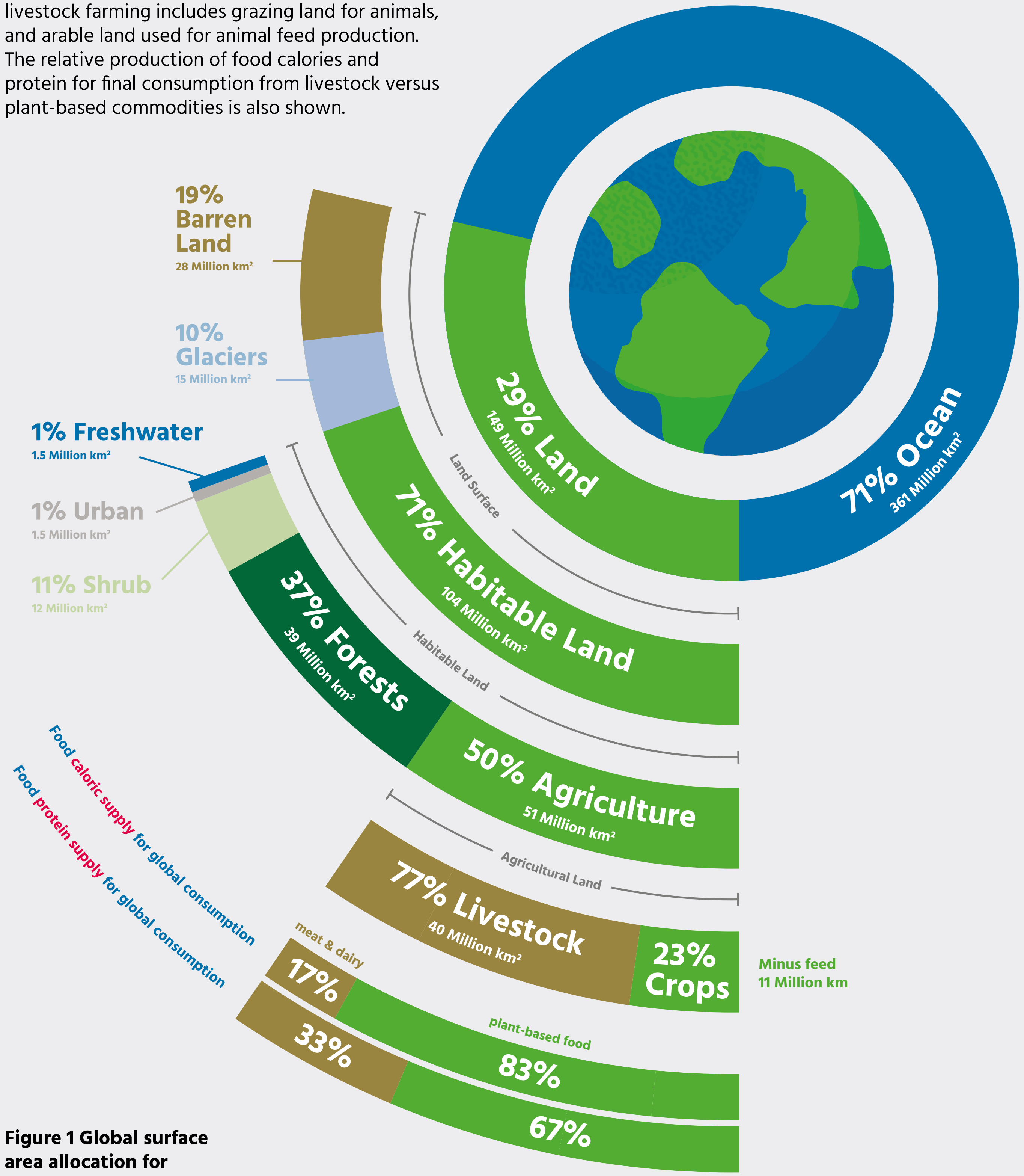


Figure 1 Global surface area allocation for food production

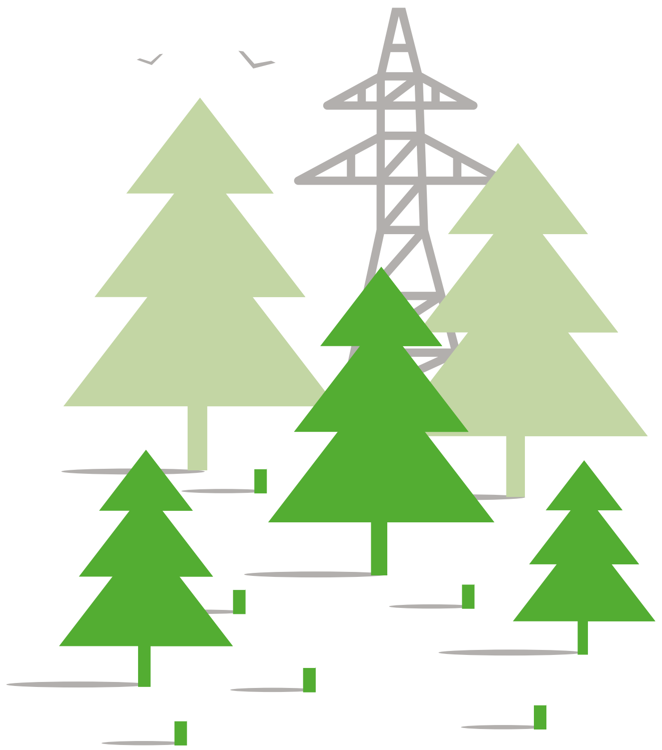
[i] Though it should be noted as nutrient dense products, meat and dairy provide considerable key nutrients and particularly minerals in the diet.

Data source: WWF Living Planet Report 2016

Intensification of land use

Whilst the rate of expansion of agricultural area has slowed since the 20th century, cultivation intensity has increased. Since the 1960s, global per capita food calories increased by about one-third, with the consumption of vegetable oils and livestock products more than doubling. Production output per unit of land rose by 60% while the area under cultivation increased 5%.[17]

Intensification may have avoided further land use change and the related depletion of carbon sinks and biodiversity habitats, yet it had a major impact on local biodiversity and the environment. This includes pollution, decline in surface water quality, soil degradation, increased NO_2 and CH_4 emissions, and a collapse in soil and farmland biodiversity. Over this period, the global use of inorganic nitrogen fertiliser increased nearly nine-fold.[18] In Europe, farmland birds have declined by 57% since 1980 and the decline in insect abundance and variety is becoming a major concern. Intensification ultimately has economic consequences too. Land degradation is now estimated to reduce productivity of 23% of the global land surface.[19] The challenge is to undo the negative impacts of intensification without further expansion of agricultural lands (see section 5 on the role of dietary shifts).



Bioenergy, forests and plantations

Crops grown for bioenergy (wheat, oilseeds, maize, sugar), incentivised by EU policy, have expanded significantly in recent decades: 60% of the rapeseed grown in Europe goes to produce biodiesel.[20] 65% of imported palm oil is for biodiesel (53%) and for electricity and heating (12%).

This is an incredibly land-inefficient way to produce energy.[21] Bioenergy production is increasingly seen as having major direct impact on land (such as soil erosion though maize) but also via indirect land use change and crops are displaced elsewhere. Other countries, including the US, Japan, Brazil and Indonesia increasingly have their own policies driving bioenergy and biofuel demand.

While some argue that the current land take of bioenergy is still relatively modest (compared to future scenarios; see section 4), as a proportion of the additional demand for land it is much higher, for example, biofuels accounted for 90% of vegetable oil demand increase since 2015.[22] This additional demand is often met through direct encroachment into natural habitat like tropical rainforests, or involves indirect land use change by displacing food crops which then need to be produced elsewhere. As mentioned, 60% of the rapeseed grown in Europe goes to produce biodiesel,[23] displacing food crops which has led to indirect land use change both in Europe and globally; demand for liquid biofuels in Europe has been associated with 'large scale' land use change land grabbing in many other parts of the world[24] (see **A biofuel example: Germany**). In the UK, one of the largest power stations, Drax, is using wood pellets from mature hardwood forested areas in North America that are being gradually replaced by plantation forests so removing both existing carbon stocks and biodiverse rich habitats.[25]

For soy alone, calculations have shown that between now and 2030 demand for biodiesel from the EU, Brazil, the United States and Argentina, and by the aviation industry could increase by about 12 million tonnes. Even when accounting for simultaneous production of soy meal from the soybean crop this increase could require up to 4.2 million hectares[26] (equivalent to the UK's entire cropland).

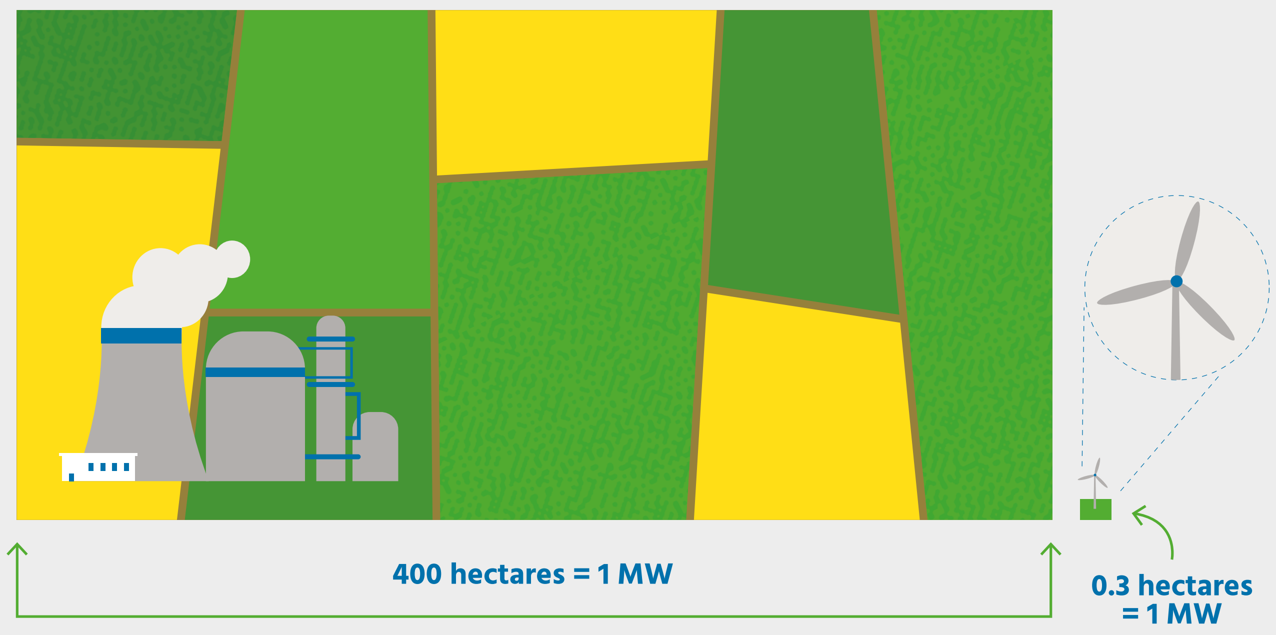
Forests are also under threat in the rush for bioenergy. As well as vital habitat, forests act as carbon sinks, absorbing roughly 2 billion tonnes of carbon dioxide each year. As shown in **Figure 1** [see page 7], forests make up 37% of the world's habitable land. 93% percent of forest area is composed of naturally regenerating forests, 7% is planted/plantation.[31] The plantations may be for pulp, timber or increasingly for energy generation in power stations and have low biodiversity potential. Much of the 93% of natural forest ecosystems are being put to productive use and so quality and quantity is decreasing, and they are under significant threat via development, felled for timber and pulp, and cleared for plantations, crops or pastureland. According to the UN's Food and Agriculture Organization (FAO), around 420 million hectares of forest have been lost to agriculture and other land uses since 1990.[32] Forest fires (exacerbated by climate change) and fragmentation are also major threats.

A biofuel example: Germany

Fuelled by subsidies for biogas production, Germany, which leads the European biogas industry, has seen an area of around 2.2 million hectares (around 20% of Germany's cropland) converted to energy crops, 0.9 million hectares of that maize[27]. The conversion of biodiversity-rich grasslands to maize fields has led to so called 'maize-deserts', void of almost any wildlife and prone to soil-erosion and worsening flood risks.[28] This increased competition for land threatens food supply, and harms biodiversity: in 2011, for the first time in 25 years, Germany did not produce enough grain to meet its own needs,[29] and a 2014 study estimated that the increase of farmland for maize cultivation in Germany may result in a significant decline of farmland bird population by 2050 of around 10%, or up to 0.4 million breeding pairs.[30]

Bioenergy VS wind energy

For the same production capacity, bioenergy occupies 1300 times more land than wind.



Renewable energy land needs

In addition to bioenergy, other forms of renewable energy such as wind, solar, and hydro have varied land take. Solar, when located appropriately, comes with low impacts, particularly when installed on existing structures or combined with productive use of land. Wind energy also has a low land requirement compared to biomass: :a 1 MW biogas plant requires roughly 400 hectares of land[33] whereas a wind turbine of the same capacity of would require approx. 0.3 hectares.

Further, the land around or under wind and solar can be used productively. Turbines can disrupt ecosystems, so spatial planning must ensure that wind farms are compatible with nature.[34] Hydro power has unacceptable ecological impacts on rivers and Europe's potential has been exploited so thoroughly so further growth should only come from retrofitting and efficiency gains.

Space for nature

Globally, estimates for how much land is managed for or left untouched for nature vary but data from the International Union for Conservation of Nature (IUCN) suggests that by 2019, protected areas covered 15.3% of global land and freshwater environments (excluding Antarctica) and only 7.5% marine areas.[35] At the 2021 CBD, a new target is expected for committing to protecting 30% of land by 2030. In Europe, only a small amount of land in the EU is currently left as natural ecosystems and for carbon sequestration, and these are rapidly shrinking. The Natura 2000 network of supposedly protected terrestrial and inland water habitats, covers about 18% of the land surface but the latest available figures show only 58% of these sites have management plans, or have plans in development.[36]

Urban build up

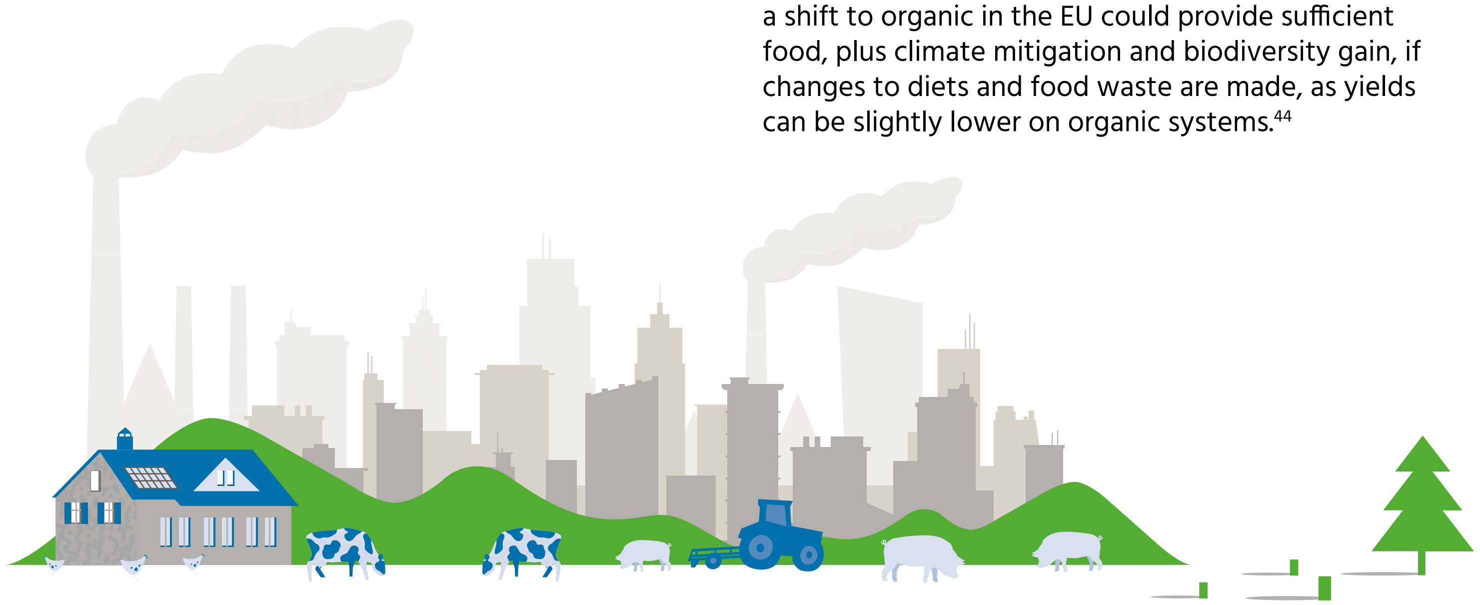
Only a tiny portion of land is used for urban build up (1% globally, 2.9% Europe in 2012[37]), although this is site specific, and the picture is unevenly distributed. For example, in very densely populated regions like Flanders, Belgium, land sealing is a big problem. Further, land sealing tends to happen disproportionately on very productive land (either for growing food or for nature).

Section four

Future scenarios: demands for land

Our current use of land, in terms of both quantity and quality, is already unsustainable and future UN projections suggest populations growth to 9.15 billion by 2050, which will exacerbate the problem. It is estimated that in fewer than nine months, we consume more resources than our planet produces in a year. There will also be an additional 2 to 3 billion middle-class consumers by 2050 adding to the acute problem of consumption given the far greater use and waste of resources by those on higher incomes.[38] The EU has recognised these problematic predictions and, in its EU Green Deal, signalled its intention to build a new green growth paradigm that works within the planet's boundaries.

We need a robust evidence base to design this new future. The following sections look at the main 'demands for land' coming from different scientific and policy priorities, whilst exploring the synergies and trade-offs that are inherent in the (competing) different uses. Section 5 then explores how these trade-offs can be mediated by changes in production and consumption.

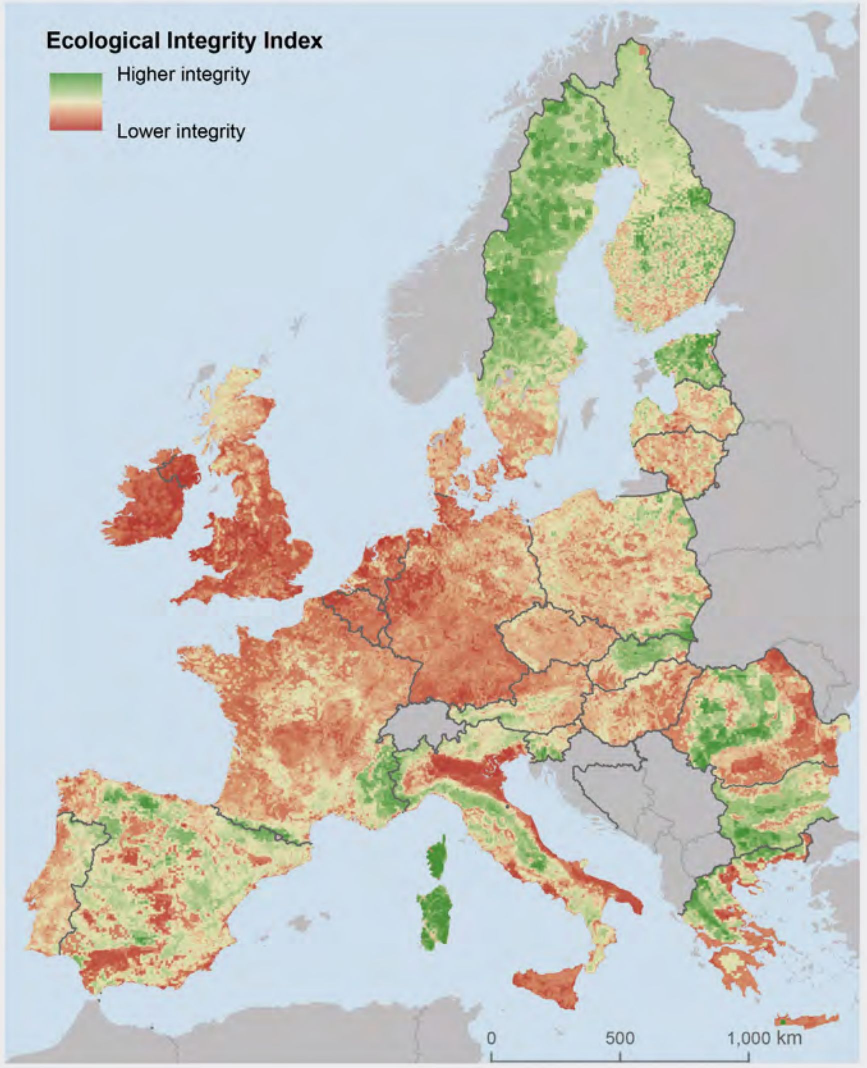


'Feeding the world'

The FAO has suggested global production of food, feed and biofuel would need to increase by 50% on 2012 levels by 2050, to feed the growing population.[39] However many experts have challenged the basis for such figures[40] and the assumptions behind such projections.[41] A 50% increase could put huge pressure on land. However, increased demand for food does not necessarily imply increased demand for land, as both the intensity of the food production, an ability to tackle food loss and waste and changing dietary habits will hugely affect how much land is needed.

Organic production can be beneficial for biodiversity and is the only type of legally defined 'sustainable' production. Recognising this, the EU has set a target for 25% of EU agricultural land to be farmed organically by 2030. The CBD[42] recommends a major shift globally to agroecological farming alongside enabling sustainable and healthy diets (see Section 5) with a greater emphasis on diversity, mostly plant-based, and more moderate consumption of meat and fish. A major independent study[43] revealed that a shift to organic in the EU could provide sufficient food, plus climate mitigation and biodiversity gain, if changes to diets and food waste are made, as yields can be slightly lower on organic systems.[44]

Figure 2 Map of ecological integrity of European and UK Landscapes[53]



To support biodiversity and agro-ecological production practices, diversity needs to be reintroduced to agricultural landscapes, including connected habitat for nature (landscape elements such as trees, hedgerows, flower strips). If a minimum of 10-14% of agricultural land were to be prioritised for nature, birds, and thus other wildlife, are likely to recover.[45] At landscape level, 26-33% may be required for landscape-level recovery.[46] Many studies show reallocating parts of farms to nature does not impact yields and can even improve them by, for instance, attracting pollinators, pest predators or reducing soil loss.[47] Conversely, loss of biodiversity negatively impacts on yields so sparing some land to bring it back can enhance productivity, especially in a longer term.

Climate change models demonstrate that business-as-usual scenarios will impact severely on crop yields and livestock and so are already affecting food security. So, we need not only to accelerate climate action but also balance how much land we devote to food production and how much to tackling climate change including devoting land to carbon sequestration.[48]

Restoring land for nature (and climate)

Globally, the evidence is clear that agriculture and land use has led to extremely poor outcomes for nature. To recover, studies point to the need for 50% of the Earth's territory to be devoted to wildlife habitat by 2050.[49] IPBES also called for the same figure to be dedicated to nature restoration,[50] and the CBD has recently called for major conservation and restoration.[51] The continued loss of species and degradation of habitats threatens our wellbeing and ultimately the survival of humanity.

In the EU alone, unsustainable intensification of agriculture and fisheries have left only 23% of protected species and 16% of protected habitats in good, and therefore sustainable, status.[52] See **Figure 2**.

Europe has a network of 'protected' sites known as Natura 2000, currently covering 18% of EU land although these are not left entirely for nature and can be badly degraded. To properly support nature, by 2030, 30% of EU land and EU sea areas should be primarily managed for nature and biodiversity.[54] This should include Natura 2000 areas with far better conservation management to achieve their nature protection purpose.

It is not sufficient to simply maintain and improve existing protected areas. We also need to restore natural habitats. EU Member States have made a commitment to restore 15% of degraded ecosystems by 2020 but have failed to pursue it. BirdLife Europe estimates that 15% (67 million hectares) of every EU Member State's territory needs to be restored by 2030 (against a 2020 baseline).[55] The most important habitats for biodiversity that need to be restored are:

- Old growth forests: Member States should set aside forests so that they can become old growth; these store up to 40 times more carbon than forestry plantations[56]
- Biodiversity rich grasslands (scrublands, Mediterranean maquis, heathlands, etc). Extensive grazing/semi natural grasslands also need to be preserved (through low density grazing by livestock or wild herbivores), which can store carbon better than 'improved grazing'[57] but this could only be achieved by reducing current levels of consumption (see section 5)
- Peatlands: drained peatlands account for 5% of the EU's GHG emissions, but should be a significant carbon sink and, when managed as such, biodiversity habitat. In many EU countries, most peat soil is drained (98% in Germany, 82% in Ireland, 61% in Finland), primarily for agriculture and forestry[58]
- Wetlands, in particular floodplains and coastal areas.

There is growing evidence[59] that functioning, biodiverse ecosystems are both more efficient as carbon stocks and less vulnerable to loss of carbon e.g. through fires, pest outbreaks and storm damage. A review of 20 years of studies on biodiversity ecosystem functions[60] found consensus that biodiversity loss reduces the efficiency by which ecosystems capture essential resources, produce biomass (i.e. food or wood), and decompose and recycle nutrients.

So, there are many benefits to restoring land for nature and using land in a more nature-friendly way: it will be more productive, store more carbon and be more resilient to the impacts of climate change such as drought or floods.

Nature based carbon sequestration

As discussed, nature restoration is part of the solution to climate change: habitats such as forests, meadows, kelp forests, coastal wetlands and peatlands, store and sequester carbon, and do this well, as well as provide other benefits for people. Restoration of nature would contribute to a doubling of EU carbon sinks by 2030, so called 'nature-based' solutions.[61]

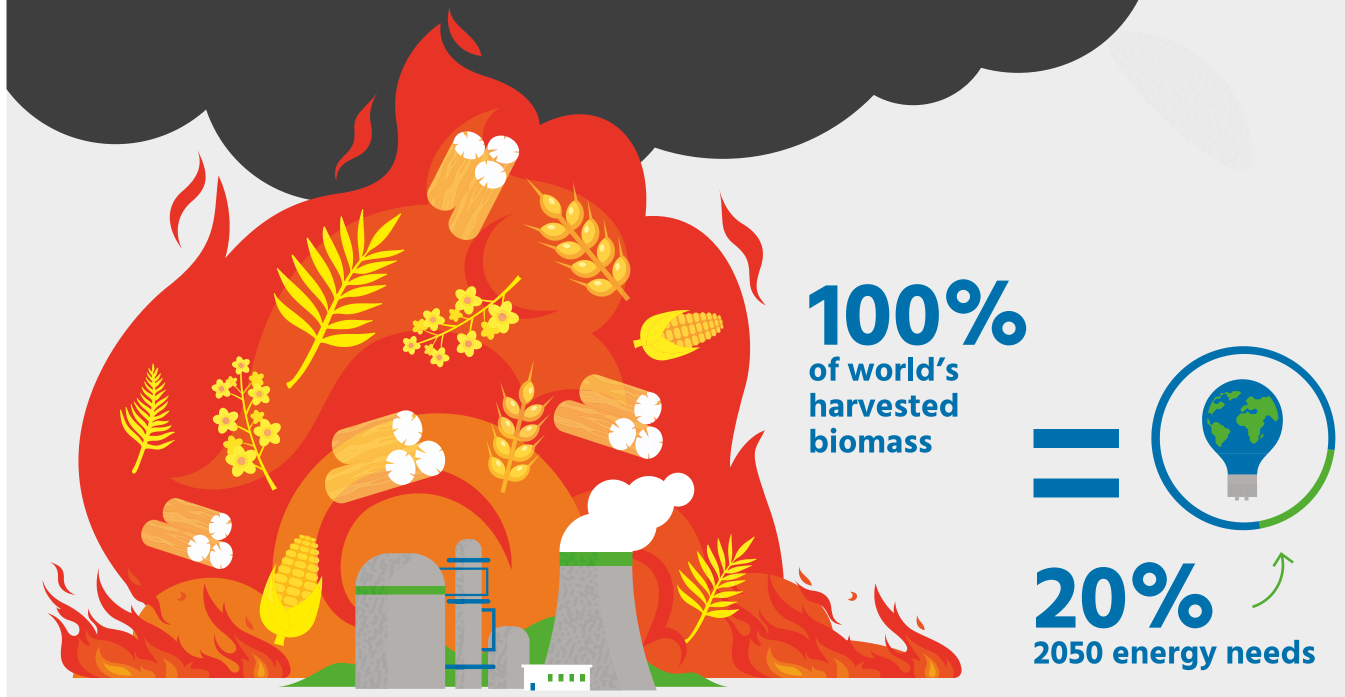
One global study suggests that changes in land use and approaches in agriculture, forestry, wetlands and bioenergy could 'feasibly and sustainably' contribute 15 billion tonnes of carbon dioxide equivalent ($GtCO_2e$) per year, around 30% of the reductions needed in 2050 to achieve the target of no more than 1.5 °C above pre-industrial levels.[62] The IPCC has also suggested that enlarging the world's forests, woodlands and woody savannahs could store around a quarter of carbon needed. This means adding up to 24 million hectares (Mha) of forest every year from now until 2030.[63]

Yet the current degradation of such systems means that the opposite occurs: a quarter of global GHG emissions are from land use (14% from agricultural production and 11% from land use, land use change and forestry (LULUCF)), and deforestation and peatland degradation are alone are responsible for about 10-15% of total CO_2 emissions.[64] Plantations are suggested as a solution. Under the 'Bonn Challenge' to restore 350 Mha of forest by 2030, nearly half (45%) of this area is made up of commercial plantations. Yet such monocultures create additional pressure on land and hence nature, whilst being inferior from a climate and biodiversity perspective.

There is an emerging consensus that it is better for biodiversity, climate and preventing increased pressure on land to combine carbon sequestration and nature restoration as synergistic rather than separate land uses.

Bioenergy cannot power the world

Burning all the world's harvested biomass (all food, timber, cotton etc) would provide only 20% of global energy needs.



Bioenergy and Carbon Capture and Storage

As noted, using crops for bioenergy is incredibly inefficient, has incredibly high land use requirements and yet production will increase under most climate models because they rely heavily on bioenergy (with carbon capture and storage, or BECCS). These decarbonisation modelling and scenarios are used by countries to inform their national energy and climate plans for reaching the Paris Agreement goals.[65] Many plans rely heavily on so-called 'negative emissions technologies' (NETs) i.e. taking CO_2 out of the atmosphere, often to offset the need for greater emissions reduction, and BECCS is a star player.[66]

For instance, even in IPCC pathways limiting global warming to 1.5°C with limited or no overshoot (Pathway 1-3), the ones that rely on some BECCS (2 and 3) project far higher land is needed for bioenergy crops (an additional 0.7 to 2.6 million km^2 compared with pathway 1 without BECCS). The scenario in which emissions are not cut urgently (Pathway 4) places a strong emphasis on reducing emissions through BECCS, which would require 7.2million km^2 (700million hectares) of land.[67] Previous IAM models relying even more on BECCS implied an even higher area of 25-80% of global cropland needed[ii], and whichever model you look at massive deployment of BECCS implies huge land take that competes with food production and nature restoration.

Another key problem is that these technologies are not actually yet viable or tested at scale so relying on them to offset carbon emissions is an unrealistic and high-risk strategy, both from the climate perspective and in terms of land use implications.[68] Current CCS operations are also highly energy intensive, so very inefficient in terms of cost and impact.

Models generally assume that biomass for energy is inherently carbon-neutral (and thus that BECCS, by capturing and storing the emissions from combustion, is carbon-negative) but this is not a valid assumption. The land being used to produce the feedstock (such as maize, wheat, oils and wood pellets from e.g. eucalyptus and Sitka spruces plantations) will compete with land for nature, carbon sequestration (both above and below ground) and food production.[69]

The huge land take associated with many of today's *existing* bioenergy targets is worrying (see Section 2) but predicted expansion is hugely alarming.

One estimate suggests that if all the world's harvested biomass (currently used for food, fibre, wood, clothing etc.) and hence all globally productive land, was used for energy production, it would only produce around 20% of estimated 2050 energy needs (or 33% of today's global energy use).[70]

No spare land

Decarbonisation scenarios that advocate bioenergy justify its use based on 'sustainable' harvesting of forests or the availability of spare or unused land. Yet there is little 'spare land' – the potential land area for growing biofuels in Europe could at best supply 0.5-1% of current EU road transport energy needs – and would come with 'significant environmental impacts', including biodiversity loss and carbon impact.[71]

Recent assessments have concluded that from a climate perspective there is no such thing as 'spare land' for bioenergy. This land could be better used for food, feed, or sustained carbon storage, known as the 'opportunity cost'.[72] Often, land allocated for bioenergy is high in carbon and biodiversity but not necessarily forest e.g. grasslands.[73] Assumptions made that such non-forest land is not important for carbon storage or biodiversity need to be challenged. Similarly, taking biomass for energy from forests also decreases carbon stocks in forests, as well as harming biodiversity.[74]

In short, the direct and indirect effects of land use change related to NETs including BECCS need far greater challenge. Without significant policy measures acting on diets and food wastes, further extraction will not operate in harmony with nature and the climate. There are also significant justice and rights issues associated with land and land grabs from communities are already well documented for biofuels.

Despite these severe limitations and the social and environmental harm of BECCS and bioenergy from burning wood or crops, many agro-economic models still see bioenergy as a cost-effective option for mitigating climate as they do not yet factor these wider issues in.

Bioeconomy

The bioeconomy is all aspects of the economy which involve biological based materials. Many hope the bioeconomy will expand, pointing to the ability of biomass to sequester carbon when growing, and then used as feed, fuel or fibre, to replace existing products. This could be timber replacing concrete building materials or bioplastics to replace fossil fuels plastics. For instance, the use of 1 tonne of wood instead of 1 tonne of concrete in construction can lead to a 2.1 tonne carbon dioxide reduction.[75]

However, such products are challenged in the same way as bioenergy, in terms of how much land and other materials are embedded in them, which clearly also depends on consumption and production levels of these products, and the final use, reuse or recycling options. It is not possible to replace fossil-based products with bio-based products 1:1 without significant land use expansion. The European Commission has been pushing the bioeconomy but released an updated Bioeconomy Strategy in 2018,[76] which now stresses that the bioeconomy (including bioenergy) should be achieved within planetary limits.

There are always opportunity costs to increasing the demand for land for any products, which will always compete with vital biodiversity, climate and food needs. Switching to 'bio plastic' production without reducing consumption of such products is not the solution, and any net expansion of land being used to produce such items must be avoided.

[ii] https://theconversation.com/climate-scientists-concept-of-net-zero-is-a-dangerous-trap-157368

Section five

Modelling future needs

The use of integrated models can improve the understanding of land use under different future socio-economic settings. Combined with alternative socio-economic scenarios these can be useful in policy making.

Yet models are only as good as the data and assumptions fed into them and can be misleading and inaccurate when it comes to integrating complex land use information. Models that involve a greater land area response tend to assume that 'extra' land can be made available, likely at low additional cost, and to a large extent due to how they classify land and what land cover types can be expanded into.

The European Commission's basis for EU biofuel policy post 2020 is the GLOBIOM model, which seeks to better integrate land use changes into bioenergy emissions accounting.[iii] Whilst the model points to higher emissions from bioenergy than previously assumed for many feedstocks, it nonetheless indicates that up to 10% of land in the EU could be 'spared' for cultivating biomass for energy.[iv] However, this is based on the flawed assumption that the land classed as 'spare' for bioenergy, would not be absorbing carbon were it reforested or left to natural secession. According to Searchinger et al. 2018[v], 'methods for evaluating the effects of land use on greenhouse gas emissions systematically underestimate the opportunity of land to store carbon if it is not used for agriculture.'

When this assumption is incorporated, it becomes clear that dedicating any land to bioenergy is inferior in terms of reducing greenhouse gas emissions than simply doing nothing on a given piece of land. This is even before taking into account the value of alternative land uses for biodiversity and other ecosystem services. For example, on agricultural land, there is significant evidence that dedicating at least 10% of land to space for nature would dramatically increase populations of farmland birds that are in serious decline. There is therefore a need to both better integrate the 'opportunity cost' of using land for bioenergy into land use models from a climate perspective, and also to analyse the biodiversity and other ecosystem values of allowing natural secession, such as flood defences and soil erosion.

Recognizing that all land is not equal in terms of biodiversity and carbon stock value, and whether a piece of land is suitable to grow crops or is protected, is information that needs to be carefully fed into models. Often models fail to recognise differences in impacts – such as assuming that conversion from forest to agricultural land is the same as the reverse. A study in 2015[77] reviewed the estimates of available global cropland across different models (for instance for use in energy crop production). They found that differences in the estimates of 'available land' link to the assumptions built into models, such as: which land covers or uses can be converted to cropland and the ease of doing so; assumptions regarding land regulation; and the different underlying data sources. Outcomes ranged between 5,131 and 1,552 million hectares available depending on which constraints and assumptions were used. The highest suggests there is land available over three times the current cropped area.

Models also tend to discount costs to biodiversity and climate, overstate climate benefits of bioenergy and ignore the land use implications and the opportunity costs. They take an optimistic view of bioenergy and can be flawed in several critical ways:

- They prioritise food production and bioenergy, keeping these factors stable, over biodiversity conservation. The value of preserving biodiversity and its role in maintaining the productivity of ecosystem functions and in mitigating climate change are not well incorporated. This is best highlighted by the importance given to bioenergy as a negative emissions solution in these models.
- They do not factor in many of the costs of using new land for bioenergy or food and see this land as 'spare' rather than having value as natural habitat. Many models are now introducing specific forest modules to account for driving forces of demand for wood products. Afforestation as a means of carbon sequestration is likely to drive forest cover at the expense of agricultural land in some cases: the impact of afforestation from natural to plantation on biodiversity and carbon storage is not well captured in models.
- They focus on the choice between increasing yields on existing land versus expanding into new land, treating consumption as constant rather than looking, for instance, at the role of dietary shifts and demand side policies.
- They treat bioenergy as carbon neutral which makes it fare better from a climate perspective, but still ignore opportunity costs associated with ecosystem degradation.

A cross-checking function on land suitability and true costs, which would be complicated by land rights and ownership, should be included into models for the purposes of policy development.

It is possible to do this modelling much better, such as those conducted by the Food and Land Use Coalition (FABLE) network which set limitations for the future based on goals to for biodiversity, climate change and the food provision in a sustainable way. Their approach – based on detailed work in 20 countries[78] – presents pathways towards sustainable land-use and food systems for these countries and show how countries can meet mid-century objectives on food security, healthy diets, greenhouse gas emissions, biodiversity, forest conservation and freshwater use.

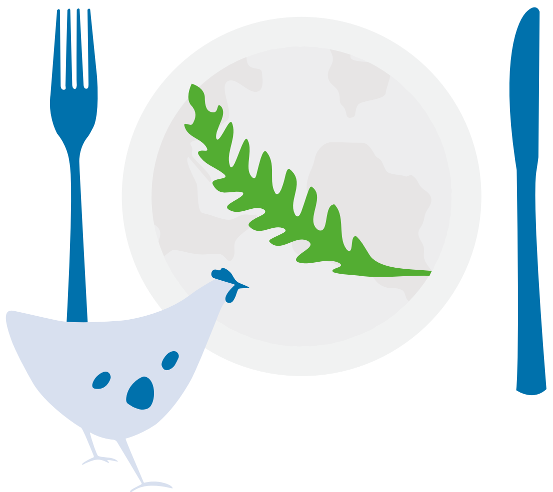
[iii] https://www.transportenvironment.org/sites/te/files/publications/2016_04_TE_Globiom_paper_FINAL_0.pdf
[vi] This has now been incorporated into the EU's long-term vision for a climate neutral Europe, consisting of a 25-page communication supported by a 400-page staff working document (SWD).
[v] https://www.nature.com/articles/s41586-018-0757-z

Section six

How changing diets and food waste can cut land pressure

Conventional Dairy Farm in Germany © Fred Dott Greenpeace

Demands change, in both what we eat (such as moving from meat to more plants, or beef to chicken), how its grown and what is wasted, are needed to achieve sustainability goals and changes to consumption away from livestock heavy diets will be key.



Research suggests that by growing food exclusively for human consumption – rather than using crops for livestock feed and biofuels – global calorie availability could be increased by as much as 70%, feeding an additional 4 billion people.[79] Several studies indicate that halving consumption of meat (all types) by 2050, would lead to an estimated 23% decrease in cropland required in the EU,[80] and the IPCC similarly suggested in their land report that dietary changes are vital. These shifts are needed but must not result in conversion of important biodiverse rich areas, such as unimproved grasslands, to food production.

In terms of how food is grown, as noted previously studies have indicated that we can feed the world using organic systems without increasing demand for agricultural land, using largely existing pasture-fed livestock and cutting food waste by half.[81] The IDDRI[82] study showed that we can reduce EU's land use for agriculture by 2% overall, produce agro-ecologically on the remaining land, including 10% of farmland reserved for nature ('agroecological infrastructures'), and even continue to export some produce. We would need to cut production of meat and dairy by 40% and end biofuel production. The land saved would then still allow for maintaining extensively managed grassland habitats for biodiversity purposes.

Addressing food loss (on farm, in transit) and waste (retail and consumer) can save significant amounts of land needed for agriculture. The FAO estimates that around a third of the world's food was lost or wasted every year, from production to consumption, representing a huge waste of land.[83] In Europe, a 60% reduction in food waste by 2030 would reduce Europe's land-use burden by an area larger than Croatia.[84]

One mistake of the land sparing versus land sharing concept that predominates in some discourse is that it assumes consumption to be a constant whereas this should not be the case given the inefficiencies and harm caused by current western diets. Policies to shift consumer food waste have been partially successful[85] and dietary shifts through, for instance, education or changing public procurement to use fewer high land consuming products, could have significant impact if done well. Political responses can often be rapid, for example, in response to food price and availability shocks as seen in the 2007/2008 commodity crisis. Whilst not necessarily a desirable tool, this led to some countries implementing export bans to rapidly protect domestic markets and consumers in the face of scarcity.[86]

Cutting consumption and therefore demand for land for meat and dairy (and forestry), eliminating biofuels, and drastically reducing food waste, would significantly relieve pressure on land, allow agroecological methods and open possibilities for restoration of habitats like grasslands, peatlands and forests.

Section seven

External dimensions and equity considerations

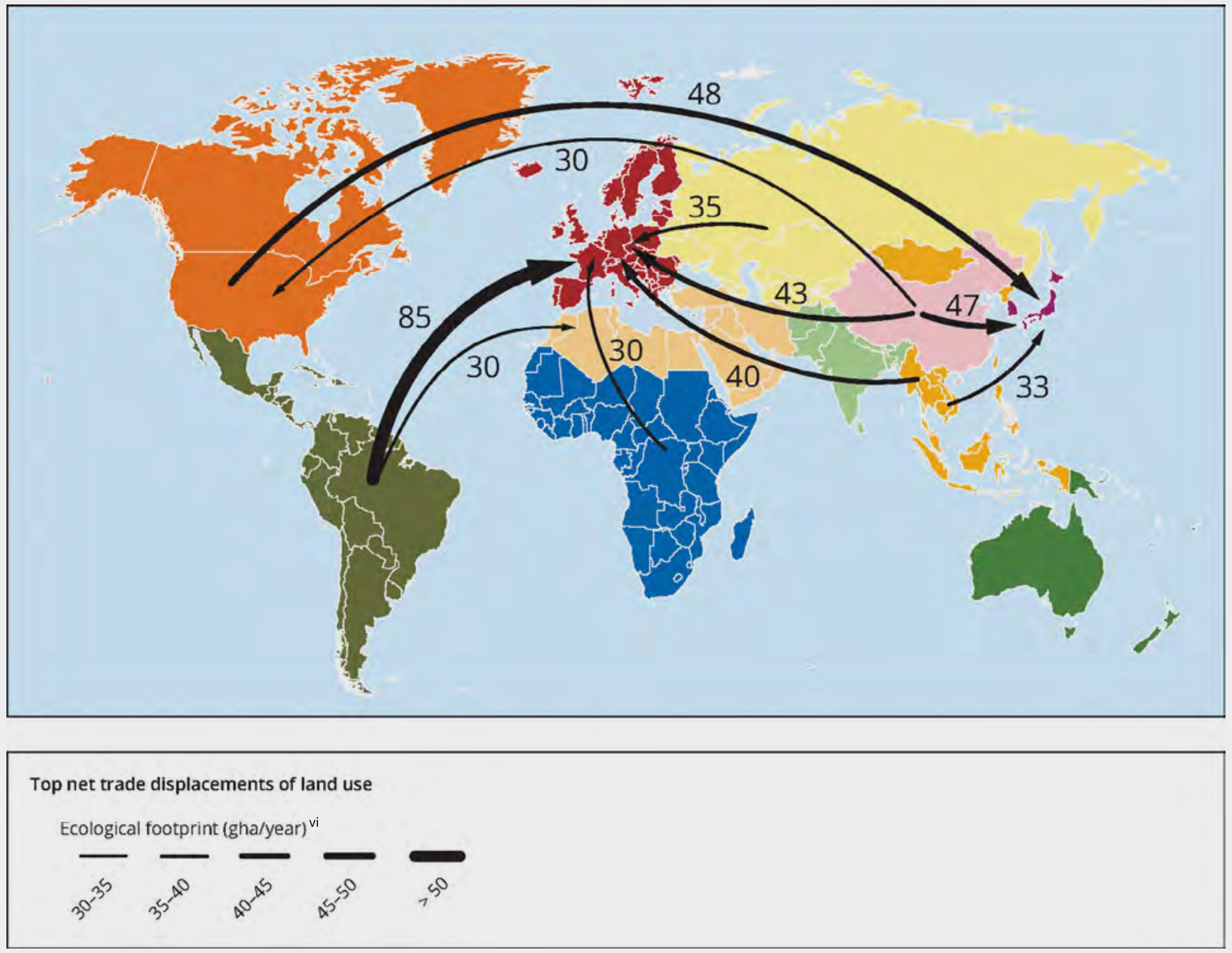


Figure 3 Top net trade displacements of land use (EEA)[87]

There is an equity consideration in terms of land use and where nature is conserved and restored: it would be hypocritical for regions such as the EU to demand that other countries stop destroying their nature rich ecosystems such as forests, whilst Europe continues to do so. Such an approach could also undermine efforts at global level to achieve climate and biodiversity targets and the Sustainable Development Goals. From the nature perspective alone, species need habitat in all countries and across all landscapes.

Currently, Europe is responsible for much 'environmental dumping' due to the lack of action given to addressing consumption of raw materials by industries including agriculture, and the lack of action to address unsustainable western dietary habits. Whilst European countries have historically promoted themselves as feeding the world, and whilst the EU is a net exporter of agricultural products, it is also a net importer of *agricultural land* in the form of feed imports. See **Figure 3**.

We need better ways of distributing the burden of area-based conservation fairly and providing the resources for gathering data, mapping, and developing stakeholder processes for shared goals in all nations.[88] Additionally, much of the area seen as having production potential is occupied by indigenous groups or subsistence farmers who are rarely considered in analyses of the results and who should be involved and have agency in any proposed changes.

[vi] gha/year = million global hectares per year

Section eight

Conclusions and Principles

Ensuring the right use of land is critical for climate, biodiversity, and sustainable development targets and this will require pathways for short-, medium- and long-term action. Studies analysing the results of, and differences between, models of future land use, conclude that the future of land use is critical for environmental and climate perspectives.[89]

Given that 50% of habitable land globally is agricultural land and 37% is forests, these sectors are key areas for action. We need to deliver nature protection and in additional restoration, of which a majority is not exploited, and the rest harvested at very moderate levels.

Land is finite, so we cannot simultaneously prevent conversion of natural landscapes and expand agriculture and bioenergy production. Nor can we continue to intensify through increased inputs without further depleting soil and water quality, which may ultimately lead to land abandonment and expansion into new frontiers. We need to boost the use of agro-ecological farming techniques with landscape and nature areas on farmed land to secure in field benefits for nature and climate. Consumption changes will free up space needed for large scale nature restoration.

Growing demands for **bioenergy** and other bio-based products will increase pressure on land and ecosystems, and whether this can be kept at sustainable levels or combined with nature conservation goals will depend on how much is expected to be produced. The debate on how much land is available for these is often flawed as it is based on a question of what land assets can be sacrificed. Incentivising and subsidising the production of bioenergy, afforestation, and other forms of land use is damaging. Instead of prioritising biofuels, we should be promoting renewables like wind and solar and restoration of natural ecosystems and sinks.

We still need to **feed a global population** and we need to make food production more sustainable whilst not increasing demand for land. Overall, we need to stop agriculture expansion and ultimately reduce the amount of land for farming so we can sequester more carbon in abandoned lands through natural regrowth but avoiding harming biodiversity.[90] Land is rarely valued equally by all competing users, so a more comprehensive look at the true cost of land use and conversion is needed. For example, deforestation can severely impact on neighbouring crops by affecting rainfall and climatic shifts outweighing any benefit of converting the forest land, yet short term gains often dominate decision making.

We need a system-wide change in our approach to land use; moving away from land sparing versus sharing arguments which fail to account for supply and demand side drivers. **Models** are used to address these issues, but the results are often interpreted differently between groups. Too often viewed in isolation and without full understanding of assumptions and goals, they can lead to a shift in public, industry or sector opinion which then influences policy. The inclusion of environmental true cost factors and new land use paradigms into integrated economic models will help determine system wide implications of a land use transition. Such modelling is being done but needs mainstreaming.

Much of the land area identified for production potential is occupied by **nature or by indigenous groups or subsistence farmers** who are rarely adequately considered in models or analyses of the results. Biodiversity and indigenous land rights need to be better incorporated into the models and decision-making process.

The evidence suggests that future nutritional security can be achieved through efforts which protect biodiversity, ensure food access and emissions reductions, namely: switching to better renewables that do not rely on combustion of natural resources, dietary shift, cutting waste and nature restoration.

Considering this, we propose a set of principles that can guide the assumptions and policies (including targets) of the EU and Member States going forward about what and how much we use land for, and what the practices on that land should look like:

1. **Systematic management of land use** – needs to be adopted at EU level as well as national and local to avoid unacceptable trade-offs from a biodiversity and equity perspective.
2. **Space for biodiversity** – sufficient land needs to be dedicated to biodiversity conservation and natural climate sequestration (i.e. 30% by 2030 globally), and any policies which affect land use in the EU or overseas, must consider and avoid impacts on biodiversity, nature connectivity, and be synergistic with ecosystem restoration.
3. **Better land use assessment and modelling** – the interests of nature protection must be better incorporated into assessments of future land use as well as economic costs of environmental harm (such as soil biodiversity degradation impact on yields). In all land-climate-energy interaction studies using integrated models the local biodiversity, social, and environmental issues should be addressed in an ex-ante assessment. Many outputs would be different if full environmental impacts were properly accounted for in decisions.
4. **Decarbonisation before energy crops and offsetting** – decarbonisation should be a priority above expanding land intensive energy production (such as energy crop or wood pellets). Our energy future must be based on wind, solar and geothermal. Renewable energy (wind and solar) and related infrastructures should be pursued in the most biodiversity friendly manner possible, including through spatial planning, technical mitigation, and balanced deployment of technologies, in line with ecological carrying capacity.
5. **Protect nature-based solutions** – natural forests and other natural carbon sinks must be retained, and carbon sequestration should always contribute to ecosystem and biodiversity health and resilience. Climate adaptation policies should prioritise solutions that specifically enhance and work with natural habitats. In addition, some biodiversity habitats are important and should be protected even when not necessarily carbon intensive e.g. sand dunes.
6. **End global land degradation by Europe** – the EU must ensure that no policies and activities drive extinctions and ecosystem degradation beyond its borders.
7. **Inclusive policies** – ensure that citizens, indigenous and family farming communities are directly involved in decisions which affect land use and land use change.
8. **Nutritional food security** – feeding the world nutritiously and sustainably must be not only about quantity of food or calories, but also what is produced, its nutritional value and how it is distributed and used.
9. **Dietary shifts** – to manage the challenges we need to be halving meat and dairy consumption and production in the EU by 2030, cutting food loss and avoid overproduction though better infrastructure, and forecasting by supply chains and halving food waste by 2030 (from farm to fork).
10. **Farming agro-ecologically** – we need to shift our EU farming systems to agro-ecological production which includes habitat for nature inside the farmed landscape (i.e. not ‘land sparing’), and so delivering on SDG 15: Life on Land, as well as covering climate goals.
11. **Avoid agriculture expansion** – we must avoid expanding the agricultural frontier, which means addressing consumption, meeting our protein needs in a much more efficient and healthy way than is currently the case.
12. **A circular economy** – we need to aim for full circularity of material use, doing far more to encourage reduction in material needs, reuse and clean recycling and replacing the linear growth paradigm with one in which humans can live decent lives in harmony with nature and the limits of the planet.

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