



2023 Scenathon results

Pathways for food  
and land-use systems  
in the Rest of EU  
region



### **About FABLE**

The Food, Agriculture, Biodiversity, Land-Use, and Energy (FABLE) Consortium is a collaborative initiative to support the development of globally consistent mid-century national food and land-use pathways that could inform policies towards greater sustainability. The Consortium brings together teams of researchers from 24 countries and international partners from the UN Sustainable Development Solutions Network (SDSN), the International Institute for Applied Systems Analysis (IIASA), the Alliance of Bioversity International and CIAT, and the Potsdam Institute for Climate Impact Research (PIK). <https://www.fableconsortium.org/>

### **About the authors**

The pathways for food and land-use systems in ROEU were developed by Yiorgos Vittis (International Institute for Applied Systems Analysis, FABLE Secretariat - [vittis@iiasa.ac.at](mailto:vittis@iiasa.ac.at))

### **Recommended citation**

Vittis, Y. (2024). FABLE Scenathon 2023 Pathways for food and land-use systems in the Rest of the EU region. Paris: Sustainable Development Solutions Network (SDSN). 10.5281/zenodo.11551100

### **Countries in the “Rest of EU” region**

Austria, Belgium, Bulgaria, Croatia, Cyprus, Czechia, Estonia, France, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain.

## Contents

1. Regional context
2. Methods
3. Results
4. Scenarios and assumptions

Our food and land-use systems are critical for staying within our planetary boundaries and the Earth’s system resilience. Among the six Transformations required to achieve the Sustainable Development Goals (SDGs), the fourth Transformation—focusing on food, land, and water—is crucial. This Transformation is key to achieving SDG 2 (Zero Hunger), SDG 6 (Clean Water and Sanitation), SDG 12 (Responsible Consumption and Production), SDG 13 (Climate Action), SDG 14 (Life Below Water), and SDG 15 (Life on Land). Moreover, it supports the remaining SDGs, underscoring its crucial role in fostering a sustainable future.

This document presents the results of the 2023 ‘Scenathon’, a modelling exercise by the FABLE Consortium exploring three alternative futures for national and regional food and land-use systems. The term ‘Scenathon’ stands for ‘a marathon of scenarios’ and refers to FABLE’s iterative process for ensuring that national and regional pathways have coherent trade assumptions and align with global sustainability targets (see the 2024 Sustainable Development Report for more information).

Through these long-term pathways, we can identify trade-offs and synergies between different goals and see the impact of various actions, as well as key levers for guiding sustainable development policies through 2030 and 2050. Together with our modelling tools and methods, these results are designed to support decision-making and the development of better policies and targets to drive the transformation of our food and land-use systems.

**Countries in the “Rest of EU” region:** Austria, Belgium, Bulgaria, Croatia, Cyprus, Czechia, Estonia, France, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain.

Figure 1. Historical share of GHG emissions from Agriculture, Forestry, and Other Land Use (AFOLU) to total AFOLU emissions and removals by source in 2020

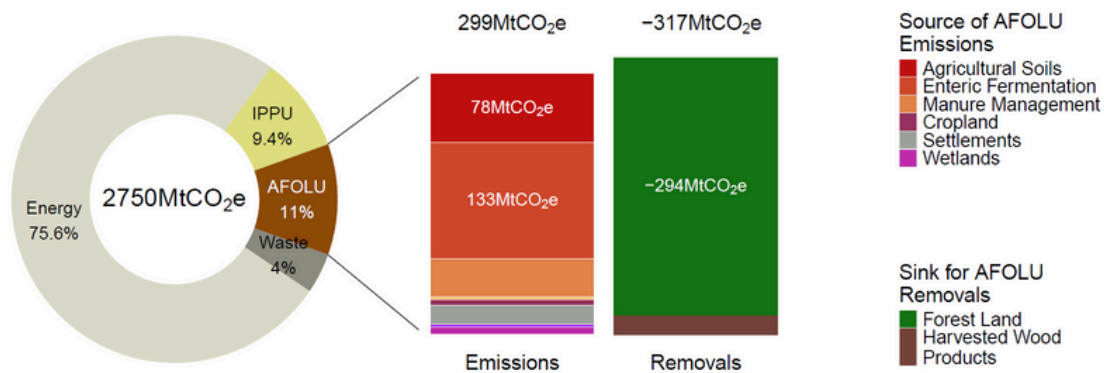
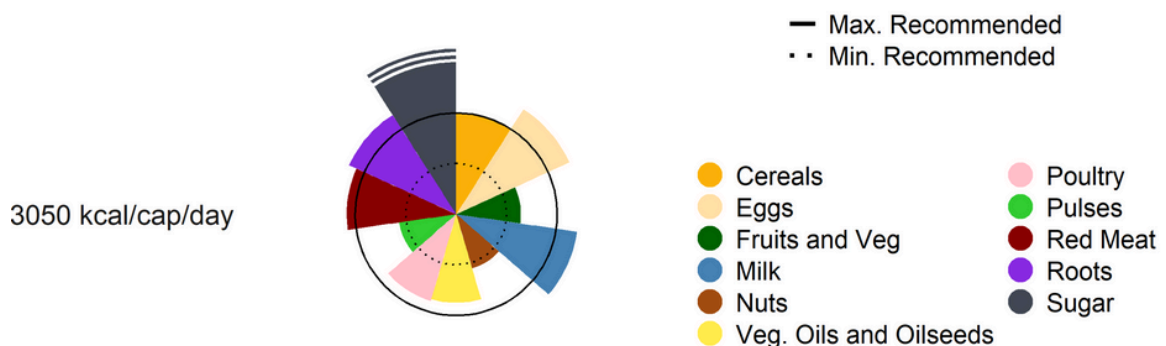




Figure 2. Daily average kilocalorie intake per capital per food category in 2020



This table summarizes regional targets for food and land use, derived from regional commitments, policies, and strategies. It provides an overview of the region's current ambitions to transform its food and land-use systems. If the region lacked quantitative national targets, we have estimated targets based on qualitative pledges.

SDG	Indicator	Regional Target (Assumption: A, Official Source: OS)
 2 ZERO HUNGER	Undernourishment	Making sure that everyone has access to sufficient, nutritious, sustainable <u>food</u> (OS)
	Overweight / obesity	Reversing the rise in overweight and obesity rates across the EU by 2030 (A) Reduce current obesity rates (60%) by half, to <u>30%</u> (OS)
	Diet-related diseases	Reduce the number of people unable to afford a quality meal every second day in half to 17 million <u>people</u> (A)
	Other food-related targets	Further reduce food waste by another 25% of current waste <u>volumes</u> (A)
 13 CLIMATE ACTION	Total GHG emissions reduction	Net GHG emissions reduction by 100% by <u>2050</u> (OS)
	Agriculture GHG emissions reduction	360 million tonnes CO <sub>2</sub> e in <u>2040</u>
	Land use and land use change GHG emissions reduction	-310 Mt CO <sub>2</sub> e by <u>2030</u> (OS)
	Reduce or halt deforestation	Avoid that the listed products Europeans buy, use and consume contribute to deforestation and forest degradation in the EU and globally. Improve forest management to avoid <u>illegal</u> . (OS)
 15 LIFE ON LAND	Promote afforestation	1.5 Mha of afforestation by <u>2050</u> . (A)
	Expand protected areas or 'Other effective area-based conservation measures'	Protect 30% of the land by 2030 and 40% by <u>2050</u> .(A)
	Reduce or halt use of agrochemicals and other agricultural practices that harm biodiversity	50% reduction of agrochemicals by <u>2050</u> (A)
	Reduce or halt loss of natural ecosystems	Legally protect a minimum of 50% of the EU's land areas by 2050*.

	Limit water use	5% reduction of water stress <u>overall</u> (OS)
	Limit N and P use	Reduction in fertiliser use of at least 20% by <u>2030</u> . (OS)
	Famer's income	3% of direct payments budget to support young <u>farmers</u> (OS)
	Employment in the agricultural sector	<8 million annual working unit (full time equivalent) in <u>2025</u> (OS)

\*Note: both targets of i) reducing loss of natural ecosystems (3a) and ii) expanding protected areas (3c), are connected to the EU 2030 Biodiversity Strategy which sets out a target of protecting a minimum of 30% of the EU's land areas. Nonetheless, to enable greater level of ambition and thus more sustainable results, we have set a target of protecting a minimum of 50% of the EU's land areas by 2050 for 3a, and protecting a minimum of 40% of the EU's land areas by 2050 for 3c. Such targets may create contradictions to meeting other types of targets (e.g. food production levels) and as such, expanding the protected land to the full extent of the target may in some cases be infeasible, depending on how these are prioritised. More research is required in order to quantify those relationships and understand more thoroughly the current barriers of implementing such ambitious targets for environmental conservation and biodiversity.

## Model

Using the open-access [FABLE Calculator](#) and the FABLE decentralized modelling infrastructure, we have developed three alternative pathways —Current Trends, National Commitments, and Sustainable Pathway— to explore the impact of various practices and policies on achieving sustainability targets through 2050. We compare our results with targets across food security and nutrition, GHG emissions reduction, forest and biodiversity conservation, and sustainable use of water, nitrogen, and phosphorus.

For each of these pathways, we have established various assumptions regarding the evolution of several model parameters. These parameters include population growth, dietary patterns, food waste, food import and export levels, crop and livestock productivity, agricultural expansion, afforestation, livestock density, protected areas expansion, post-harvest losses, biofuel demand, urban expansion, agricultural practice coverage, and irrigation area expansion. These assumptions detail the extent to which these factors will drive changes in food and land systems from 2020 to 2050.

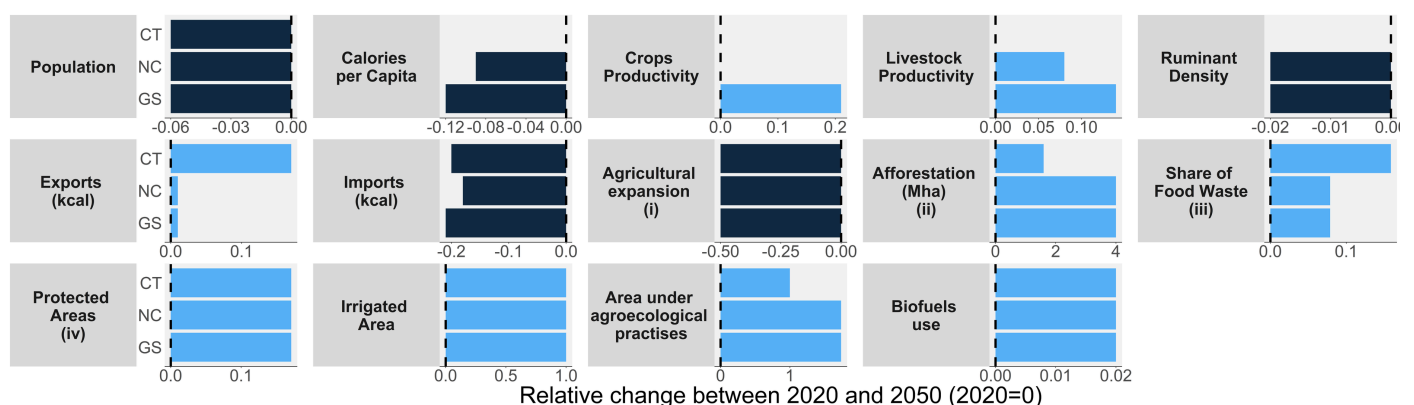
## Pathway narratives

**Current Trends:** Represents a low-ambition trajectory primarily shaped by historical trends and existing policies, offering a glimpse into a future heavily reliant on the current level of implementation and enforcement.

**National Commitments:** Attempts to predict how food and land systems will evolve if national strategies, pledges, and targets concerning climate, biodiversity, and food systems are met. This is based on a review of policy documents that describe the national climate and biodiversity strategies, the UN food system pathway, the national dietary guidelines, and other relevant policy documents for food and land systems.

**Global Sustainability:** Scenario selections reflect the same selections as in National commitments with the only difference for Diet scenario which was set to EAT Lancet Average.

Figure 3. Assumptions on the levers for change in each pathway



**Notes:** (i) Results are expressed in code, taking the value 1 for 'Free expansion scenario', -0.5 for 'No deforestation' and -1 for 'No Agricultural expansion'.  
(ii) Results are expressed in a net increase rather than relative change.  
(iii) Results are expressed % of consumption that is wasted.  
(iv) Results are expressed in % of total land in 2050.

Figure 4. Computed daily average intake per capita over 2000-2050

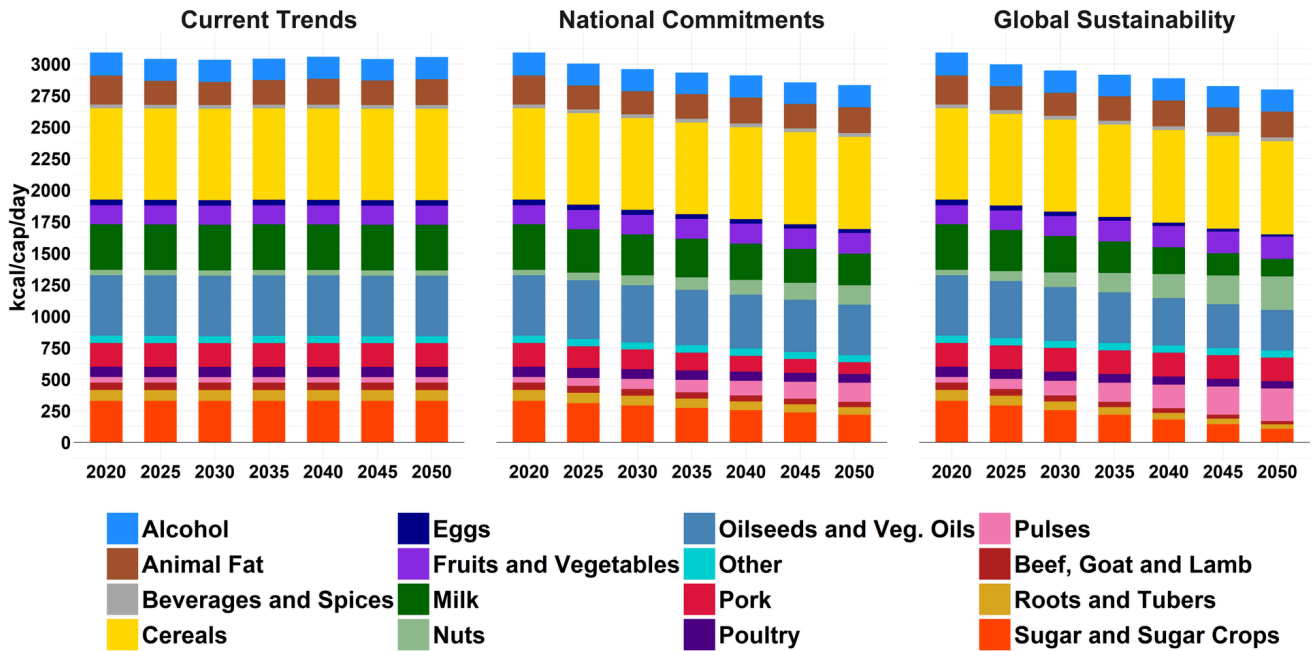


Figure 5. Comparison of the computed daily average kilocalorie intake per capital per food category across the three pathways and the prevalence of undernourishment in 2050

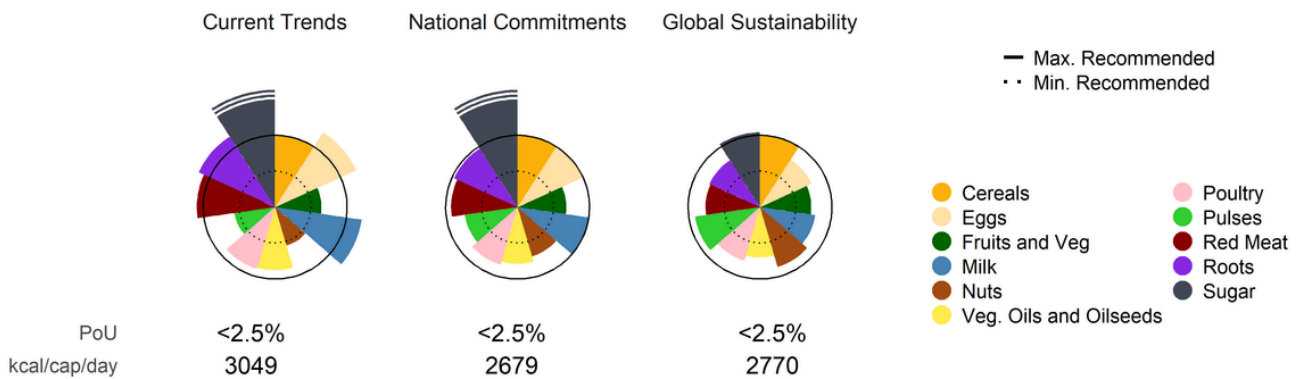


Figure 6. Evolution of land cover 2000-2050

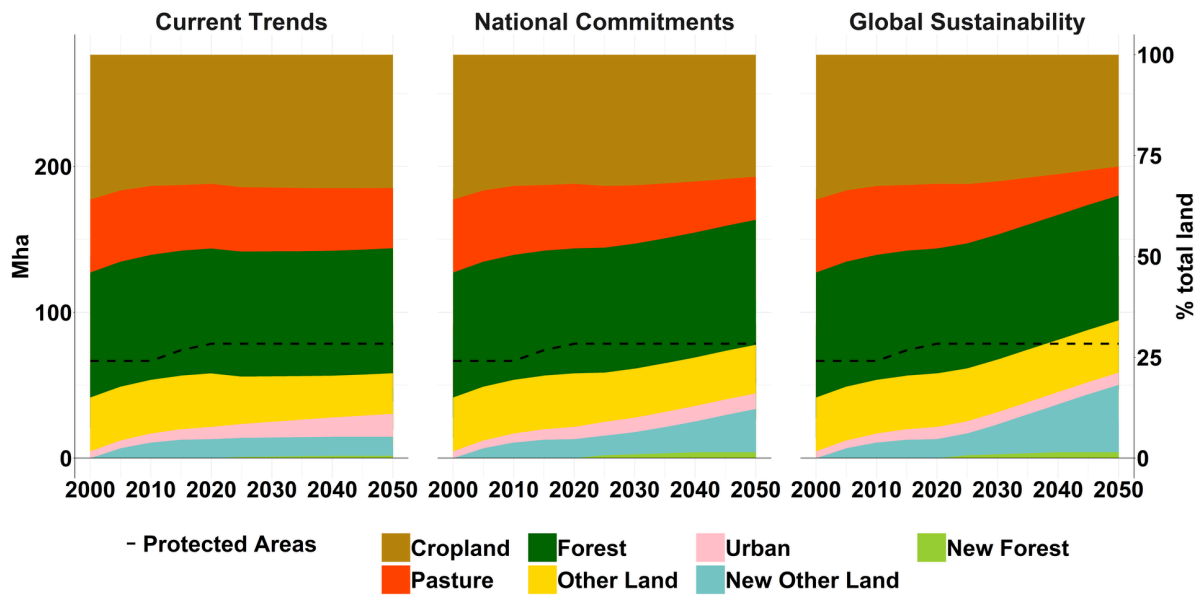


Figure 7. Evolution of the cropland composition 2000-2050

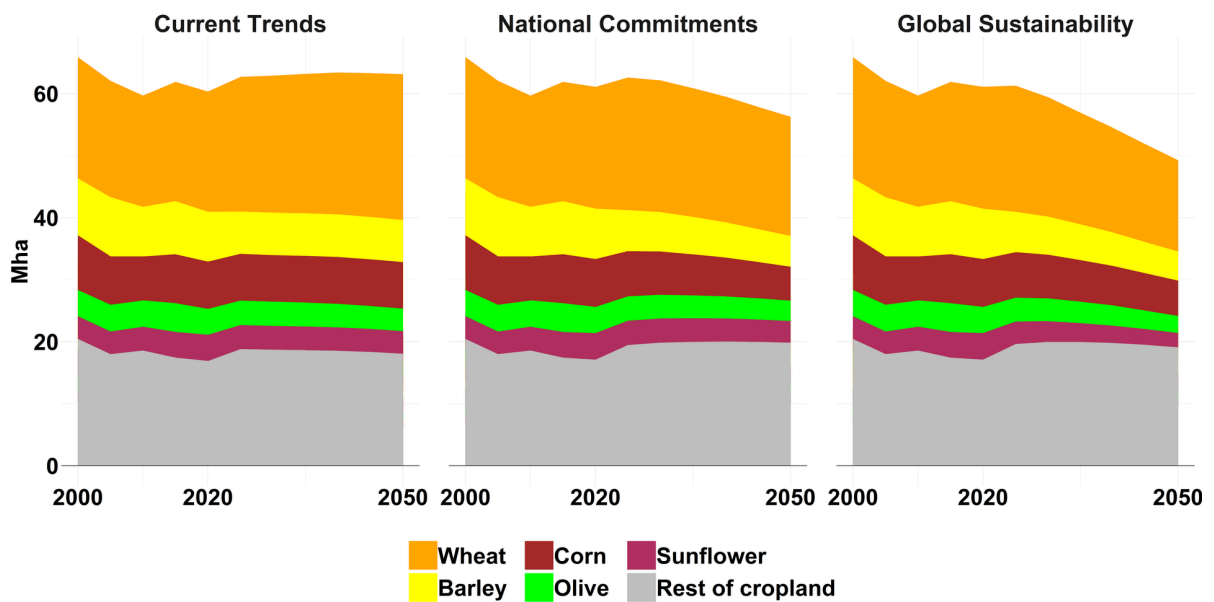




Figure 8. Projected AFOLU emissions and removals between 2020 and 2050 by main sources and sinks across pathways

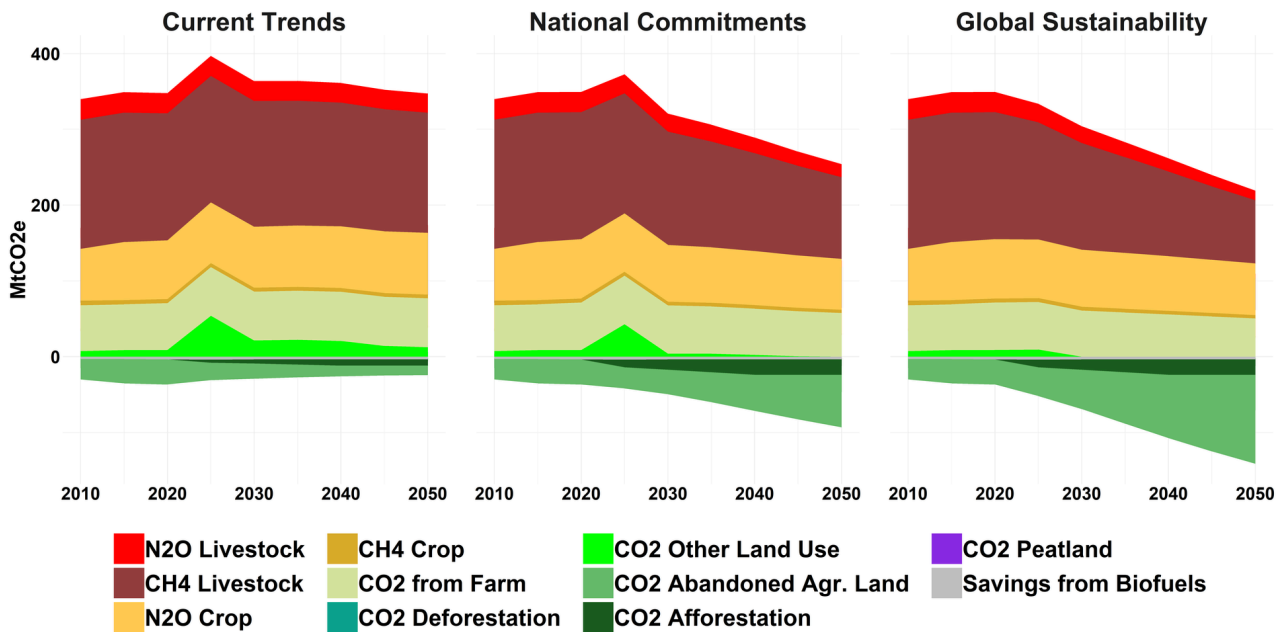


Figure 9. Share of cropland under agroecological practices

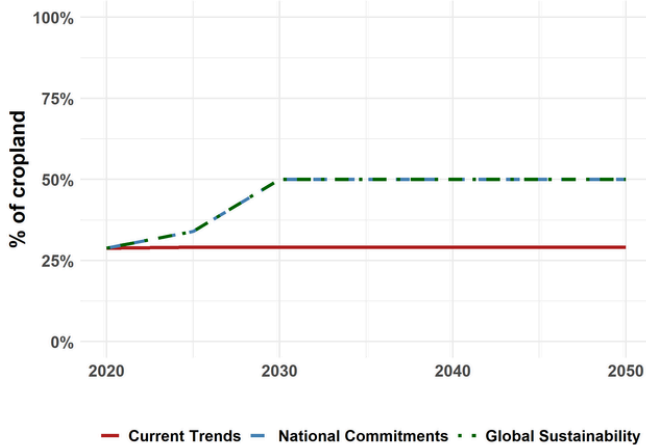
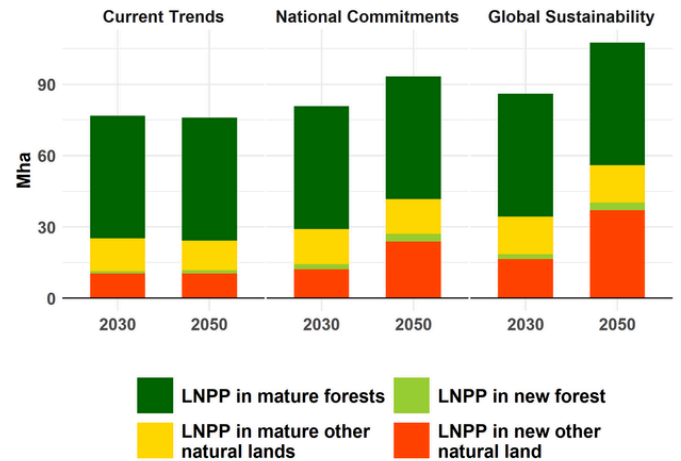


Figure 10. Total area of land where natural processes predominate (LNPP)



Agroecological practices included: Cover crops, cultivar mixtures, diversified farming systems, embedded natural, organic farming, no/minimal tillage.

Figure 11. Nitrogen application

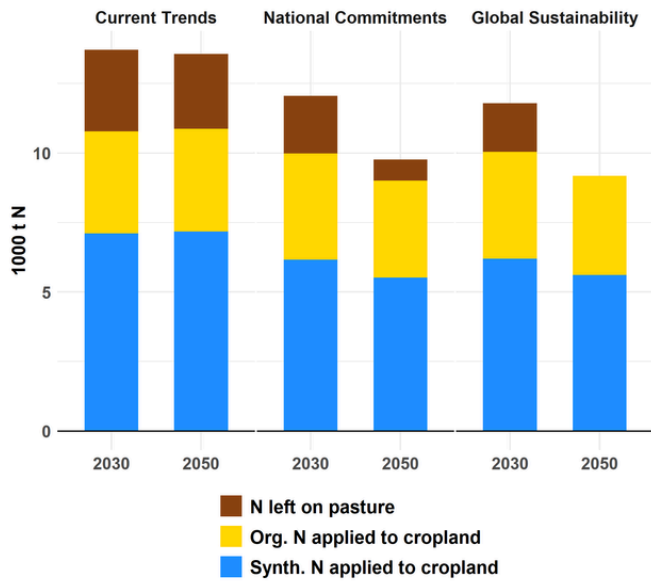
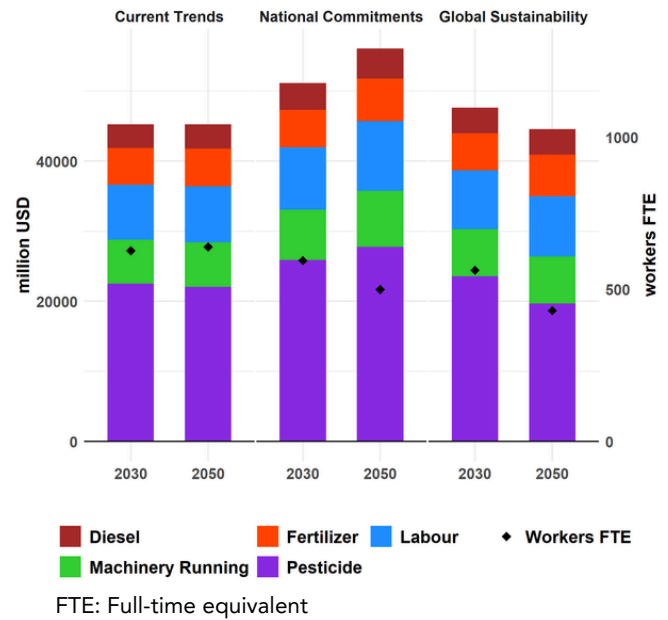


Figure 12. On farm production costs



For more detailed results and visual data, visit [www.scenathon.org](http://www.scenathon.org)

# Scenarios and assumptions

		A) CURRENT TRENDS	B) NATIONAL COMMITMENTS	C) GLOBAL SUSTAINABILITY
<b>1. Macroeconomics</b>	<b>1.1)</b> GDP per capita	SSP2	SSP2	SSP2
	<b>1.2)</b> Population	UN_medium: medium growth	<a href="#">EU population</a> was 451 million persons on 1 January 2023 (451,385,792). <a href="#">It is projected to decrease by 6% in 2100</a> , after having a peak of 453 million people at 2026. The <a href="#">2050 levels</a> will be similar to current values (447,877,407) though with a small decline of about -1%. We therefore choose the UN medium growth population scenario.	Same as CT
	<b>1.3)</b> Inflation	Current Dollars: prices expressed in current terms (current dollar around the year 2020)	According to the European Central Bank, inflation and prices are projected to stabilize and decrease to before energy crisis levels. The Harmonized Index of Consumer Prices is projected to decrease to an average of 5.4% in 2023 and then to 3.0% in 2024 and 2.2% in 2025. We therefore select an average inflation change and prices scenario.	Average
	<b>1.4)</b> Inequalities			
<b>2. Land</b>	<b>2.1)</b> Constraints on agricultural expansion/deforestation	NoDeforestation	<a href="#">EU forest strategy for 2030</a> sets a target for protecting EU's last remaining primary and old-growth forests. We therefore select the no deforestation-2030 scenario.	Same as National Commitment
	<b>2.2)</b> Afforestation, and forest plantations targets	BonnChallenge	BonnChallenge pledges (total of 1600 ha), no time horizon so, set to 2050. Additionally, the <a href="#">EU Green deal targets for additional planting of 3 billion trees by 2030</a> in the EU. Using average stocking and spacing requirements from Ireland's <a href="#">TEAGASC</a> (3,000 trees per hectare) we estimate an additional land extent of 1 million hectares for afforestation. We assume the targets should be further improved to the additional plantation of 3 million hectares to meet sustainability targets	Same as National Commitment
	<b>2.3)</b> Urban and settlements area	No Change	<a href="#">EU projects that built-up areas</a> are likely to expand by more than 3% between 2015 and 2030, reaching 7% of the EU territory by 2030. We therefore choose a current trend of urbanization, since the current trend of increase will keep up until 2030.	No Change
	<b>2.4)</b> Protected areas	No change	The EU Biodiversity Strategy for 2030 sets the target of <a href="#">protecting 30% of EU land and sea by 2030</a> .	Same as National Commitment

# Scenarios and assumptions

		A) CURRENT TRENDS	B) NATIONAL COMMITMENTS	C) GLOBAL SUSTAINABILITY
<b>3. Productivity and management</b>	<b>3.1)</b> Crop productivity for the key crops	No growth	Middle Growth	Middle Growth
	<b>3.2)</b> Cropland under agroecological practices	No change	EU 2030 biodiversity strategy targets <a href="#">legally protecting a minimum of 30%</a> of the EU's land areas. We therefore choose a share of cropland of 30% to be under a mix of agroecological practices.	Same as National Commitment
	<b>3.3)</b> Livestock productivity for the key livestock products	No Growth	BAU Growth	High Growth
	<b>3.4)</b> Pasture stocking rate	No Growth	BAU Growth	High Growth
	<b>3.5)</b> Forest management			
<b>4. Trade</b>	<b>4.1)</b> Share of consumption which is imported for key imported products (%)	Stable Imports	Using OECD <a href="#">current and projected import statistics</a> we estimate an increase of ~22% in imports between 2020 and 2024. We apply this rate of increase to the top 4 imported goods in the EU: Maize, Wheat, Pigs and Soy (Cake of soya beans and soya beans).	Same as National Commitment
	<b>4.2)</b> Evolution of exports for key exported products (1000 tons)	Exports are multiplied by 1.5 by 2050	Using OECD <a href="#">current and projected import statistics</a> we estimate an increase of ~25% in exports between 2020 and 2024. We apply this rate of increase to the top 4 imported goods in the EU: Wheat, Pigs, Maize and Barley	Same as National Commitment
<b>5. Food</b>	<b>5.1)</b> Average dietary composition	No change	<p>Healthy, balanced and sustainable diets for all European consumers (<a href="#">EU Code of Conduct on Responsible Food Business and Marketing Practices</a>)</p> <p><a href="#">Improved food consumption patterns in the EU:</a></p> <ul style="list-style-type: none"> <li>- Encourage increased consumption of fruits and vegetables, wholegrain cereals, fibre, nuts and pulses, including locally-produced varieties (e.g. by increasing the availability thereof and/or access thereto)</li> <li>- Provide/promote more sustainably-produced food products/meals (e.g. sustainably produced organic food; higher animal welfare standards; sustainable fisheries, aquaculture and algae products)</li> </ul>	EAT Lancet Average

# Scenarios and assumptions

		A) CURRENT TRENDS	B) NATIONAL COMMITMENTS	C) GLOBAL SUSTAINABILITY
			<ul style="list-style-type: none"> <li>- Improve, where feasible, the nutritional composition and environmental footprint of food products/meals, e.g. through product reformulation and new product development/ innovation</li> <li>- Review and/or offer a range of appropriate portion and serving sizes aimed at sustainable food consumption</li> <li>- Promote consumer awareness of healthy, balanced and sustainable diets, including sustainable food consumption, as part of healthy &amp; sustainable lifestyles.</li> </ul> <p>Given the targeted sustainable diet we introduce a new diet in the national pathway scenario which is the average of the current diet (taken from <a href="#">FAO Food balance sheets</a>) and the EAT-Lancet average diet.</p>	
	<b>5.2)</b> Share of food consumption which is wasted at household level	Current	<p><a href="#">A 50% reduction of per capita food waste</a> at the retail and consumer level by <b>2030</b>.</p> <p>Post harvest losses scenario: Based on EU's target to <a href="#">reduce food losses at production stage</a> we choose the reduced post harvest losses.</p>	Same as National Commitments
<b>6. Biofuels</b>	<b>6.1)</b> Targets on biofuel and/or other bioenergy use	No change	EU sets a target for <a href="#">transitioning towards advanced biofuels</a> made from sustainable feedstock. By 2030, the EU aims to increase the share of renewable energy in transport to at least 14%, including a minimum share of 3.5% of advanced biofuels.	Same as National Commitments
	<b>6.2)</b> Targets on other non-food use			
<b>7. Water</b>	<b>7.1)</b> Irrigated crop area	No growth	EU is under water scarcity pressures and has already seen a <a href="#">decrease in the share of irrigated areas</a> (6.1 % between 2005 and 2016). As such we choose the no irrigation expansion scenario.	Same as National Commitments