

2023 Scenathon results

# Pathways for food and land-use systems in Greece



**FABLE**  
CONSORTIUM



### **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**

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### **Recommended citation**

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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 significantly supports the remaining SDGs, underscoring its crucial role in fostering a sustainable future.

In this document, we present 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. These results, together with our modelling tools and methods, 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.

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

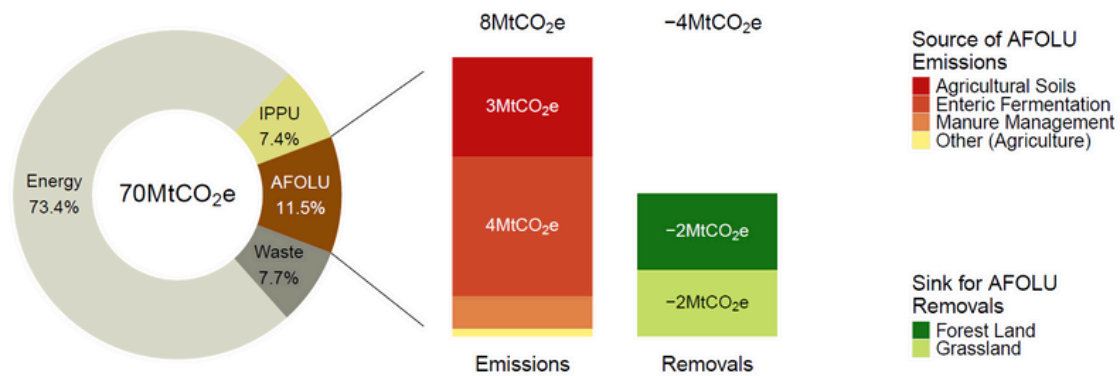
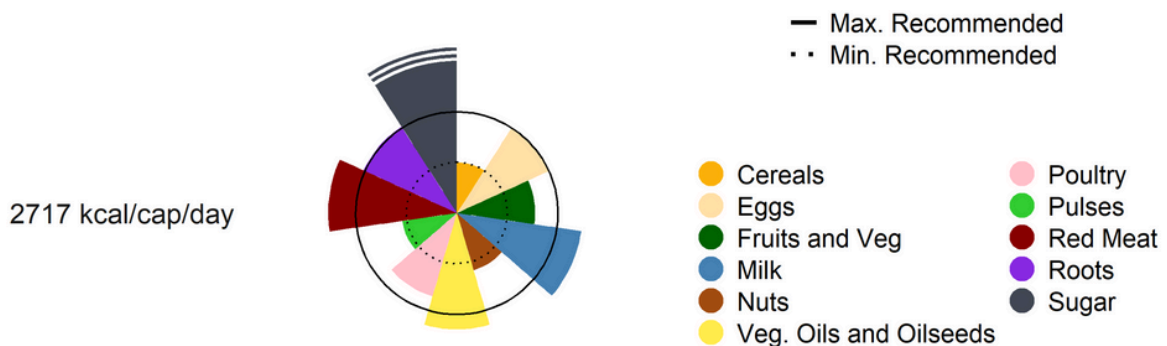





Figure 2. Daily average kilocalorie intake per capital per food category in 2020



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

SDG	Indicator	National Target (Official source: OS, Assumption: A)
 2 ZERO HUNGER	Undernourishment	Zero <u>undernourishment</u> (OS)
	Overweight / obesity	Reduction of childhood obesity from 25% to at least 10% by <u>2030</u> (OS)
	Diet-related diseases	-25% in premature mortality from NDCs by 2025 compared to 2015 (A)
	Other food-related targets	Sustainable food production systems + resilient agricultural <u>practices</u> by 2030
 13 CLIMATE ACTION	Total GHG emissions reduction	55% reduction by 2030 and 80% by 2040 compared to 1990 before achieving zero-net emissions by <u>2050</u> . (OS)
	Land use and land use change GHG emissions reduction	-3 MtCO <sub>2</sub> e by <u>2030</u> (A)
	Agriculture GHG emissions reduction	15% reduction by 2030 compared to <u>1990</u> (A)
	Reduce or halt deforestation	0% deforestation by <u>2030</u> (OS)
	Other climate mitigation related targets	Renewable Energy Target: At least 42,5% (new binding target), but aiming for 45% by <u>2030</u> (OS)
 15 LIFE ON LAND	Promote afforestation	Afforestation of 50,000 hectares by <u>2030</u> (OS)
	Reduce or halt loss of natural ecosystems	Halt the loss of biodiversity and the degradation of ecosystem services by <u>2026</u> (OS)
	Expand protected areas	Protected areas represent 30% of land and water by <u>2030</u> (OS)
	Expand agroecology	25% of agricultural area under <u>organic farming</u> (OS)
	Reduce or halt use of agrochemicals and other agricultural practices that harm biodiversity	50% reduction of chemical and more hazardous pesticides and more pesticides by 2030 compared to the annual average of 2015- <u>2018</u> (OS)
	Other biodiversity related targets	Reduction by 50% in sales of antimicrobials used for farmed animals and aquaculture during 2020- <u>2030</u> (OS)

	Agricultural exports	Annihilate the trade deficit in the agri-food <u>sector</u> (OS)
	Employment in agri	Maintain >10% of total <u>employment</u> (A)
	Timber exports	3x wood & wood product exports by 2030 compared to <u>2020</u> (A)
	Limit nitrogen and phosphorous use	Reduce N and P fertiliser by 20% by 2030 compared to <u>2015</u> (OS)
	Limit water use	Reduce water consumption in agri by 10-20% by 2030 compared to <u>2020</u> (A)
	Other water related targets	Reduce Infrastructure Loss Index (ILI) in drinking water grid to less than 1.5/EU rules aim to encourage and facilitate water reuse in the <u>EU</u> (OS)

## 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.

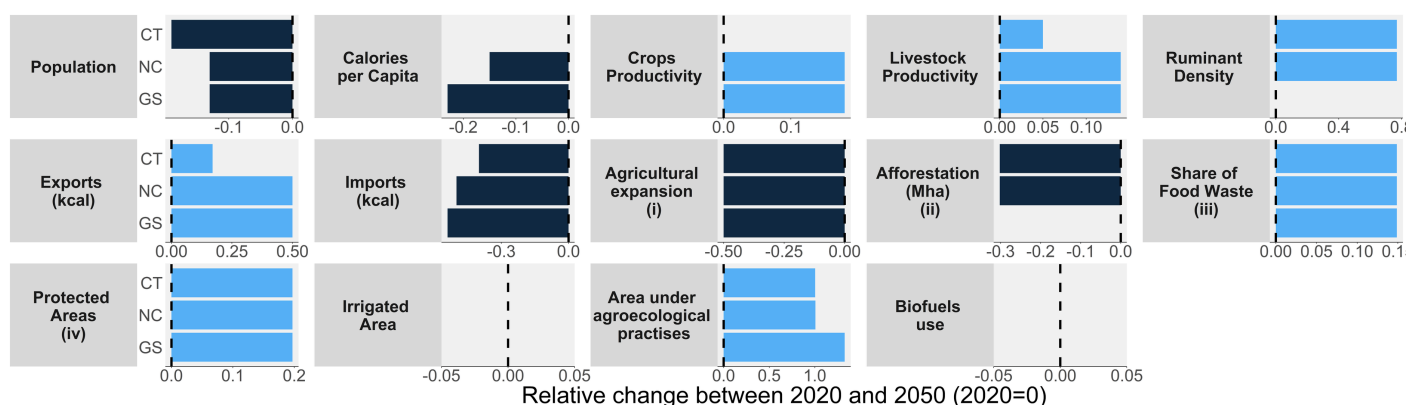
## Pathway narratives

**Current Trends:** We assume high urbanization and an uptick in economic activity, no change in dietary consumption for the general population, a 50% surge in key exports, and increased reliance on food imports. Moreover, we assume no substantial shift in biofuel demand, no afforestation target, and no change in post-harvest losses. This Pathway is embedded in a global GHG concentration trajectory that would lead to a radiative forcing level of 6 W/m<sup>2</sup> (RCP 6.0), or global mean warming increase likely 2-3°C above pre-industrial levels.

**National Commitments:** we underscore specific numerical and qualitative targets based on Greece's NECP, the Pissardies Committee Plan for the Greek Economy, and the commitments accruing from EU participation. The pathway entails a medium to high speed of economic growth, a shift to a healthy diet (as described by the EAT-Lancet Committee), and reduced imports. Nonetheless, exports are expected to double by 2050 reflecting the country's aspiration for outward-oriented economic growth, and productivity is expected to surge both for crops and livestock production. This Pathway is embedded in a global GHG concentration trajectory that would lead to a lower radiative forcing level (RCP 4.5) and assumes the expansion of protected areas and an increase in agricultural land under organic practices.

**Global Sustainability:** We assume a lower speed of economic growth compared to national commitments, albeit with the assumption that higher crop and livestock productivity remains stable. In addition, afforestation is aligned with the Bonn challenge, and ruminant density does not grow as assumed in the national commitments pathway. The global sustainability pathway is underpinned by a global GHG concentration trajectory leading to a lower radiative forcing level of 2.6 W/m<sup>2</sup> by 2100 (RCP 2.6), in line with limiting warming to 2°C.

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

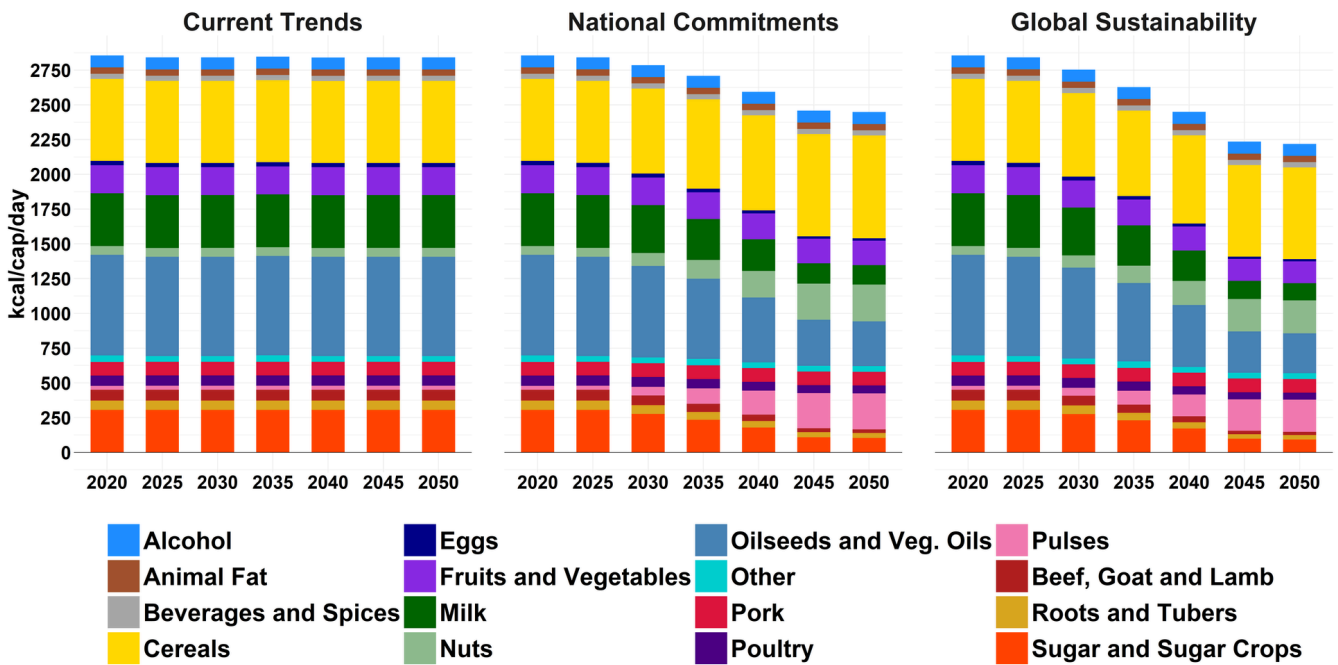


Figure 5. Comparison of the computed daily average kilocalorie intake per capital per food category across the three pathways and the prevalence of undernourishment in 2050

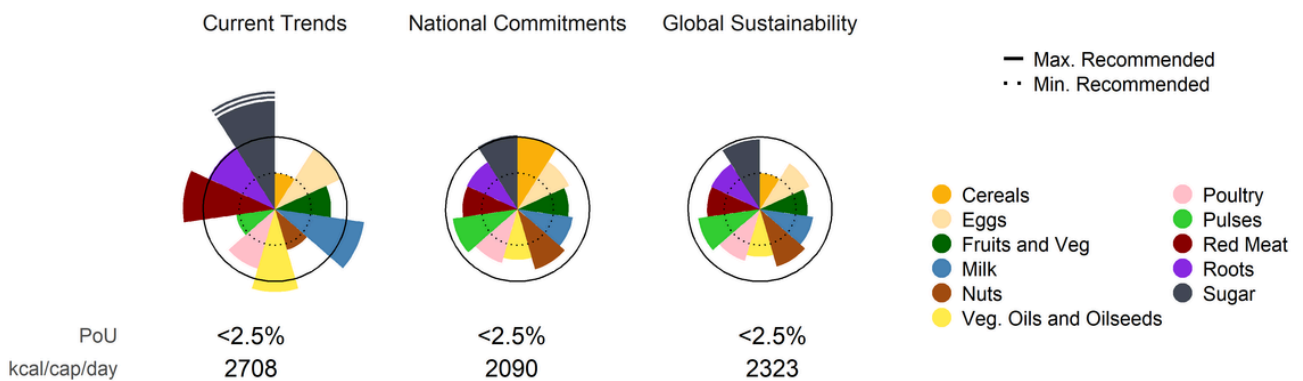


Figure 6. Evolution of land cover 2000-2050

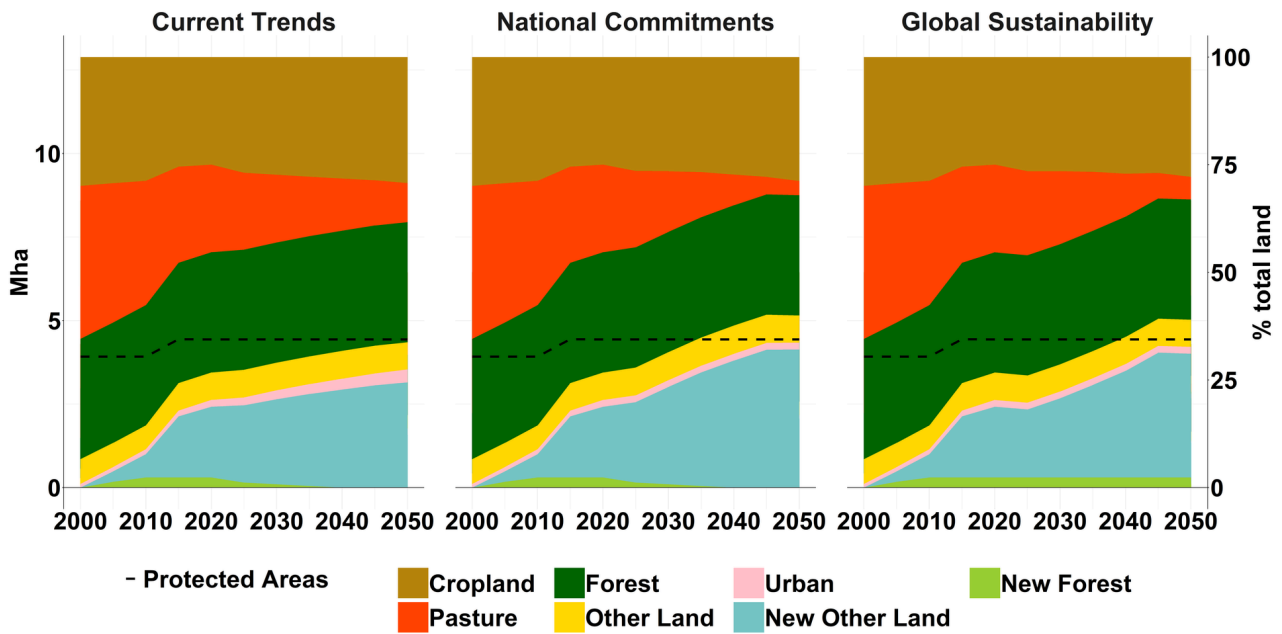


Figure 7. Evolution of the cropland composition 2000-2050

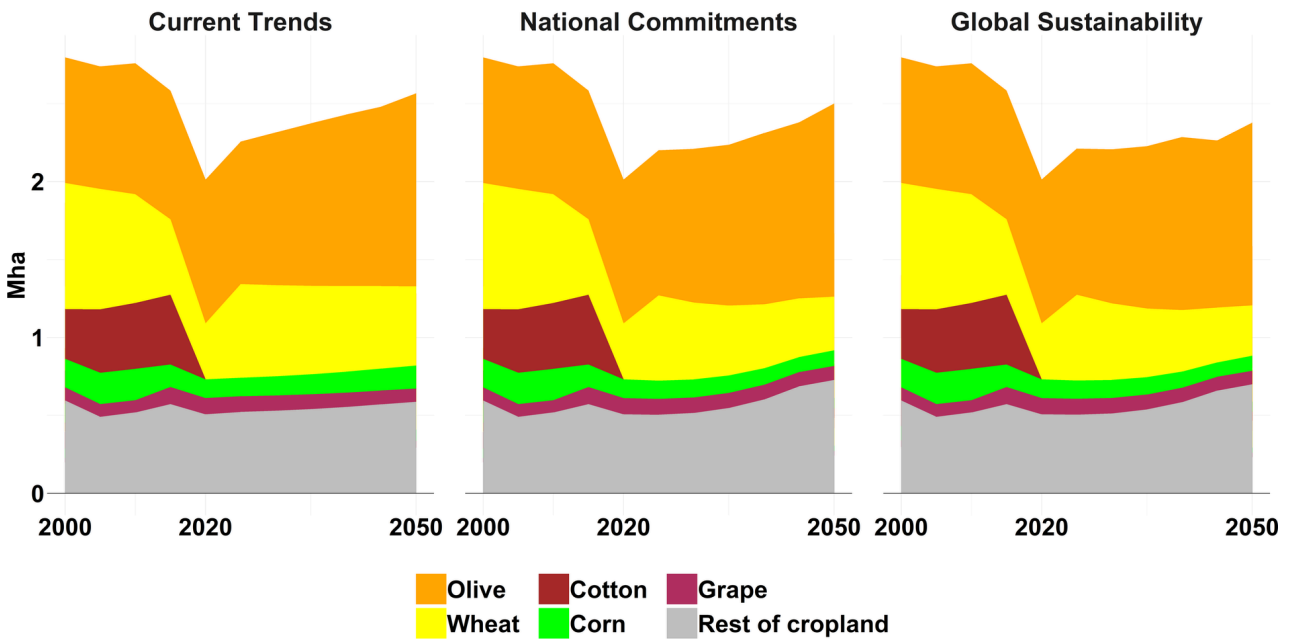




Figure 8. Projected AFOLU emissions and removals between 2020 and 2050 by main sources and sinks across pathways

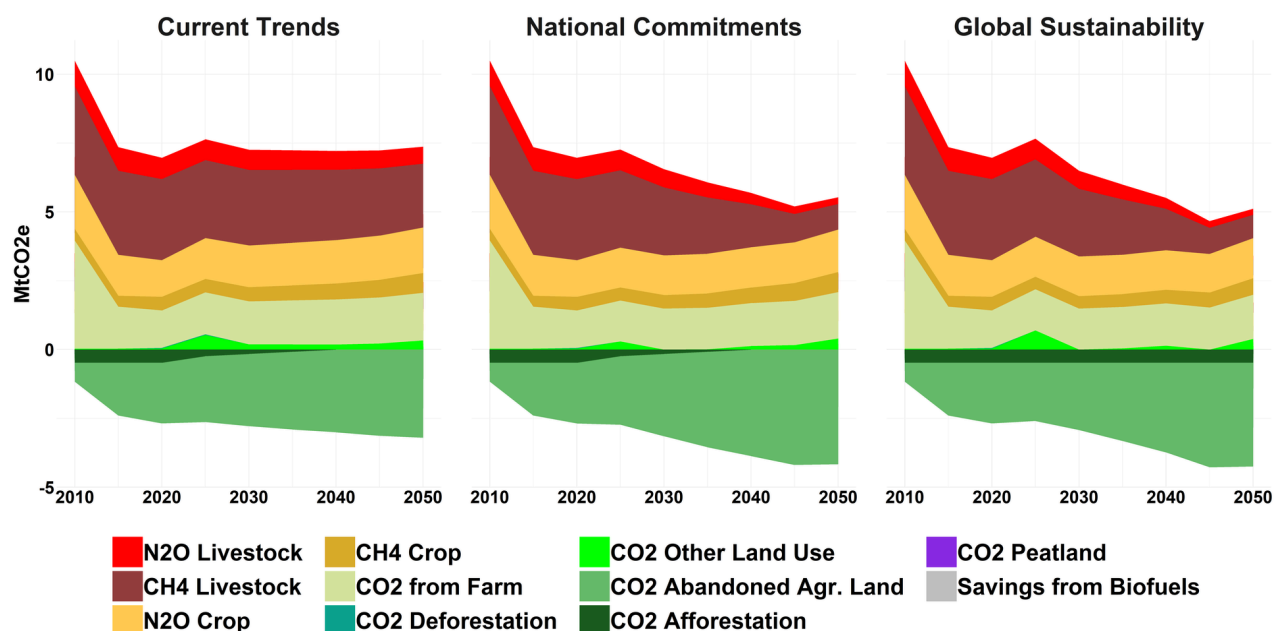


Figure 9. Share of cropland under agroecological practices

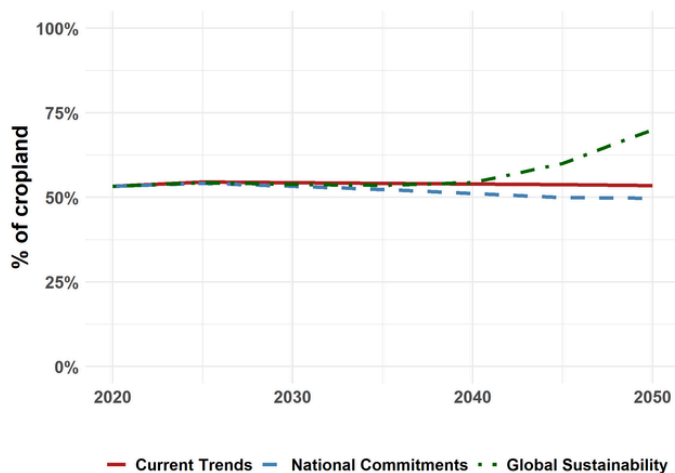
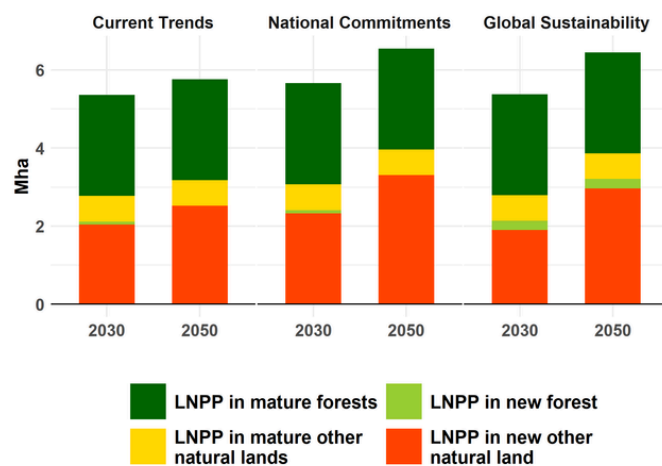


Figure 10. Total area of land where natural processes predominate (LNPP)



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

Figure 11. Nitrogen application

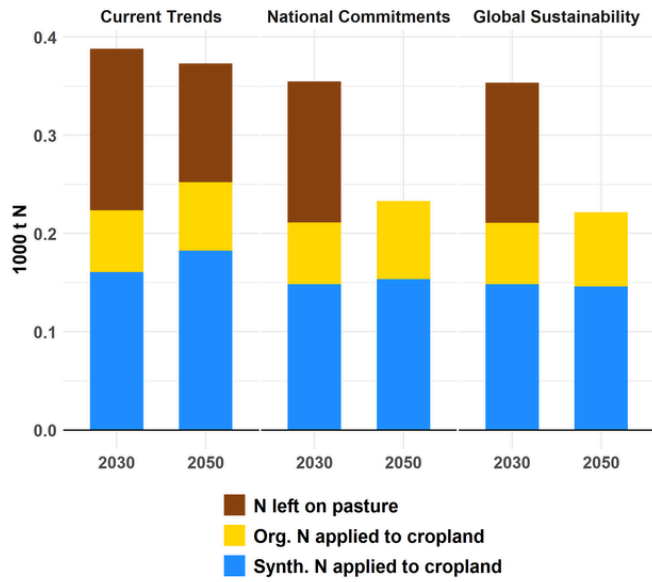
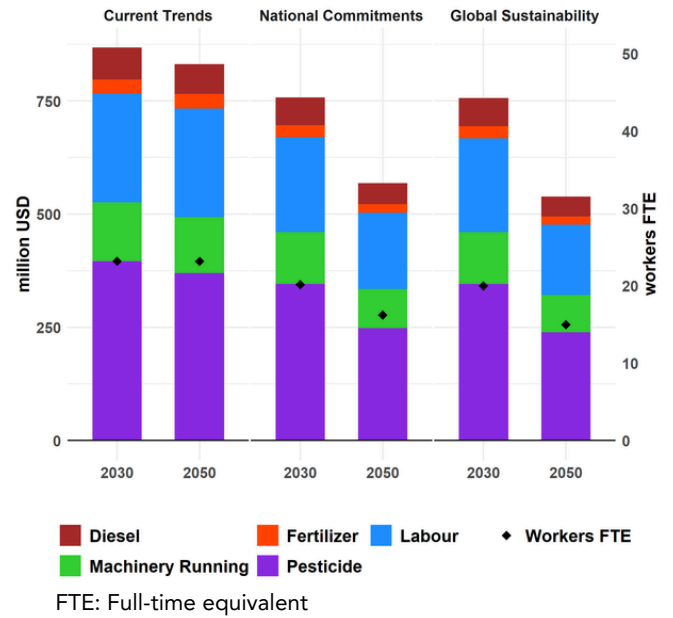


Figure 12. On-farm production costs



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

# Scenarios and assumptions

		<b>A) CURRENT TRENDS</b>	<b>B) NATIONAL COMMITMENTS</b>	<b>C) GLOBAL SUSTAINABILITY</b>	<b>Justification</b>
<b>1. Macroeconomics</b>	<b>1.1)</b> GDP per capita	2% y-o-y Growth	3.5% y-o-y Growth until 2030	2 - 3.5% y-o-y growth until 2030	<a href="#">Recovery Plan for the Greek Economy - Pissarides Report.</a>
	<b>1.2)</b> Population	1.5 - 2.5 million reduction by 2050	Maintain a population of no less than 10 million	Maintain current trend	<a href="#">Essay on Greek Population</a>
	<b>1.3)</b> Inflation	4.2% in 2023 and 2.4% in 2024	2% y-o-y	Maintain current trend	<a href="#">Economic forecasts by the European Commission</a>  <a href="#">European Central Bank</a>
	<b>1.4)</b> Inequalities	Gini Index 33.5 in 2020 - moving away from Target according to SDG 10	Gini Index drop below 30 by 2030	Decrease by 20% by 2030	<a href="#">OECD- Distance from SDG Targets</a>
<b>2. Land</b>	<b>2.1)</b> Constraints on agricultural expansion/deforestation	Promotion of no deforestation and expansion of agricultural land tied to agroforestry targets	Increase legislation stringency regarding deforestation for agricultural expansion and enhance monitoring and implementation.	Halt deforestation by 2030; agricultural expansion limited to unforested areas	<a href="#">Greece RDP</a>
	<b>2.2)</b> Afforestation, and forest plantations targets	3.5 - 4 Mha of Forest Area in 2030.	4.2 - 4.5 Mha of Forest Area in 2030.	4.2 - 4.5 Mha of Forest Area in 2030.	<a href="#">Inclusion of Project "SUB1: National Recovery Plan" (Code OPAP TA 5201358) in the Recovery and Resilience Fund - Decision by the Deputy Minister of Finance</a>  <a href="#">Global Forest Watch</a>  <a href="#">FAOSTAT Land-Use</a>
	<b>2.3)</b> Urban and settlements area	128,900 sq. km. as of 2015 urban land area	0.2% growth	0.2% growth	<a href="#">The World Bank</a>

# Scenarios and assumptions

		<b>A) CURRENT TRENDS</b>	<b>B) NATIONAL COMMITMENTS</b>	<b>C) GLOBAL SUSTAINABILITY</b>	<b>Justification</b>
	<b>2.4)</b> Protected areas	1249 protected areas, 30.2% of land, 19.4% of sea	By 2030, protected areas cover at least 30% of the land area and sea of the country	By 2030, protected areas cover at least 30% of the land area and sea of the country	<a href="#">Replies on Questionnaire on "Human Rights, Transformative Actions and UN Sustainable Development Goals</a>
<b>3. Productivity and management</b>	<b>3.1)</b> Crop productivity for the key crops	As of 2022, agricultural productivity: Sugar beet (excluding seed): 42.91 tonne/ha; Potatoes (including seed potatoes): 26.45 tonne/ha; Grain maize and corn-cob-mix: 19.75 tonne/ha; Rice: 5.74 tonne/ha; Wheat and spelt: 2.72 tonne/ha; Barley: 2.44 tonne/ha Rye and winter cereal mixtures (maslin): 1.76 tonne/ha; Tobacco: 1.43 tonne/ha; Cotton fiber: 1.29 tonne/ha; Oats: 1.18 tonne/ha	Converge to EU average in crop yields for main crops: Cereals, Rice, Olives, Citrus fruits, Nuts. Green maize: 3.5 tn/ha, Wheat & Spelt: 4 tn/ha; Barley: 4 tn/ha, Cotton Fibre 1.5 tn/ha, Oats 3.5 tn/ha, Rye: 3.5 tn/ha	Converge to EU average in crop yields for main crops: Cereals, Rice, Olives, Citrus fruits, Nuts. Green maize: 3.5 tn/ha, Wheat & Spelt: 4 tn/ha; Barley: 4 tn/ha, Cotton Fibre 1.5 tn/ha, Oats 3.5 tn/ha, Rye: 3.5 tn/ha	<a href="#">EUROSTAT</a>
	<b>3.2)</b> Cropland under agroecological practices	Area under organic farming as of 2020, 10.2% of utilized agricultural area	20% or above by 2050	Above 20% by 2050	<a href="#">EUROSTAT</a>
	<b>3.3)</b> Livestock productivity for the key livestock products	As of 2019, livestock production : Bovine: 231.8 Kg/ head Sheep and goat: 11.3 Kg/ head Pig: 67.7 Kg/ head Chicken Meat: 1.7 Kg/head Cattle Milk: 7.6 Kg/head	>200 Hen Eggs and double the yield for Cattle Milk, Goat Milk, Pig Meat and Goat & Sheep Meat	2x the yield in Hen Eggs, Cattle Milk, Goat Milk, Pig Meat and Goat & Sheep Meat	<a href="#">EUROSTAT - APRO MT PANN</a>

# Scenarios and assumptions

		<b>A) CURRENT TRENDS</b>	<b>B) NATIONAL COMMITMENTS</b>	<b>C) GLOBAL SUSTAINABILITY</b>	<b>Justification</b>
		Goat Milk: 1.4 Kg/head Hen Eggs: 180 Eggs/head			
	<b>3.4)</b> Pasture stocking rate	Minimum stocking density levels for pastureland (which are set at 0.2 LU/ha for all categories of animal)	Maintain stocking rate around current levels	Maintain stocking rate around current levels	<a href="#">Convention on Biological Diversity 5th National Report by Greece</a>
	<b>3.5)</b> Forest management	Permanent deforestation halted. Forests are in continual deterioration due to poor management, competitive agricultural and settlement use, intense pasture, and summer fires. High slopes make harvesting extremely difficult, occurring only during May - Sept. when climatic conditions are favorable, but this is an inappropriate period.	By 2030, promote the implementation of sustainable management of all types of forests, halt all deforestation, increase thinning and pruning as preventive measures, and increase forest sector contribution to GDP from 0.05% to the EU average of 0.2%	By 2030, promote the implementation of sustainable management of all types of forests, halt all deforestation, increase thinning and pruning as preventive measures, and increase forest sector contribution to GDP from 0.05% to the EU average of 0.2%	<a href="#">EU Forest Strategy</a>
<b>4. Trade</b>	<b>4.1)</b> Share of consumption which is imported for key imported products (%)	8.5 - 10 billion yearly imports of agricultural products	Reduction to achieve a neutral agricultural trade balance	Reduction to achieve a neutral agricultural trade balance	<a href="#">Atlas of Economic Complexity</a>
	<b>4.2)</b> Evolution of exports for key exported products (1000 tons)	6 - 7 billion yearly agricultural exports 2010 - 2020 - 9~10% of total exports (goods and services)	Increase to achieve a neutral agricultural trade balance	Increase to achieve a neutral agricultural trade balance	<a href="#">Atlas of Economic Complexity</a>
<b>5. Food</b>	<b>5.1)</b> Average dietary composition	Average dietary energy supply, 2019-2021: 3412 kcal / capita/ day, of which, as of 2019: cereals: 811 kcal/capita/ day; fats and oils: 842 kcal / capita/ day; meat: 290 kcal / capita/ day; sugar:	Diet shifts to the Lancet diet by 2050 (EAT, Planetary Health diet)	Diet shifts to the Lancet diet by 2050 (EAT, Planetary Health diet)	FAO. 2022. World Food and Agriculture - <a href="#">Statistical Yearbook 2022</a> . Rome.

# Scenarios and assumptions

		<b>A) CURRENT TRENDS</b>	<b>B) NATIONAL COMMITMENTS</b>	<b>C) GLOBAL SUSTAINABILITY</b>	<b>Justification</b>
		332 kcal / capita/ day; roots, tubers, and pulses: 118 kcal / capita/ day; fruit and vegetables: 287 kcal / capita/ day; dairy and eggs (exl. butter) 430 kcal / capita/ day; beverages and other: 189 kcal / capita/ day; fish and seafood: 38 kcal / capita/ day.			
	<b>5.2)</b> Share of food consumption which is wasted at household level	As of 2019, the total per capita food waste generation in Greece is estimated to be 76.1 kg/inh-y.	Reduce food waste by 30% by 2035 and to relative EU median levels by 2050	Reduce food waste by 30% by 2035 and to relative EU median levels by 2050	<a href="#">Sustainable development in the European Union - Monitoring report on progress towards the SDGs in an EU context - 2023 edition</a>  <a href="#">Food waste volume and composition in households in Greece</a>
<b>6. Biofuels</b>	<b>6.1)</b> Targets on biofuel and/or other bioenergy use	The projection of 2030 predicts that the bioethanol share will fall to 71%, the biodiesel will also fall to 12%, but BTL (biomass to liquids) will emerge and stand at 12% market share, especially due to second and third-generation biofuels.	Greece plans to increase the RES-T to 19% in 2030 (10% without multipliers) with biofuels accounting for 80% of the RES-T or about 371 ktoe (vs. 157 ktoe in 2018). Contribution from biofuels from Annex IX-A feedstocks is expected to reach 197 ktoe in 2030 (vs. 0 ktoe in 2018). Greece has introduced a target for advanced biofuels of 0.2% in volume.	Greece plans to increase the RES-T to 19% in 2030 (10% without multipliers) with biofuels accounting for 80% of the RES-T or about 371 ktoe (vs. 157 ktoe in 2018). Contribution from biofuels from Annex IX-A feedstocks is expected to reach 197 ktoe in 2030 (vs. 0 ktoe in 2018). Greece has introduced a target for advanced biofuels of 0.2% in volume.	<a href="#">Overview of biofuels policies and markets across the EU-27 and the UK</a>  <a href="#">The Greek Biofuel market: Trends, prospects and challenges</a>
	<b>6.2)</b> Targets on other non-food use	-	The contribution made by biofuels produced from wastes,	The contribution made by biofuels produced from wastes,	<a href="#">Directive 2009/28/EC of the European</a>

# Scenarios and assumptions

		<b>A) CURRENT TRENDS</b>	<b>B) NATIONAL COMMITMENTS</b>	<b>C) GLOBAL SUSTAINABILITY</b>	<b>Justification</b>
			residues, non-food cellulosic material, and lignocellulosic material shall be considered to be twice that made by other biofuels	residues, non-food cellulosic material, and lignocellulosic material shall be considered to be twice that made by other biofuels	<a href="#">Parliament and of the Council of 23 April 2009</a>  <a href="#">The Greek Biofuel Market: Trends, Prospects and challenges</a>
<b>7. Water</b>	<b>7.1) Irrigated crop area</b>	Over the period 2011 - 2018, 36% of the agricultural area was irrigated.	Greece's target is to improve water management on 17.5% of agricultural land and water efficiency for 5% of irrigated land through irrigation infrastructure	Greece's target is to improve water management on 17.5% of agricultural land and water efficiency for 5% of irrigated land through irrigation infrastructure	<a href="#">Agriculture and rural development - European Commission</a>