FOOD & AGRICULTURE

IMPACT VISION



SHIFT

v1.0 (July 2024)

FOREWORD

SHIFT Invest's mission is to fight climate change, biodiversity loss and natural resource depletion. SHIFT invests in four high burden sectors: Food & Agriculture (F&A), Energy, Mobility & Logistics and Green Industries. In this document, we share our impact vision for F&A. We believe a shift is needed in the way we use our land, water and soil. This change needs to be fundamental to ensure we maintain access to nutritious food in a way that is less damaging to our planetary system.

The purpose of this document is **to outline key drivers of negative impact along the value chain on the one hand, and solutions** that have been shown to have the **greatest magnitude and importance**, collated from key academic institutions, interest groups, and (non)governmental organisations[1] on the other hand. Exact numbers vary between sources (e.g. the GHG emissions associated with agriculture) depending on the methodology and scope used by the source. The goal is not to provide the most accurate assessment of various impact and mitigation potentials, but to demonstrate the relative importance and magnitude of each.

This strategy is by no means exhaustive as the problems posed to nature by the F&A sector are complex, interconnected, and also dependent on action taken in the public sector and international arena.





1. For example, the Intergovernmental Panel on Climate Change (IPCC), Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES), European Environmental Agency (EEA), Food and Agriculture Organisation (FAO), World Wildlife Fund (WWF), Ellen MacArthur Foundation (EMF).

EXECUTIVE SUMMARY

SMART FOOD & AGRICULTURE

The impact challenge in Food & Agriculture

- Feeding almost 8bn people with our current system is degrading terrestrial and aquatic ecosystems, depleting natural resources, and driving climate change.
- While we produce sufficient food, we nonetheless fail to meet current food demand, and the latter is expected to grow further with population and wealth.
- While the EU has a wide variety of sustainability strategies for F&A, ambition is undercut by (national) lobbying and the latest Common Agricultural Policy.
- F&A[1] is the second largest emission source globally, and unique as it constitutes a bigger proportion of non-CO_2 GHGs.
- F&A is also the main driver of biodiversity decline. Although biodiversity is complex and difficult to condense into one unit of measurement, impacts can be proxied by measures of common pressures on biodiversity (land use change, pollution, etc.).



SHIFT's view on the required transition

- SHIFT recognizes that impact in F&A goes beyond climate change and aims to target a wide variety of impact domains / KPIs. The food and agriculture sector is also uniquely suited to realize CO_2 reductions via land and ocean-based sequestration.
- The most efficient (impact / EUR invested) mitigation measures for climate change are demand-based, i.e., lie at the point of the consumer: they can avoid a greater quantity and range of adverse upstream impacts with fewer measures through, among others, plant-based diets and food waste solutions. Solutions on this end have relatively fewer trade-offs.
- The most effective mitigation measures for biodiversity lie in promoting sustainable plant-based diets, implementing food waste solutions, and adopting regenerative agricultural practices.
- However, mitigation is difficult due to many competing demands for land and water resources: food, fuel, materials, etc., which makes the potential for (unintended) adverse social or environmental impacts and tradeoffs higher than for most other sectors.
- It is important to be as comprehensive as possible when performing an assessment of potential adverse impacts and risks, especially given their higher likelihood in this sector. The latter includes, among others, factors related to animal welfare.

1. Measured as GHG emissions from agriculture, forestry and land use (AFOLU).

SHIFT IMPACT VISION FOR FOOD & AGRICULTURE

SHIFT's mission is to mitigate climate change, biodiversity loss and resource depletion in food & agriculture, by investing in:

Sustainable production, for example:

Regenerative practices: the F&A sector plays a crucial role in protecting our climate & biodiversity

Carbon monitoring and sequestration as our land and water resources are important carbon sinks

Effluent monitoring and reduction to prevent pollution of natural resources and harm to biodiversity

Resource (e.g., water & energy) efficiency to fight the depletion of important natural resources that are heavily used in the F&A sector



Sustainable consumption, for example:

Sustainable, plant based healthy diets because this has the highest potential impact per invested euro with minimal trade-offs

Reduced food and packaging waste (across the value chain) as there are large saving potentials both environmentally as well as financially

Increased transparency with the potential to improve climate change, biodiversity loss and resource depletion



…to avoid and reduce adverse impacts, and improve positive ones and bring back the balance between nature and society

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01. SETTING THE STAGE



SHIFT

WHY INVESTING IN F&A MATTERS

F&A HAS A DIRECT NEGATIVE IMPACT ON MANY OF THE MOST AT-RISK PLANETARY BOUNDARIES

The F&A sector has a huge terrestrial footprint[1]

Over 1/3rd of the global land surface and nearly 3/4 of available freshwater resources are devoted to crop or livestock production. The sector delivers essential resources like food, wood, and other (ecosystem) services. Food production and agribusiness is a US$5 trillion industry.

Pressures will grow

The global population will likely reach 10bn by 2050, and together with income growth is expected to lead to a 45% increase in food demand between 2017 and 2050[2]. Already today, we do not meet current food demand, with almost 10% of the global population going hungry due to limited access to (nutritious) food, despite food production being sufficient[3]. This speaks to many other societal problems that are characteristic of the sector: poverty amongst a large percentage of smallholder farmers, child labor and slavery in the food value chain, poor working conditions, and growing rates of malnutrition and obesity.

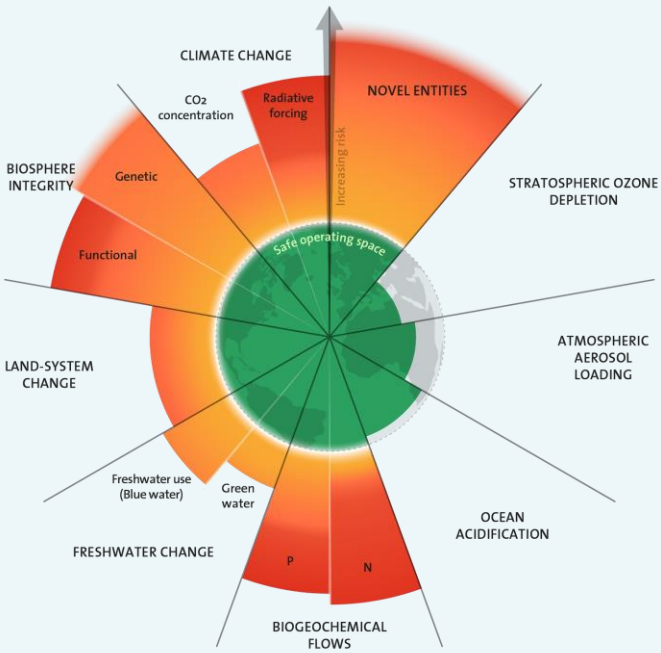
F&A is considered "the main driver of environmental degradation in Europe[4]"

F&A has a direct negative impact on many of the **most at-risk planetary boundaries** and is the primary force behind the transgression of boundaries biogeochemical flows, climate change, biosphere integrity, land-system change, and freshwater use[5,6].

There are mitigation options with demonstrated potential to address many of these challenges, as well as wider problems related to these

As mentioned, F&A is inextricably linked with some of the most serious socio-environmental challenges that have ever faced humanity, and therefore some mitigation measures have a notable wider impact potential.

The planetary boundaries framework[7]



1. WWF (2021); 2. State of Climate Action (2021); 3. Ritchie, Rosado & Roser (2023) & FAO (2021); 4. Pe'er et al. (2020), referring to AFOLU; 5. Based on most recent analysis in Persson et al. (2022) and Steffen et al. (2015); 6. See Appendix; 7. Azote for Stockholm Resilience Centre, Stockholm University, based on Richardson et al. 2023, Steffen et al. 2015, and Rockström et al. 2009

POLICY LANDSCAPE - OUTLINE

THE EU HAS A VARIETY OF STRATEGIES AND POLICIES FOR FOOD & AGRICULTURE

F&A IS COVERED BY THE 'FARM TO FORK' & 'BIODIVERSITY' STRATEGIES, THE 'EFFORT SHARING REGULATION', THE 'COMMON AGRICULTURAL POLICY' AND OTHER NEW LEGISLATIVE FRAMEWORKS



F2F is a European Commission (EC) "communication": it indicates political views and intentions but is **not legally binding.** It should lead to concrete plans including legislative actions/revisions[4].

Examples of concrete targets in Farm to Fork (F2F) strategy[1] (part of the Green Deal):

Reduce dependency on pesticides and antimicrobials

- Reduce the overall use and risk of pesticides and use of more hazardous pesticides by 50% by 2030
- Reduce overall EU sales of antimicrobials for farmed animals and in aquaculture by 50% by 2030

Reduce excess fertilization

- Reduce nutrient losses by 50% by 2030 (without deterioration in soil fertility)
- Reduce the use of fertilizers by 20% by 2030

Improve animal welfare: revise the animal welfare legislation to align with latest scientific evidence and broaden scope (YE'23)

Increase organic farming: place 25% of EU agricultural land under organic farming management by 2030

Reverse biodiversity loss (separate Biodiversity Strategy[2])

- Transform 10% of agricultural area to high-biodiversity landscape features
- Eliminate or reduce by-catch of species to a level that allows recovery and conservation
- Deforestation-free commodities in EU market[5]

As part of the F2F strategy, the EC is expected to adopt a legislative framework for sustainable food systems by the end of 2023 (now postponed)[6]. This should promote policy coherence at EU and national level and mainstream sustainability in all food-related policies.

The EU does not have a sectoral emissions target for the F&A sector. **GHG emissions from agriculture** are covered by the **Effort Sharing Regulation (ESR),** which requires EU emissions from all ESR sectors to **decrease by 40% by 2030 compared to 2005[3]**. The EU also signed the Global Methane Pledge, to reduce global methane emissions by 30% below 2020 levels by 2030. The agriculture sector will be key to achieving this target.

The Common Agricultural Policy (CAP) is the funding instrument the EU uses for the agricultural sector (subsidy allocation, a.o., comprises 36% of total EU budget), which contains some environmental instruments and conditions. In the new CAP ('23 - '27), 40% of funding is earmarked for climate action *(see next page).*



1. Farm to Fork Action Plan (2020); 2. Biodiversity Strategy (2021), expected to be supplemented with regulations such as the Nature Restoration Law as a result of the Global Biodiversity Framework (2022); 3. Climate Action Tracker (2022); 4. Timeline of F2F Actions ; 5. EC, covering palm oil, beef, coffee, cocoa, soya, wood, rubber, and derivatives of these products (2023); 6. The EC is unlikely to meet this deadline.

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POLICY LANDSCAPE – CRITIQUE ON F&A

…HOWEVER, THE CURRENT REGULATION IS INSUFFICIENT TO MEET GLOBAL TARGETS

PROGRESS IS TOO SLOW, AND CRITICS BELIEVE MORE IS REQUIRED

For decades in EU policymaking, agriculture has, to a large extent, been kept outside of environmental policy. Historical progress is negligible or has stagnated and a step-change is required to get on track[1]:

GHG emissions in EU agriculture have only declined by 2% since 2005[4]. Emission reductions need to occur 2.4x faster for a 22% reduction by 2030 and 39% by 2050 to meet global targets on climate change.

The €100bn CAP funds set aside for climate action in the EU between 2014-2020 have had little impact on emissions. The CAP mostly financed measures with a low potential to mitigate climate change, did not limit livestock emissions (50% of agriculture emissions), and supported farmers who cultivated drained peatlands (20% of emissions)[2]. In November 2023, the European Parliament scrapped core elements of the sustainable use of pesticides (SUR) regulation[5], and the Commission renewed a 10-yr license on the controversial herbicide glyphosate[6]. It is unclear whether the Commission will take action to realise the F2F strategy in 2024.

Despite the new CAP's (into effect as of 01/23) increased focus on the environment and climate, it has very limited environmental ambition which will make it difficult to achieve climate and biodiversity goals set out in the Farm to Fork strategy and ESR. 3,600+ scientists signed a letter[3] to communicate significant concerns due to, amongst others:

Subsidies with low/perverse environmental requirements: coupling of some subsidies to high-input production fosters GHG emissions and supports practices with demonstrated negative impacts on biodiversity;

Budget cuts for rural development programs: problematic as these have the potential to be the most effective tools to support pro-environmental farming practices;

Lack of consistency and transparency: instead of conducting a deep reform, CAP elements have been restructured and renamed in a way that is difficult to understand and undermines transparency and legitimacy;

Misleading claims: proposal states 40% of expenditures will be labelled as climate friendly, despite them not being systematically linked to any effective measure for GHG reduction or climate adaptation;

Voluntariness: legal framework has vague requirements that allows farmers to choose unambitious light green options & it is up to member states to decide which farms qualify.

1. Farm to Fork Action Plan (2020); 2. Biodiversity Strategy (2021), expected to be supplemented with regulations such as the Nature Restoration Law as a result of the Global Biodiversity Framework (2022); 3. Climate Action Tracker (2022); 4. Timeline of F2F Actions ; 5. EC, covering palm oil, beef, coffee, cocoa, soya, wood, rubber, and derivatives of these products (2023); 6. The EC is unlikely to meet this deadline.

BARRIERS TO CHANGE

MITIGATING F&A'S ENVIRONMENTAL BURDEN IS HIGHLY COMPLEX AND MULTI-DIMENSIONAL

High risk of trade-offs and maladaptive mitigation

There are many competing demands for land so mitigation in food and agriculture cannot be pursued in isolation: solutions need to address or at least not significantly harm efforts at mitigation in other sectors, other environmental impacts, or other sustainability goals such as food security and poverty. Poorly designed or implemented mitigation measures (can) have considerable negative tradeoffs, depending also on geography. This is further enhanced by significant risks associated with current and expected climate change impacts on the F&A sector.

Large variation of impacts and mitigation potential across regions and producers

Impact and capacity for mitigation varies significantly per region and producer as there is a complex interplay between land management and GHG fluxes in different geographies. This is still not well-understood, but impacts can vary up to 50x among producers of the same product[1]. As such, there is a relatively small and specific group of producers who are responsible for a significant degree of adverse impacts. The regional variance and uncertainty also makes it difficult to predict and measure the effectiveness of (especially nature/land-based) mitigation measures.

Cultural values and social acceptance

It is not possible to achieve the 1.5°C target without both supply *and* demand-side mitigation in F&A[2]. Barriers to agricultural and food-based mitigation will be strongest where historical practices represent long standing traditions like dietary customs. This also includes regulatory / political factors; adoption of new agricultural production methods often requires new investments and changes in labour practices. For example, modern agriculture is built on the principle that nature can be artificially and chemically enhanced and replaced *ad infinitum* in order to produce more food on less land[3]. This extractive paradigm will be difficult to change.

Structure of the agricultural industry and value chain

Agricultural value chains are globalized and opaque, making mitigation challenging. It is also one of the most heavily subsidised sectors in the world, dependent entirely on indirect and direct financial support for mostly unsustainable, large-scale, industrialised production[3]. This also hinders the commercial viability of many mitigation measures. Emerging oligopolies in sectors such as seeds and agrochemicals also mean that a handful of players have an outsized influence on markets and lobbying power to obstruct reforms. Outside of these large players, the industry consists of millions of fragmented smaller companies where coordinated systems-change will be difficult.

Sources: IPCC WGIII CH7 (2022) & IPCC WGIII CH5 (2022)
1. Poore & Nemecek (2018); 2. Clark et al. (2020); 3. WWF (2021)

F&A AND SHIFT'S MISSION

INVESTING IN SOLUTIONS BASED ON THREE CHALLENGES AS PART OF SHIFT'S MISSION



CLIMATE CHANGE

Food and agriculture are the main drivers of global emissions after energy, accounting for approx. 18% of global GHG emissions. The emissions profile of F&A[5] differs from other sectors, with a bigger proportion of non-CO_2 greenhouse gasses.

Mitigation has been negligible until now and the sector will likely remain a major source of emissions (and one of the only sectors that cannot fully eliminate emissions[1]), despite it also being an important sink.



BIODIVERSITY LOSS

Our global food system is the primary driver of biodiversity loss, with agriculture alone being the identified threat to 86% of species at risk of extinction, mainly through driving habitat loss and degradation[2].

Increased conservation of natural habitats and rewilding is necessary but cannot succeed without more sustainable forms of consumption and production to relieve pressure on biodiversity.



NATURAL RESOURCE DEPLETION

¾ of global freshwater resources are used for crops or livestock, and from a scarcity perspective, irrigation drives up to 90-95% of global scarcity-weighted water use[3]. Impacts on biomass and land are also driven to a large extent by agriculture.

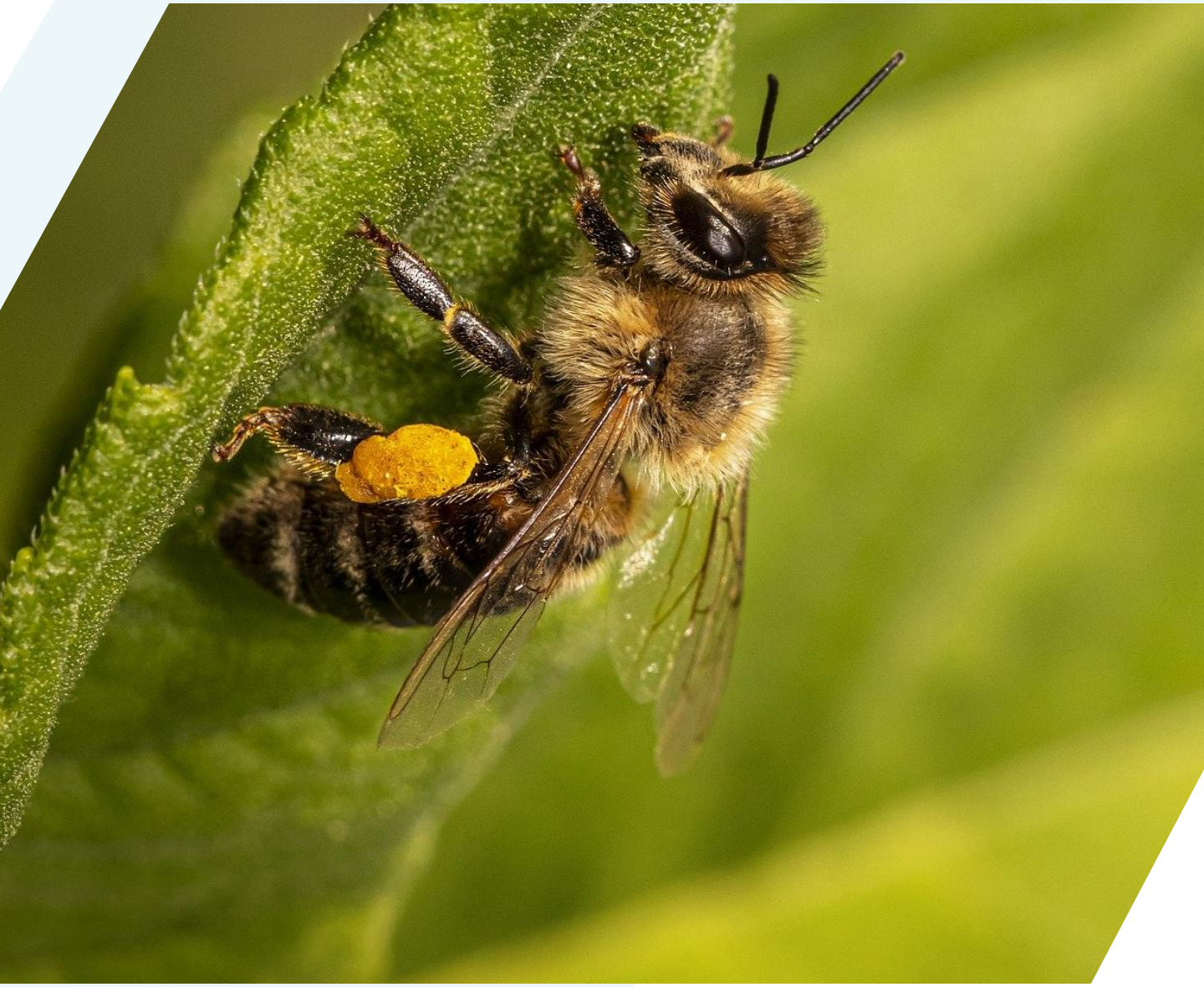
Decoupling resource use from human wellbeing and environmental impacts is challenging in this sector as these factors are directly and inextricably interrelated. *(for more, see Appendix)*

We see that many of the solutions in food and agriculture addressing climate change and biodiversity loss directly or indirectly also address natural resource depletion (like water and land use).

Nature and climate also reinforce each other in a way that is inseparable: as the climate changes, it drives biodiversity loss, and as biodiversity declines, so do carbon sinks and the environmental resilience needed to resist further impacts of climate change. As a result, in many cases, there are synergies between climate and biodiversity action, but in some cases there are also tradeoffs[4].

1. ENCO (2023); 2. UNEP (2021); 3. Poore & Nemecek (2018); 4. See also fig.3 in Pörtner et al. (2023) on positive and negative interactions of climate and biodiversity actions.; 5.

02. F&A AND CLIMATE CHANGE



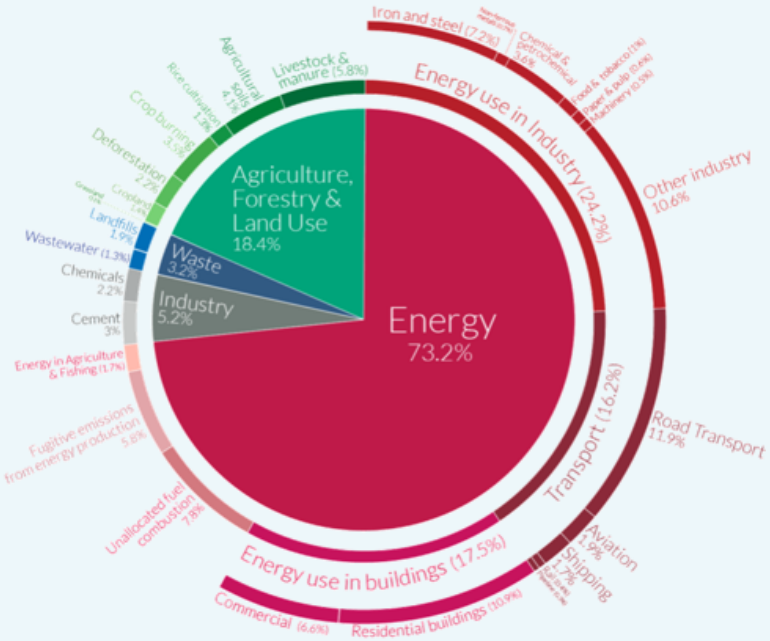
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GHG EMISSIONS IN FOOD AND AGRICULTURE

FOOD AND AGRICULTURE ARE THE MAIN DRIVERS OF GLOBAL EMISSIONS AFTER ENERGY

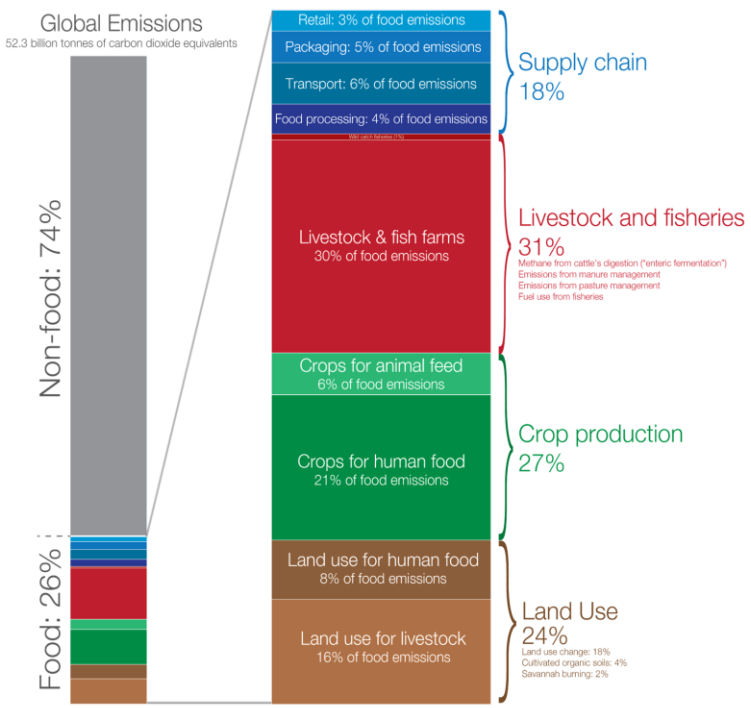
F&A (AFOLU) DIRECTLY ACCOUNTS FOR A SIGNIFICANT PROPORTION OF GLOBAL GHG EMISSIONS[1]...

Global GHG emissions by sector (2016)[2]



...AND THE FOOD SYSTEM AS A WHOLE ACCOUNTS FOR 1/4TH

Global GHG emissions from food production (2018)[2] (see Appendix for more detail)



AFOLU = Agriculture, Forestry and Land-Use

1. IPCC, 2022; 2. Graphs from Ritchie (2020 and 2021), note: this data underestimates the emissions associated with deforestation for agriculture, and excludes emissions from the post-retail stage (estimated at 0.5bn tonnes CO_2e from cooking + 1.6bn tonnes CO_2e from waste); More detail on the emission intensity of different protein sources in the Appendix

SOURCES OF CO_2, CH_4, AND N_2O EMISSIONS IN F&A

UNLIKE OTHER SECTORS, F&A (AFOLU) HAS A RELATIVELY LARGE PROPORTION OF NON-CO_2 GREENHOUSE GASES

CARBON DIOXIDE (CO_2)

- AFOLU accounts for 14% of *total* anthropogenic CO_2 emissions
- Unclear trend: emissions growth in tropical regions and decline in temperate and boreal regions

MAIN DRIVER

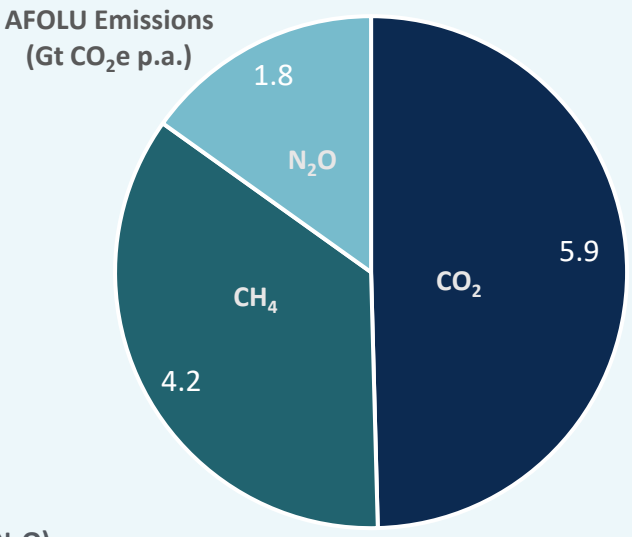
Almost 100% FOLU (deforestation via burning & bulldozing)[1]

METHANE (CH_4)

- AFOLU accounts for 41% of total anthropogenic CH4 emissions
- 10% increase in AFOLU CH4 between 1990-2019

MAIN DRIVER

- 89% agriculture, of which:
  - ~70% enteric fermentation (esp. from ruminants like cows and sheep)
  - ~ 25% rice cultivation
- 11% FOLU (e.g. biomass burning)



NITROUS OXIDE (N_2O)

- AFOLU accounts for 69% of *total* anthropogenic N_2O emissions
- 25% increase in AFOLU N_2O between 1990-2019

MAIN DRIVER

95% agriculture, of which ~90% from agricultural soils, via nitrogen fertilizer, manure application to croplands, and manure production and deposition on pastures

Note: from a global perspective, Europe's regional agriculture-based GHG contribution is minor due to almost no deforestation. However, from a consumption perspective, it is material, as you would then account for emissions (e.g., from deforestation) from imported food and feed[2].

AFOLU = Agriculture Forestry and Land Use; FOLU = Forestry and Land Use; LULUCF = Land Use, Land Use Change, and Forestry (incl. deforestation); Source for data: IPCC, 2022

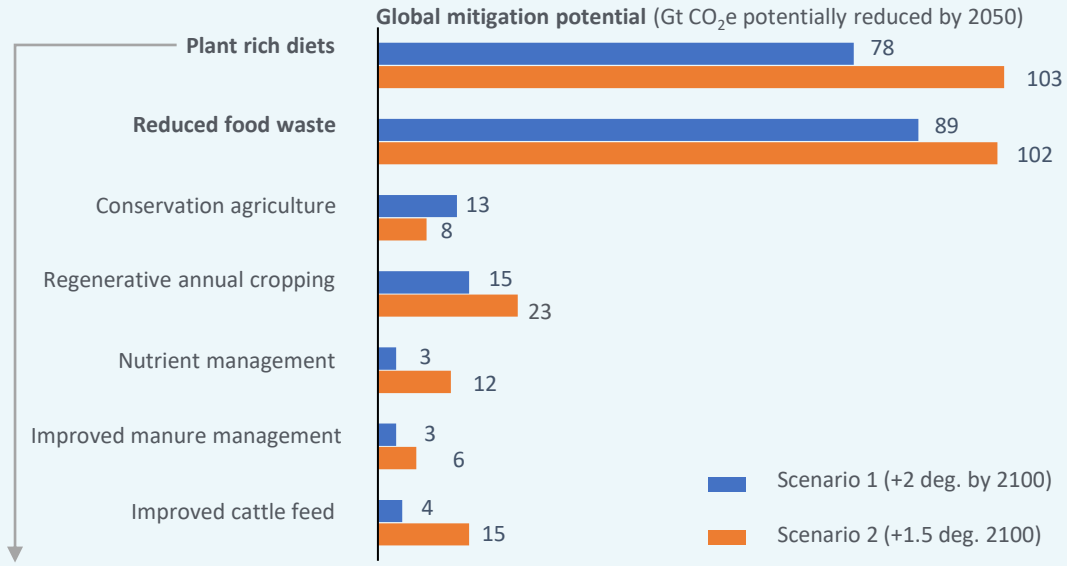
1. ¾ of deforestation is driven by agriculture (Ritchie, 2021); 2. WWF (2021 & 2022) reports that the EU is one of the world's largest importers of tropical deforestation and imported emissions, surpassed only by China. In NL, the commodities soy (50%), cocoa (26%) and maize (16%) account for the majority of GHG emissions associated with land-use change from imports (total = approx. 44 Mt CO_2e p.a.).

LARGE DIFFERENCE IN EXPECTED MITIGATION

SUSTAINABLE DIETS, REDUCED FOODWASTE & SOIL CARBON SEQUESTRATION CONSIDERED HIGH IMPACT

GLOBAL POTENTIAL GT CO_2e REDUCED BY 2050, PROJECT DRAWDOWN[4]

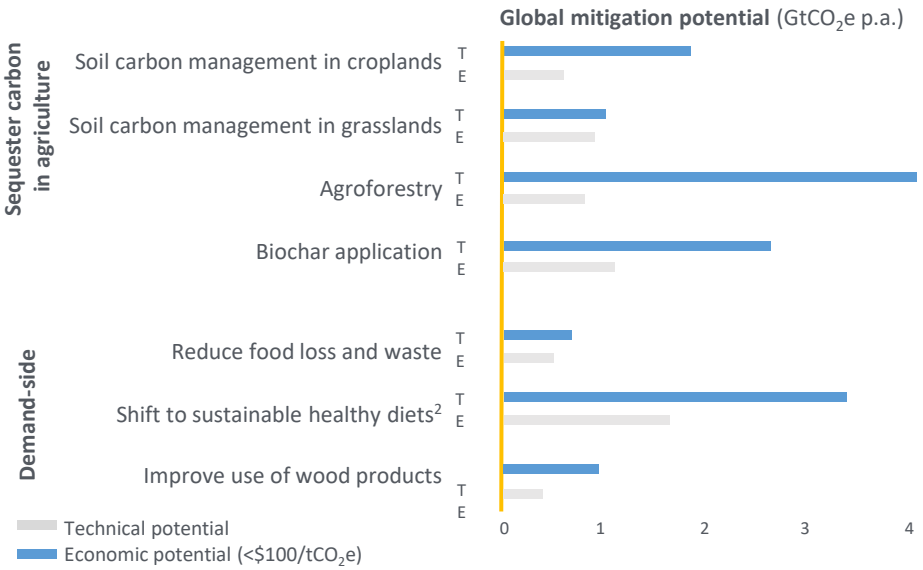
Project Drawdown examines the potential impact of existing known solutions, indicating the relative importance of these solutions[3]. Two scenarios are shown with varying expected contributions of the categories for each scenario to restrict global warming within either 1.5 or 2 degrees. Scenarios integrate mitigation approaches to account for resource constraints, feedback effects, among others.



ROI: a 2023 report by BCG finds that per dollar, investments in plant-based alternatives reduce 3x more emissions reductions than investments in technologies like green cement and 11x more than zero-emission cars[5].

ANNUAL MITIGATION POTENTIAL OF F&A MEASURES, IPCC

The IPCC[1] identifies two categories of mitigation measures that are considered important for **Developed Countries**: a) carbon sequestration in agricultural land (see annex slide), and b) demand-side measures. F&A (AFOLU) sector can provide 20-30% of global mitigation for 1.5°C, with varying degrees of economic feasibility.



IPCC and Project Drawdown use different scenarios and calculations, and yet arrive at similar directions for the most impactful solutions. Many of these are at the point of consumer: the IPCC has a chapter dedicated to the mitigation potential of demand-based measures, as food comprises 28% of the average household carbon footprint, and 48% and 70% of impacts on land and water resources.

1. IPCC WGIII CH7 (2022); 2. Defined by the FAO and WHO as dietary patterns that promote all dimensions of individual's health and wellbeing; have low environmental pressure and impact; are accessible, affordable, safe and equitable; and are culturally acceptable (IPCC WGIII CH12, 2022). 3. Assessment of solutions with robust evidence-base (excl. emerging innovations) (2020). 4. See also this slide; 5. BCG (2022)

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03. F&A AND BIODIVERSITY LOSS



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BIODIVERSITY AND FOOD AND AGRICULTURE

FOOD SYSTEMS ARE TO NATURE LOSS WHAT ENERGY SYSTEMS ARE TO CLIMATE CHANGE[1]

BIODIVERSITY HAS DECLINED BY 68% SINCE 1970[2]

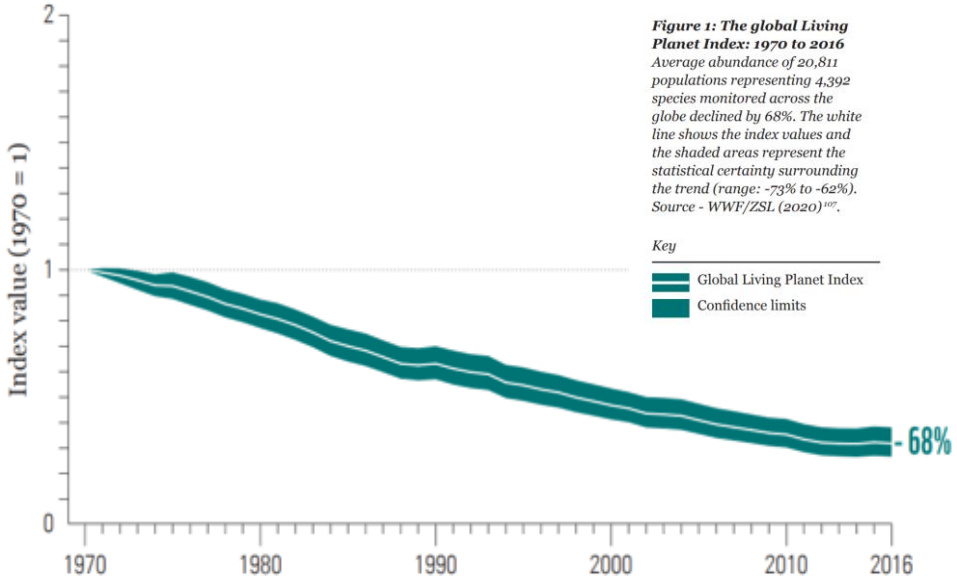


Figure 1: The global Living Planet Index: 1970 to 2016
Average abundance of 20,811 populations representing 4,392 species monitored across the globe declined by 68%. The white line shows the index values and the shaded areas represent the statistical certainty surrounding the trend (range: -73% to -62%). Source - WWF/ZSL (2020)[107].



Of the 25,000 species evaluated to be (critically) endangered by the IUCN Red List, agriculture is considered a threat for 15,000 of them (60%)[3].

FOOD IS RESPONSIBLE FOR MANY ADVERSE IMPACTS ON BIODIVERSITY[2]



Agriculture is responsible for **80%** of global **deforestation**



Agriculture accounts for **70%** of **freshwater use**



Drivers linked to food production cause **50%** of **freshwater biodiversity loss**



Drivers linked to food production cause **70%** of **terrestrial biodiversity loss**



52% of agricultural production land is **degraded**



The entire food system is responsible for **25%** of **GHG emissions**

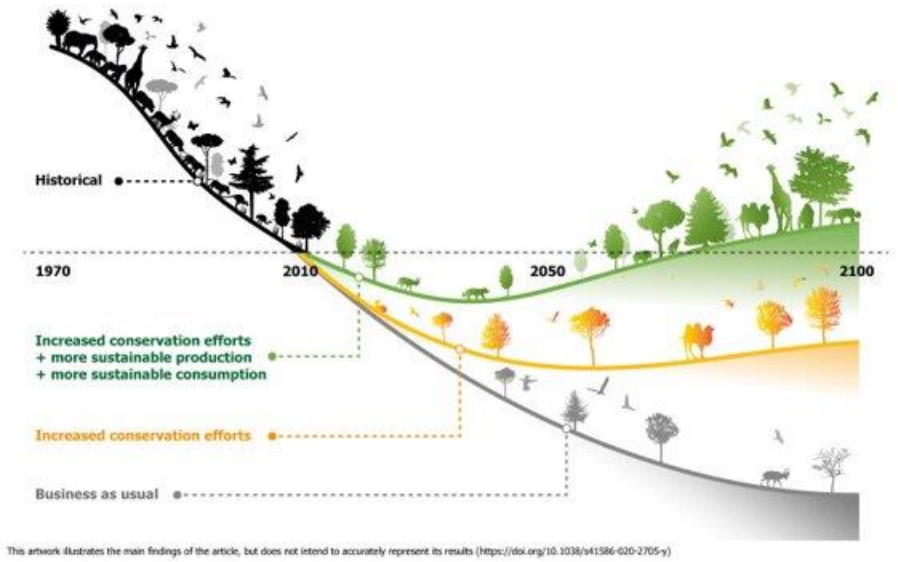
1. WWF (2021); 2. Graph and data from from LPI (2020); 3. IUCN Red List of Threatened Species (2022)

TOP SOLUTIONS FOR BIODIVERSITY LOSS MITIGATION

CONSERVATION AND SUSTAINABLE PRODUCTION & CONSUMPTION ARE NEEDED FOR BIODIVERSITY

CONSERVATION AND SUSTAINABLE PRODUCTION & CONSUMPTION

Bending the curve of biodiversity loss requires an ambitious, integrated strategy combining conservation action and changes to food systems, alongside wider sustainability efforts including on climate change[1].



This artwork illustrates the main findings of the article, but does not intend to accurately represent its results (https://doi.org/10.1038/s41586-020-2705-y)

KEY ACTIONS NEEDED TO BEND THE CURVE OF BIODIVERSITY LOSS

If implemented alone, conservation leads to increases in the price of agricultural products and increases the risk of hunger as less land and oceans will be available for food production. These social-economic 'side effects' put the implementation of biodiversity measures and its required gains at risk[2]. If conservation measures are combined with solutions that relate to sustainable production & consumption, trade-offs can be strongly reduced. Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), with 94 Governments as members, have identified several pathways[4]:

Pathways to achieve change in sustainable food production:

- Sustainable agricultural practices, incl. agroecology, multifunctional landscapes, and cross-sectoral integrated management
- Sustainable use of genetic resources in agriculture: conserving gene diversity, varieties, cultivars, breeds, landraces and species
- Biodiversity-friendly management practices in crop and livestock production, incl. use of traditional management practices associated with indigenous peoples and local communities
- Areas of natural or semi-natural habitat within and around production systems, incl. those that are intensively managed, and restoring or reconnecting fragmented habitats

Pathways to achieve change in sustainable food consumption[4]:

- Sustainable and healthy diets
- Reducing food waste from production to consumption
- Improving food market transparency (traceability of biodiversity impacts, supply chain transparency) through tools like labelling and certification
- Improving equity in food distribution and in the localization of food systems, where appropriate and beneficial to nature or nature's contributions to people

1. Image from PBL (2020); 2. Leclère et al. (2020); 3. PBL (2021); 4. IPBES (2019)

04. F&A AND NATURAL RESOURCE DEPLETION



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NATURAL RESOURCE DEPLETION

FOOD PUTS PRESSURE ON THE WORLD'S RENEWABLE RESOURCES

Natural resource use has more than tripled since 1970, with the global average material demand per capita growing from 8.4 tonnes to 13.2 tonnes in 2024. Global material productivity has also stagnated in recent years: the global economy has focused on improvements in labour productivity at the cost of material and energy productivity. The most relevant natural resources for the food and agricultural sector are[1]:

Biomass

The total tonnage of biomass demand increased from 9bn tonnes to 24 bn tonnes between 1970 and 2017, largely in the categories of crop harvest and grazing. While crop yields have increased considerably over the last decades, growing population and increasing demand for high-quality food (e.g., luxury products like coffee and cocoa) are increasing pressures.

Water

Currently about ¾ of global freshwater resources are used for crops or livestock, and from a scarcity perspective, irrigation drives up to 90-95% of global scarcity-weighted water use[2]. Besides the direct consumption of water, the construction of infrastructure like dams to support irrigation affects the continuity and flow of rivers with adverse impacts on the entire river ecosystem and downstream water provision. F&A is also one of the leading polluters of water bodies due to the intensive use of agrochemicals and runoff of organic matter, drug residues, and sediments.

Land

The impact of land-use is highly correlated with agricultural activities as half of the world's habitable land is used for agriculture[2]. 1,000 years ago, this was only 4%. There is a highly unequal distribution of land use between livestock and crops for human consumption, where livestock accounts for 77% of global farming land while only producing 18% of the world's calories and 37% of total protein.

See next page for more information on land & soil

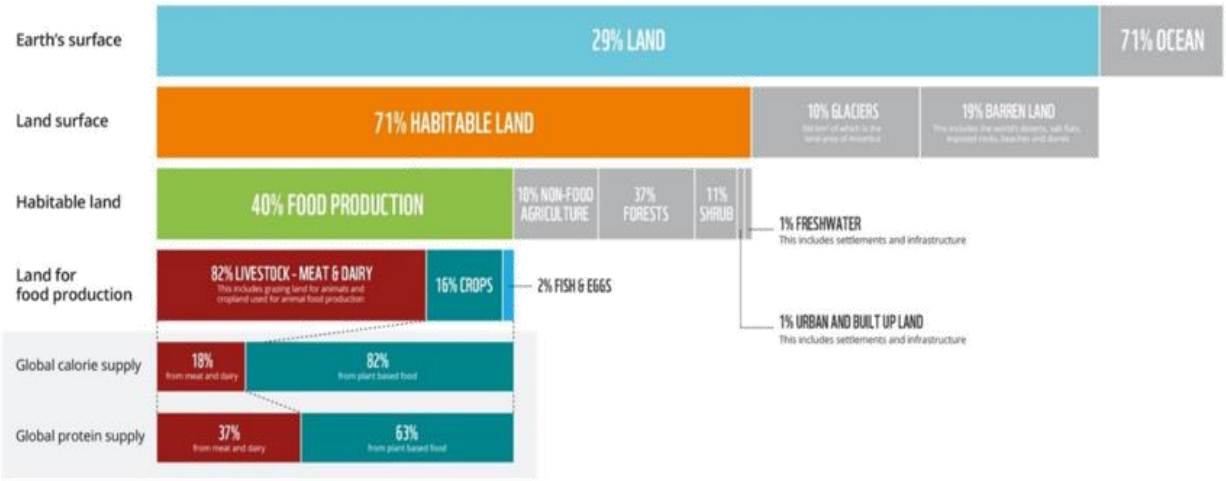
1. Global Resources Outlook (2024); 2. Ritchie & Roser (2019);

SOIL DEGRADATION

MORE THAN HALF THE LAND USED FOR AGRICULTURE IS DEGRADED

Soil is a key natural resource: it hosts at least ¼ of the world's biodiversity and stores twice as much carbon as the atmosphere. The agricultural system is a major driver of its degradation and arable land is being lost at 30-35x the historical rate.

- Land degradation and climate change is predicted to reduce global crop yields by 10-50% in some key regions
- Besides crop yields, land degradation by agriculture results in a loss of about 10% of annual global GDP through lost ecosystem services



CAUSES OF SOIL AND LAND DEGRADATION

Deforestation: agricultural expansion accounts for over 70% of the conversion of primary forest in tropical regions. Clearing large areas of forest can disrupt a region's hydrological cycle and weather patterns, creating hotter and drier weather and increasing drought. The areas with the highest forest losses (Africa, Southeast Asia, South America) are also some of the most biodiverse regions on earth.

Erosion and compaction: the permanent loss of topsoil through water, wind or tillage is happening at 100-1,000x the natural rate (80% of farmland has moderate to severe erosion). As a result, soil organic carbon has dropped by 8%, meaning soils are also less fertile and productive, retain less water, and are more prone to further erosion. The soil that is lost also ends up in aquatic ecosystems, bringing excess nutrients and causing eutrophication.

Chemical pollution and loss of nutrients: chemical agricultural inputs like fertilizers reduce soil biodiversity and disrupt biological processes occurring in the soil, like the nitrogen cycle. For instance, it disrupts the ability of fungi to fix nitrogen, a key macronutrient in the food chain. As a result, there is increased runoff of nutrients like nitrogen and phosphorous that leads to overloading in water bodies.

Source: WWF (2021)

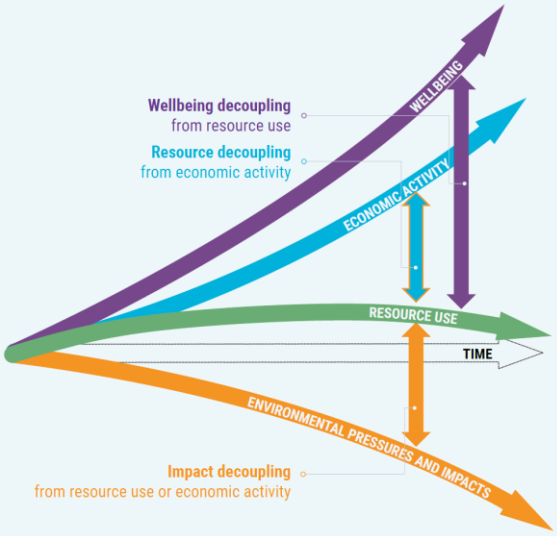
MITIGANTS TO NATURAL RESOURCE DEPLETION

COMBINING PRINCIPLES OF THE CIRCULAR ECONOMY WITH FOOD

The decoupling of natural resource use and environmental impacts from economic activity and human wellbeing is an essential element in the transition to a sustainable future.

Successful sustainability interventions decrease the amount of resources required and related environmental impacts, while still delivering on socio-economic wellbeing for all.

This is more challenging in a sector that provisions essential provisioning services such as nutrition for a growing global population. However, there is still substantial room for mitigation in reducing overconsumption of food, animal-based food, and food and agricultural waste, especially in high-income geographies.



Concept of decoupling, as illustrated by UNEP[1].
Wellbeing decoupling increases the service delivered per unit of resource use. **Resource decoupling** decreases the primary resource demand of economic activities. **Impact decoupling** decreases pressures per unit of economic activity or resource use.

The Ellen MacArthur Foundation, experts in the transition to a circular economy, highlights five specific strategies for a more balanced food system[2]:

1. **Diverse ingredients:** increase genetic diversity of crops and livestock and utilize a broader range of ingredients
2. **Lower impact ingredients:** shift from conventional animal products and high impact crops to lower impact alternatives (e.g. replace wheat with pea flour)
3. **Upcycle ingredients:** avoid sending food and byproducts to landfill by turning them into high-value ingredients
4. **Regenerative production:** employ regenerative agricultural practices to generate climate and biodiversity benefits
5. **Packaging:** eliminate, reuse, or recirculate materials that are used in packaging

1. Global Resources Outlook (2024); 2. The Big Food Redesign (2021)

CONTACT US

QUESTIONS, COMMENTS OR WANT TO CONNECT?



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I want to talk about this report and/or impact (methodologies) in F&A

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I'm a startup with an innovative solution to a problem highlighted in this report.
Fill out our form on the website to get funded: https://shiftinvest.com/getfunded
& contact Jonas at jonas.vondendriesch@shiftinvest.com

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TURNING INVESTMENTS INTO IMPACT