

AGRICULTURE

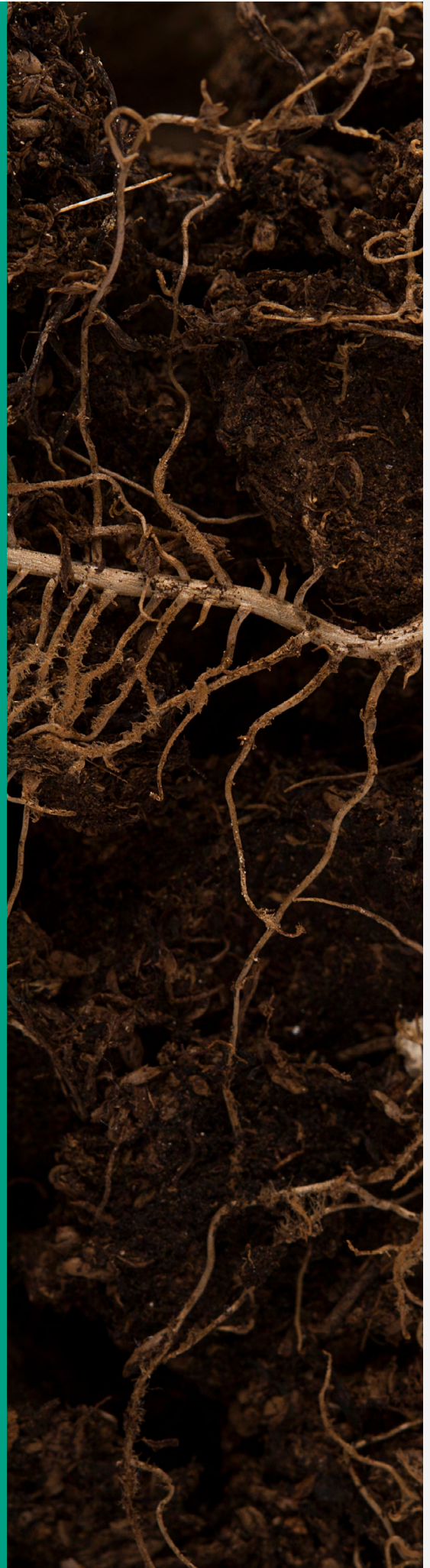
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REPLANET

INTRODUCTION

Let's set nature free.
With human help, global biodiversity can recover from the current crisis. Degraded lands can rewild. Thousands of species can be brought back from the brink of extinction. Our actions can make it possible for ecosystems to flourish, ensuring a thriving, diverse and livable planet for generations to come.



THE CHALLENGE

The last century has not been easy on the natural world: wildlife habitats are dwindling and splintering to ever-smaller fragments. We are using more than half of all habitable land for agriculture. While the rich world suffers from over-consumption, far too many people still go hungry. Should we continue expanding current farming practices and meat-heavy dietary patterns we could soon run out of wilderness.



OUR SOLUTIONS

- **Put a stop to agricultural expansion.**
By embracing new protein sources and food innovation, supporting health-conscious diets rich in vegetables, reducing food waste, and encouraging a smarter use of agricultural land with full access to novel methods applied responsibly, we can cut our land-use needs by more than half.
- **Abolish meat subsidies.**
EU funds earmarked for climate and the environment should be used accordingly. We must fully implement payments for ecosystem services and invest in the emerging alternative protein sector to reduce emissions and the use of land and water while alleviating animal suffering.
- **Change too restrictive, outdated regulations.**
The EU must make it possible for Europeans to partake in food innovation and the use of modern genomic methods with clear environmental benefits.
- **Apply the three compartment model of agriculture.**
Sustainable intensification provides food on most productive lands (1) while biodiversity-friendly low level farming on marginal lands serves as a buffer zone (2) for lands dedicated to true wilderness (3).
- **Rewild and protect half the globe.**
Dedicate land spared from agriculture to conservation and restoration of ecosystems that are of strategic importance for biodiversity and climate mitigation.



RePlanet Position on European Agricultural Policies

FOR THE LOVE OF THE LAND WE SHARE

We at RePlanet listen to environmental scientists when they say that freeing up more land for true wilderness is the most critically important goal for conservation efforts.

Land is our living space and also the home for all terrestrial wildlife. It is perhaps the most precious resource of all, and we should share it with great care. No space equals no wildlife habitats. The greatest threat to wildlife by far is humanity's most land-intensive endeavour: farming^{1,2}.

The choices we make about our food system and energy sources, however, can help us both protect remaining untouched wilderness and free up swaths of land for rewilding. Food innovation can facilitate a major shift towards plant-based diets by offering better alternatives to meat. Farming can be concentrated on the most fertile soils, while marginal lands can be returned to nature. Taken together with efforts to tackle food waste while using the best mix of agricultural practices and technologies, we think it is possible to liberate 30 to 50 percent of current agricultural lands and rewild them. Supporting the expansion of thriving, biodiverse carbon-rich environments is a win-win for both nature and the climate.

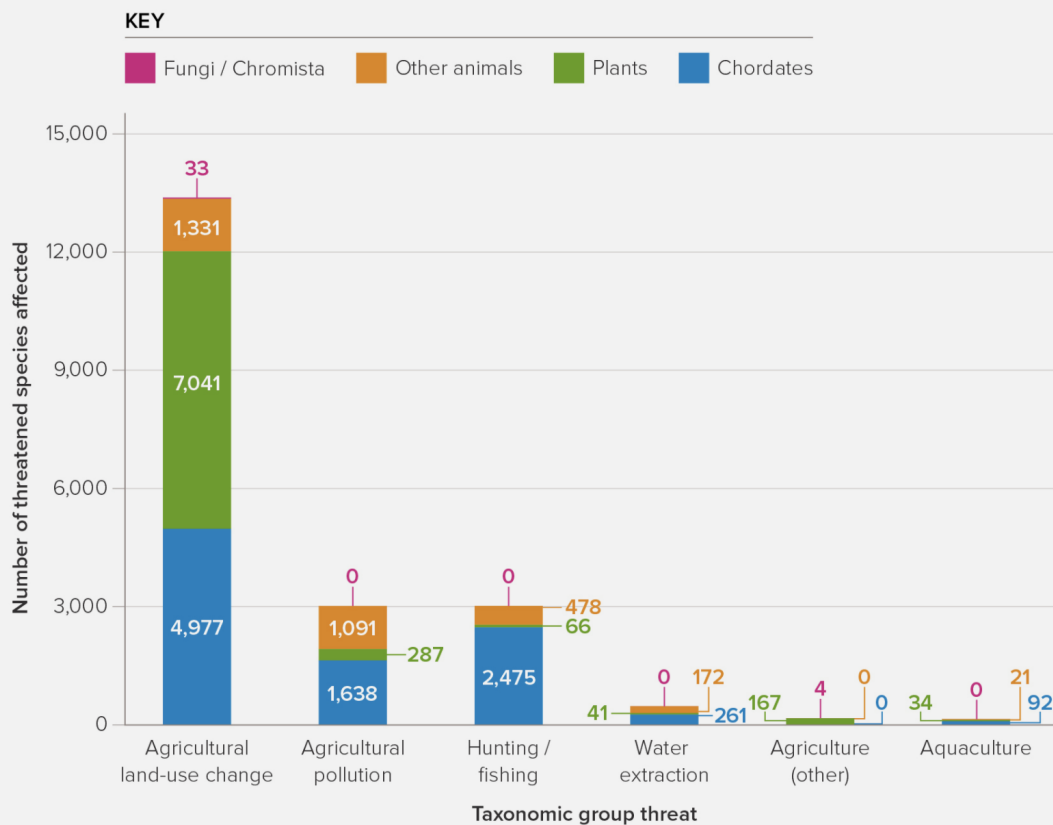


Fig.1 from Tilman and Williams Preserving global biodiversity requires rapid agricultural improvements²



IT'S TIME FOR A FOOD (R)EVOLUTION

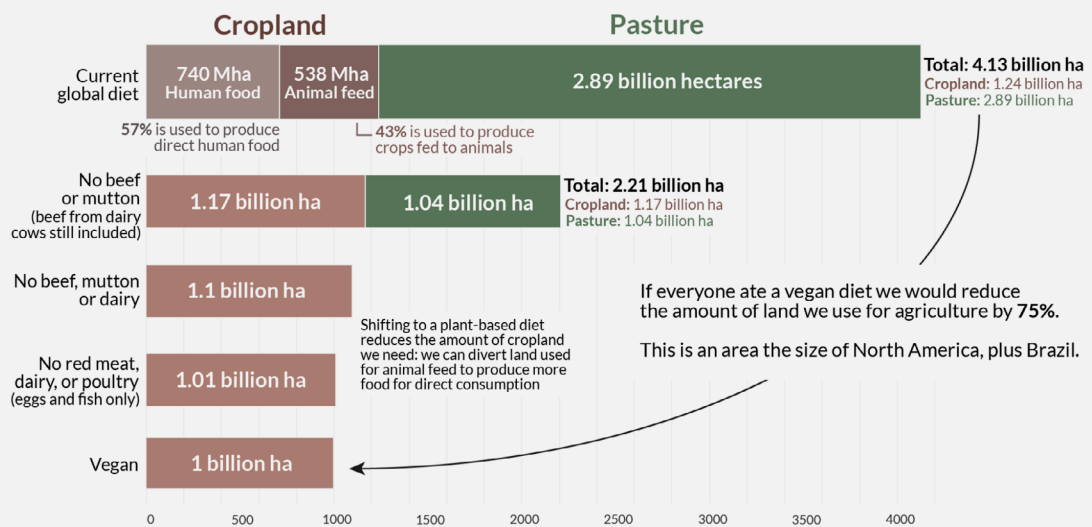
Humans are using half of all habitable land for agriculture. Most of that land is not used to grow crops for humans directly, but to provide pastures and produce feed for domesticated animals. The scale of our livestock sector is huge. Humanity's yearly consumption of mammal meat alone equals twice the mass of land mammals in existence 10,000 years ago³. The coming century will see the peak of human population growth, but an expansion of the types of diets currently prevailing in Europe and other rich countries of the world for a population of 11 billion humans would spell the end of all remaining natural habitats⁴.

We can reverse that trend. Embracing new protein sources and food innovation^{5,6}, reducing food waste, supporting health-conscious diets rich in vegetables, and encouraging a smarter use of agricultural land can put a stop to agricultural expansion⁷, and even cut our land-use needs by more than half⁸.

Global land use for agriculture across different diets



Global agricultural land use is given for cropland and pasture for grazing livestock assuming everyone in the world adopted a given diet. This is based on reference diets that meet calorie and protein nutritional requirements.



Data Source: Joseph Poore & Thomas Nemecek (2018). Reducing food's environmental impacts through producers and consumers. *Science*. OurWorldinData.org – Research and data to make progress against the world's largest problems. Licensed under CC-BY by the author Hannah Ritchie.

There is still work to be done to get our agricultural policies in tune with these goals. European lawmakers have been hesitant to commit to any targets for reduction in meat consumption⁹, and yearly billions of euros go to subsidising livestock farming (with €3.6m EU aid money even going to a campaign to promote “beefetarianism” in 2020¹⁰) and other policies that have at best a neutral, or likely a negative impact on emissions and land use¹¹. We don't have time to use our subsidy money in opposition to what is needed for meeting our climate goals. A 2019 IPCC Special Report identified diet changes as one of the practices with the largest potential to help with emission reductions, land requirements, and food security¹².



ALTERNATIVES TO ANIMAL AGRICULTURE- PRECISION FERMENTATION & CULTURED MEAT

As has been said before, the Stone Age did not end because we ran out of stones, but because better technology was developed. The variety of alternatives to animal products on the markets is increasing at a great pace, and many plant-based products are becoming increasingly similar to familiar meat products, making it easier for consumers to shift their diets. Among the most promising new technologies is the use of genetically modified microorganisms for the production of animal fats and proteins, such as those found in meat, eggs, and milk. The first applications of microbial fermentation – like cheese and sauces – can be expected in the next few years, and some, like ice cream made with microbially produced milk proteins, are already available^{13,14,15}.

Meat products can be made from ingredients produced by microorganisms or directly from animal cell cultures (cultured meat). The first cultured meat is already commercially available, albeit limited to chicken nuggets in Singapore¹⁶. But things are moving fast. Worldwide more than 60 startups are developing cultured meat, chicken and fish¹⁷. The greatest challenge is reducing the cost of production, particularly the cost of the growth medium¹⁸. For a large part this medium consists of sugars and amino acids, but the biggest cost items are the signalling proteins that control the growth of the cells.

The environmental impact of cultured meat is minuscule compared to meat, especially beef. Life cycle analyses show major reductions in emissions, land and water for alternative meat and dairy^{19,20}. An important prerequisite is that the necessary energy is produced in a sustainable way, but if that is the case, cultured meat is also more sustainable than chicken or pig meat. Considering these benefits, governments and other institutions should support innovation by investing in research and creating an industrial ecosystem in which novel food tech startups can thrive and become fully fledged companies. It is also important to implement regulations that allow novel methods to contribute to sustainability goals, including genomic techniques that have been largely restricted in Europe against the advice of its own scientific advisory institutions²¹.

RePlanet understands that eliminating meat from our diet requires a big change in culture. Meat production and consumption is ingrained in our identity, and has deep historical and societal meaning. Human cultures are not static however, and can change fast, often galvanised by technological possibilities. Societies have experienced revolutionary changes before such as the invention of agriculture, the introduction of the printing press, and the development of contraception. Technology has facilitated great shifts in norms and values sometimes within one generation. As new generations are introduced to new modes of food production and can witness significant improvements in their environment, they might be more easily swayed.



LET'S SPARE LAND FOR NATURE

Considering the great threat agricultural land use poses for wildlife, it is important to find the optimal way to combine food production and biodiversity conservation^{22,23,24}. Two approaches have been proposed²⁵: land sharing, in which agriculture with lower yields makes farmland more hospitable for a diversity of plants and animals; and land sparing, where high yielding agriculture is concentrated on a limited space to make room for nature.

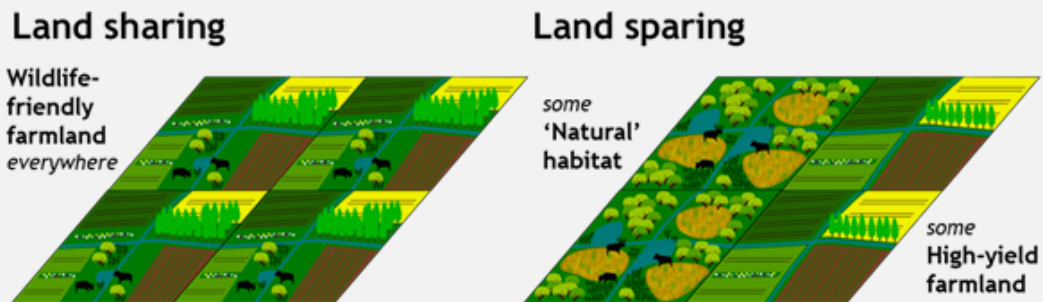


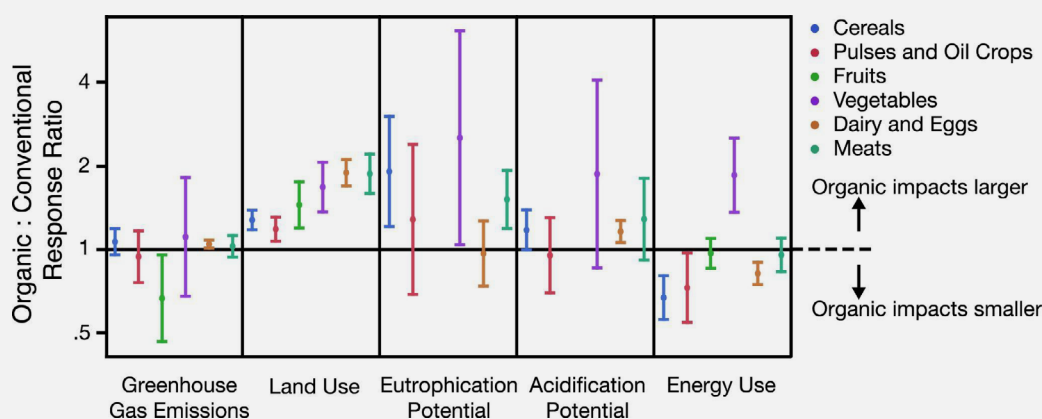
Image courtesy of Tom Finch on Royal Society for the Conservation of Birds, Centre for Conservation Science^{26,27} (Finch et al.).

Over the last fifteen years researchers have visited places as varied as Ghana, Poland and Colombia to study the abundance and richness of biodiversity in terms of birds, beetles and plants, and compare these with agricultural yields. The results show unequivocally that land sparing works best in all places and for all taxa, and the reason for that is quite straightforward: many species occupy specialised niches in natural habitats²⁸. When these habitats are disturbed by even low yielding agriculture, these specialised niches disappear and with them the species that depend on them. It doesn't matter how wildlife-friendly a farm is, the biodiversity on an agricultural field will always be marginal compared to the natural habitat it displaced. While lower yields might lead to higher biodiversity when looked at on a farm level, zoomed out to a regional or global scale they are detrimental.

It is high time these new insights found their way into policies. While the European biodiversity strategy acknowledges the importance for nature conservation and restoration, with a target of protecting 30% of land and seas²⁹, the current Farm2Fork strategy of the European³⁰ Commission still bets on land sharing with a goal to increase the area under lower-yield organic farming.



The EU biodiversity strategy demonstrates a concerning lack of focus on the greatest threat underlined by conservation scientists – that of agricultural expansion. There is no discussion in the EU targets about producing more food per field and reversing the trend of land clearance; instead they concentrate on first and foremost reducing inputs like fertilisers and pesticides. These are important areas of concern, however they should not be considered in a vacuum, but while looking at the system as a whole. We should minimise inputs in a way that does not cripple yields or increase land use and other harmful externalities. These considerations are not apparent in EU’s ambitious target of subsidising a several-fold increase in organic farming, even though comprehensive analyses find that per unit of food, organic systems require more land and cause more eutrophication than their conventional counterparts^{31,32} (see figure below).



This EU policy is particularly at odds with the science on nature conservation, which underlines the need to restore wildlife habitats and protect further areas from conversion into farmland. Lower yielding agriculture is indeed associated with higher on-field biodiversity, with some of the yields lost in favour of more weeds and insects³³, but a large body of evidence illuminates that this kind of approach entails serious negative consequences for nature conservation at large. On a global scale, environmental scientists stress that high yield farming is instrumental to avoid further farmland expansion, because freeing up more land for true wilderness, not for more field area, is the most critically important goal for conservation efforts^{34,35,36,37,38}. The kind of species that benefit from lower-yielding farm landscapes are generalist species, whereas the most vulnerable ones live in ecosystems displaced by fields^{39,40}.

Overly narrow policy focus on organic farming can also be a risk for food security, as was recently seen in Sri Lanka, where a national shift to organic farming⁴¹ caused food shortages, price hikes, and contributed to a declaration of a state of emergency. This goes to show that agricultural challenges are complex, and we need to take the voices of environmental and agricultural scientists seriously if we are to enact sustainable change.

RePlanet considers the EU target of protecting 30% of land and seas⁴² too modest. The EU designation includes a wide definition of protected areas, not strictly wilderness but also areas with low-level



agriculture or forestry. The 2021 UN joint report on biodiversity and climate change (IPBES-IPCC⁴³) suggests that the extent of effectively protected and conserved areas needed to ensure a habitable climate, self-sustaining biodiversity and a good quality of life might range from 30 to 50 percent of all ocean and land surface areas.

We need to do better, and if we use all the tools at our disposal, we can.

Food production should be concentrated on the most fertile soils, while marginal lands can be returned to nature. Combined with a drastic reduction of meat consumption, tackling food waste and demand side interventions, we think it is possible to relinquish 30 to 50 percent of current agricultural lands and return them to nature.

THE THIRD COMPARTMENT - THE NEED FOR VERY LOW YIELDING AGRICULTURE IN EUROPE

For the larger part of the world, and especially in the biodiverse tropics, a two-compartment system with high yielding agriculture and (rewilded) nature is the best way to combine food production and biodiversity. Researchers suggest that Europe, and especially North Western Europe, will require a third compartment to accommodate wildlife that has adapted to centuries of agricultural activity⁴⁴. This mainly involves farmland birds like the godwit, corncrake and the skylark and field herbs like cornflower, chamomile, wild mallow and poppy. Many of those species have high cultural value as part of traditional landscapes, but their numbers have been dwindling for decades^{45,46}.

To beat this trend, countries have implemented schemes and subsidies to make intensive agriculture more hospitable for wildlife, by for instance reinstating hedgerows, postponing mowing or the introduction of flower strips. Recent studies in the Netherlands and the UK show that all these policies hardly have any effect, mainly because yields are still too high and farming remains too intensive to accommodate the targeted species. To restore traditional farmland biodiversity, yields have to drop drastically (to approximately one tenth) for the targeted plants and animals to flourish⁴⁷. Economically this is not feasible for farmers without support. It also means that agricultural land use would have to rise dramatically to maintain the current level of food production.

RePlanet advocates for a three-compartment system, where the area spared by high yielding agriculture is not only rewilded, but in some places turned into traditional landscapes with very low yield, and where food production is only a secondary goal. Meanwhile the bulk of the food is produced on high yielding farmland using intensive and technologically advanced methods. The traditional landscapes



have high recreational value and should especially be planned around cities and in conservation areas and national parks. They also serve as a buffer, minimising the edge effect of farms on nature.

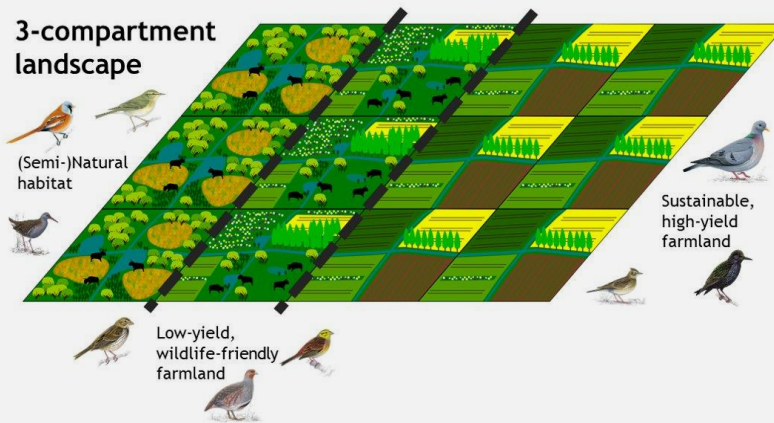


Image courtesy of Tom Finch at Royal Society for the Conservation of Birds, Centre for Conservation Science.^{48,49}

RePlanet feels a dedicated vision of a new European landscape for 2050 is necessary. We should incentivise high yield farming in areas best suited to food production, identify and protect areas most important for conservation and rewilding⁵⁰ and offer ecosystem service compensation in areas best suited for the very low level, third compartment agriculture. RePlanet supports the founding of an IPCC-like body to guide land use on a global scale.



LET'S AVOID BURNING STUFF FOR ENERGY

Increasing incentives for the burning of biomass and using productive cropland for biofuels can exacerbate deforestation, nitrogen losses and water scarcity, and increase food prices^{51,52,53} and the European Academies' Science Advisory Council warns⁵⁴ that simply swapping coal with biomass does not reduce but increases net emissions to the atmosphere. Yet current EU carbon accounting rules encourage the use of bioenergy by assigning it a zero emission status under the Emissions Trading System⁵⁵. This creates a loophole that could lead to unacceptable climate-damaging approaches. A realistic carbon balance for the energy use of biomass should be calculated instead. This balance sheet should take into account the characteristics of different types of biomass in order to avoid, for example, the burning for energy of wood more suitable for use as a building material.

Climate change is currently worsened by biomass burning, and nature protection requires land sparing for wilderness. For these reasons, RePlanet calls for a moratorium on large-scale biofuels.



Wood from sustainable forestry can be used more favourably to lower emissions through use in long-lived products such as furniture and construction. The making of cement and steel is an emissions-heavy process – these two industries together are responsible for more than one tenth of worldwide anthropogenic emissions^{56,57}. Using wood as a construction material sequesters carbon instead, and technologies for producing cross-laminated timber have been developed that are suitable for large projects like bridges and high-rise buildings, including the 85-metre high housing block Mjøstårnet in Norway.

Mjøstårnet at its opening in March 2019. Photo by Nina Rundsvæn CC BY-SA 4.0.

A biobased economy⁵⁸ will also play an important role in producing raw materials for textiles, plastics and chemicals which still rely heavily on fossil sources, such as PET bottles and other everyday objects. We need our governments and other institutions to speed up development through regulations and standards that incentivise emission reductions and better recycling practices, to enable a sustainable way of incorporating biological raw materials rather than burning them for energy.



LET'S IMPLEMENT POLICIES THAT WORK

Instead of relying on problematic legacy regulations or novel initiatives that only look good on paper, we need policies that support actual changes for the better. We need to move away from prohibitive regulations that unnecessarily restrict our ability to adopt methods with environmental and health benefits, as well as those that directly incentivise the types of farming that impose a greater burden on the natural world.

One example is the current EU GMO legislation⁵⁹, based on a late 1990s precautionary understanding of biotechnology, which leaves Europe without access to current and future gene-edited crops. These include varieties like fortified tomatoes, soybeans with healthier fatty acid profiles, and staple crops with nitrogen-fixing bacteria for fertiliser reduction, as well as drought-tolerant and heat-resistant plants for the purposes of climate adaptation and mitigation⁶⁰.

The 2021 EU impact assessment⁶¹ pointed out that the old legislation has failed to consider the societal and environmental benefits these techniques have to offer, because it was never designed to promote the sustainability of the food and agricultural sector. An overhaul of this prohibitive regulatory system is urgently needed to correct this oversight.

An example of direct incentives for environmental harm are the current large EU subsidies of animal agriculture. We can look to a better example in Costa Rica, where cheap credit for cattle initially contributed to record rates of deforestation. After the 1980s, however, cattle subsidies were abolished and replaced with a program with payments for environmental services⁶², funded partly by a small tax on fuel. From 1996, landowners could sign five or 10-year contracts for services including carbon sequestration, biodiversity protection, water regulation and enhancing landscape beauty. As a result Costa Rica more than doubled its forests in a few decades, going from a quarter to more than half of its land area covered with forest⁶³, an encouraging example in contrast to the global trend of net loss in tropical tree cover⁶⁴.

The EU should also be capable of using funds earmarked for climate spending for causes like forest protection, reforestation, sustainable forest management and agroforestry. Manipulating the market in favour of an environmentally burdensome livestock sector and a major expansion of lower yielding farmland are not ways to contribute to either climate or nature conservation goals. Instead, the science on biodiversity calls for policies that support sustainable intensification of our most productive arable lands⁶⁵, allocating marginal lands to very low yield agriculture that provides landscape and ecosystem services, and serves as protective buffer-zones to wilderness. This three-compartment model would allow us to concentrate our farming footprint while leaving more room for species and carbon⁶⁶.



THERE IS GREAT POTENTIAL FOR CHANGE

The outlined RePlanet strategy is the result of our dedication to ‘elevating humanity and liberating nature’. We are committed to finding solutions that can revitalise our planet in a way that will allow us all to thrive. The important avenues of change that we advocate for are based on thoughtful considerations of decades of scientific inquiry, and they overlap with the most promising objectives outlined in the 2019 IPCC Special Report on Climate Change and Land⁶⁷.

Out of the forty major practices reviewed in the IPCC literature, the nine approaches with the strongest potential positive effects are directly reflected in RePlanet’s strategy (see table below), while we advocate against large-scale implementation of the one approach with most apparent potential for negative effects: bioenergy⁶⁸.

Let’s focus on the strategies with greatest potential for positive change, and together lay a path to a shared future on a flourishing, revitalised planet.

Practice	Mitigation	Adaptation	Land degradation and desertification	Food security	Corresponding strategy RePlanet advocates for
Increased food productivity	L	M	M	H	Sustainable intensification (SI)
Agroforestry	M	M	M	H	The 3-compartment agricultural mosaic
Reduced deforestation and degradation	H	L	L	L	SI, diet change, reduced waste to halt agricultural expansion
Reforestation and forest restoration	M	M	M	M	Rewilding
Afforestation	M	M	L	M	Rewilding
Increased soil organic carbon content	H	L	M	L	No-till, conservation agriculture
Bioenergy and BECCS	H	L	L	L	Moratorium on large scale energy crops
Reduced post-harvest losses	H	M	M	M	Infrastructure investment in developing world
Dietary change	H	ND	H	H	Embracing diet change and food innovation
Reduced food waste (consumer or retailer)	H	ND	M	M	Campaigns to reduce food waste

Field color:
No effect
Large positive
Moderate positive
Small negative
Moderate negative
Large negative
Variable

Letters, confidence:
H=high
M=medium
L=low
ND=no data

This table summarises the nine practices from Smith et al with the most positive change potential in the areas of climate mitigation and adaptation, land degradation, and supporting food security. Their analyses formed a component of Chapter 6 of the IPCC Special Report on climate change, desertification, land degradation, sustainable land management, food security. The right-most column connects RePlanet strategies with these most important avenues of change to support environmental goals and human welfare.



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