

A close-up photograph of a coffee branch with several clusters of green coffee cherries. The leaves are dark green and glossy. The background is blurred, showing more of the coffee plant.

2023 Scenathon results

FABLE Scenathon 2023:
Pathways for food
and land-use systems
in Colombia



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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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

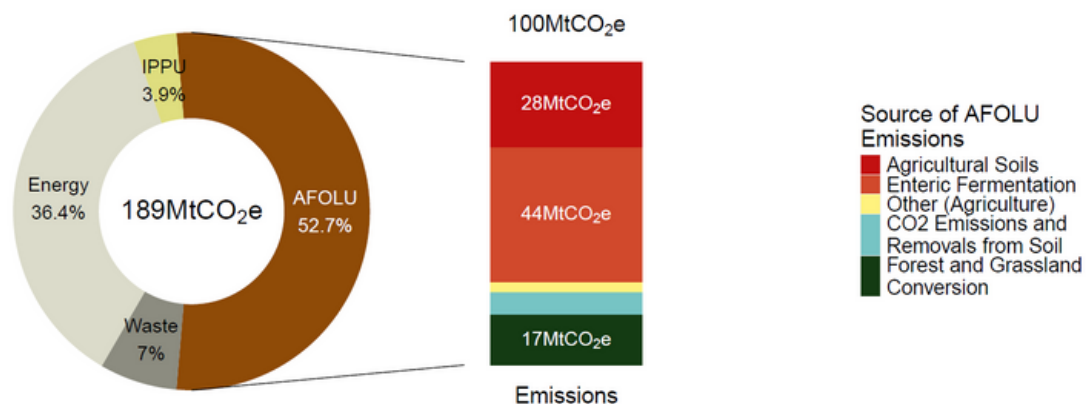
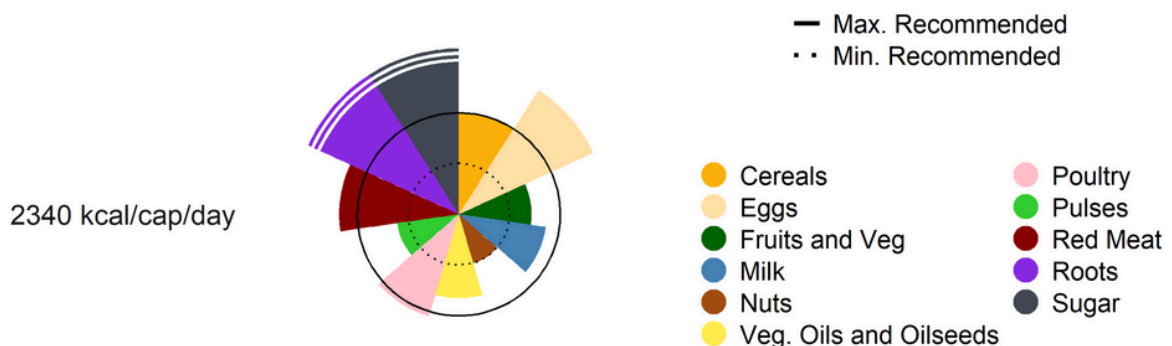







Figure 2. Daily average kilocalorie intake per capital per food category in 2020



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 (OS) Official source, (A) Assumption by the team.
 2 ZERO HUNGER	Undernourishment	<u>Significantly reduce mortality</u> from malnutrition in children under 5 years old, reducing it to 3.37 per 100,000 (OS)
	Other food related targets	The scenario fits to National Diet according to the Food Balance <u>Sheet</u> (A)
	Self sufficiency	<u>Food</u> and <u>agro-industrial sovereignty</u> through the strengthening of linkages in the production of food, inputs and equipment. Increase production by 10.38% in agricultural chains prioritized for the Human Right to Food (OS)
 13 CLIMATE ACTION	Agriculture GHG emissions reduction	Projected reduction of 12.29 MtCO ₂ e GHG emissions by <u>2030</u> (OS)
	Land use and land use change GHG emissions reduction	Projected reduction of 86.49 MtCO ₂ e GHG emissions by <u>2030</u> (OS)
	Reduce or halt deforestation	<u>Reduce deforestation</u> by 20% (limit of 140.000 Ha by 2026). Reduce net deforestation of natural forest to 0 hectares/year by 2030 (OS)
	Total GHG emissions	Emissions limit of 169.44 MtCO ₂ e (equivalent to a 51% reduction in 2030 compared to the reference <u>scenario</u>) (OS)
 15 LIFE ON LAND	Promote afforestation	Expand the areas of restoration, recovery, and rehabilitation of degraded ecosystems to 1.7 million hectares by 2030, 750,000 <u>more</u> than in <u>2022</u> . (OS)
	Expand protected areas or 'Other effective area-based conservation measures'	By <u>2030</u> , <u>increase</u> by 15% from 2021, the ecosystems not represented/ underrepresented in the National System of Protected Areas (SINAP)
	Expand cropland area under agroecological practices	The transition of 10% of conventional agricultural areas recognized in good agroecological practices, including <u>substitution</u> of <u>agrochemicals</u> (OS)
 14 LIFE BELOW WATER	Limit water use	<u>Efficient</u> use and saving of water in <u>100%</u> of the aqueduct and sewerage, irrigation and drainage, and hydroelectric production and other <u>uses</u> (OS)
 8 DECENT WORK AND ECONOMIC GROWTH	Agricultural exports	<u>Coffee</u> exports - decline 1.4% from 2020 levels. Non-traditional exports (manufacturing, agriculture and mining) increase by 6.3% from <u>2020</u> . (OS)
	Employment in agricultural sector	Create 1.7 million new jobs by <u>2026</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

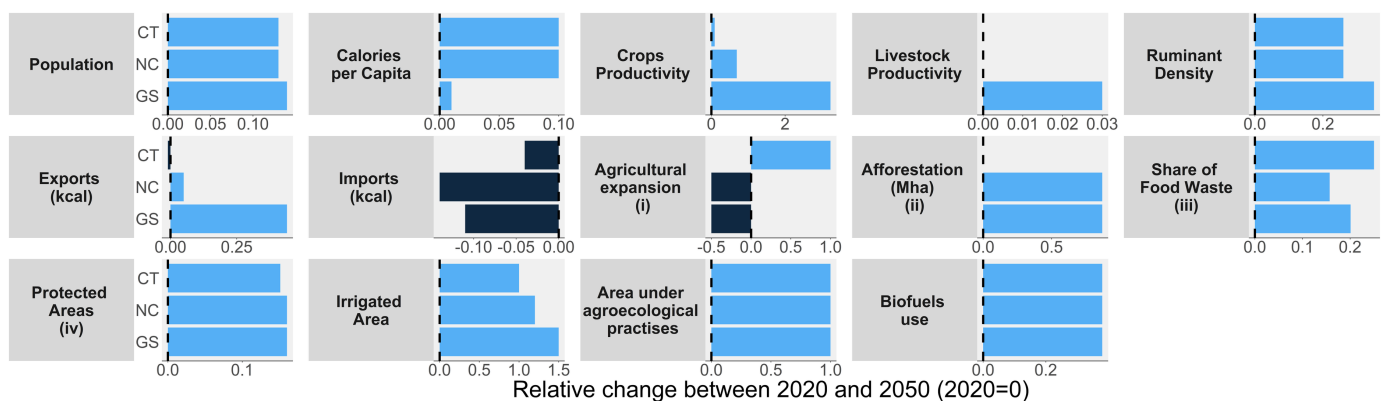
Current Trends: In the framework of the Current Trends pathway, we foresee a scenario shaped by a variety of interconnected factors. Moderate population growth is projected, rising from 51.1 million people in 2020 to 62.8 million by 2050. Alongside this, the agricultural frontier is anticipated to persist in its expansion, even into currently protected areas. Afforestation efforts are expected to remain moderate, following the trend of the last few decades. This scenario does not include plans to expand existing protected areas but does project modest increases in agricultural productivity. The share of domestic consumption met by imports will maintain its current ratio. On the economic front, we expect an uptick in exports for select agricultural commodities like coffee, plantain, palm oil, banana, and sugar. Overall, although existing policies and historical trends will contribute to a moderate slowing of population growth, they are unlikely to sufficiently address ongoing environmental challenges. Deforestation rates will continue at approximately 150,000 hectares per year, and only minimal afforestation efforts are expected through the National Restoration Plan.

National Commitments: This pathway aligns with Colombia's New National Development Plan for 2022-2026. Compared to the Current Trends, this pathway allows for moderate economic growth in Colombia. It is characterized by anticipated modest reductions in both food loss and post-harvest losses. In terms of international trade, consumer goods imports are expected to remain stable, while exports are projected to double by 2050. A slight yet consistent growth is expected in both the livestock and agricultural sectors.

Environmentally, the trajectory aims to halt deforestation by 2030, while also focusing on restoring areas impacted by agricultural expansion, persistent organic pollutants (POPs), and the implementation of the National Restoration Plan. Furthermore, it aims to expand the portfolio of protected areas in alignment with AICHI's Goal 11. This trajectory represents a more balanced approach to growth, resource management, and environmental conservation than the Current Trends pathway.

Global Sustainability: The Sustainable Pathway corresponds to a vision of the future in which Colombia adopts a set of ambitious sustainable policies and practices within the higher boundary of feasible action. Compared to the Current Trends Pathway, this future would lead to medium-speed economic growth, a transition to more sustainable diets, higher livestock and crop productivity, higher exports, and lower food waste. This vision of the future is based on the implementation of policies that would see considerable progress with regards to: (i) increased productivity and competitiveness through the sustainable use of natural capital and the promotion of social inclusion, compatible with policies such as the Green Growth; (ii) increasing productivity for prioritized crops (i.e. rice, corn, potato, sugar cane for panela, and avocado) as a result of national production management plans (POPs); (iii) increasing livestock productivity in line with mitigation measures (e.g. sustainable livestock); (iv) diversifying exports and destinations for crops and livestock, and; (v) reducing food waste in line with Colombia's Policy for Preventing Food Waste and Loss.

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

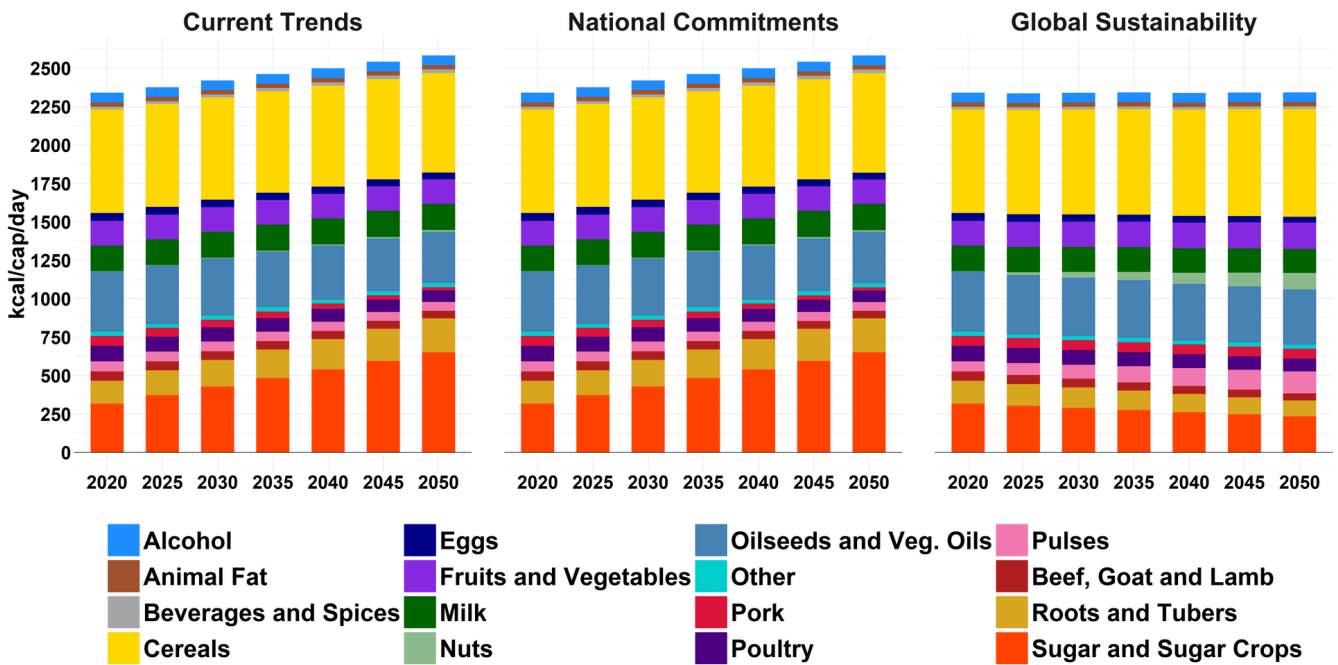


Figure 5. Comparison of the computed daily average kilocalorie intake per capital per food category across the three pathways and the prevalence of undernourishment in 2050

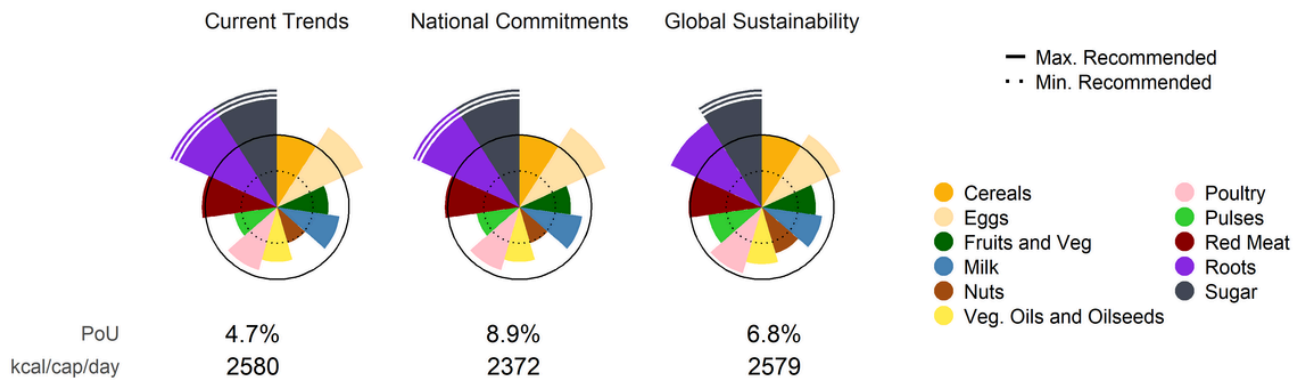


Figure 6. Evolution of land cover 2000-2050

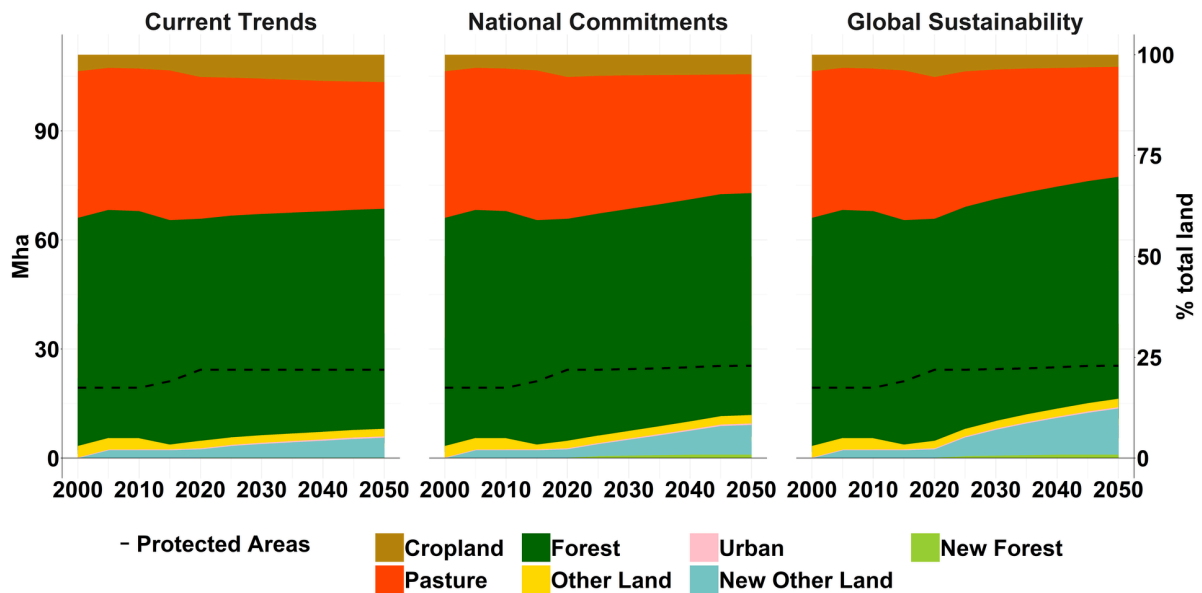


Figure 7. Evolution of the cropland composition 2000-2050

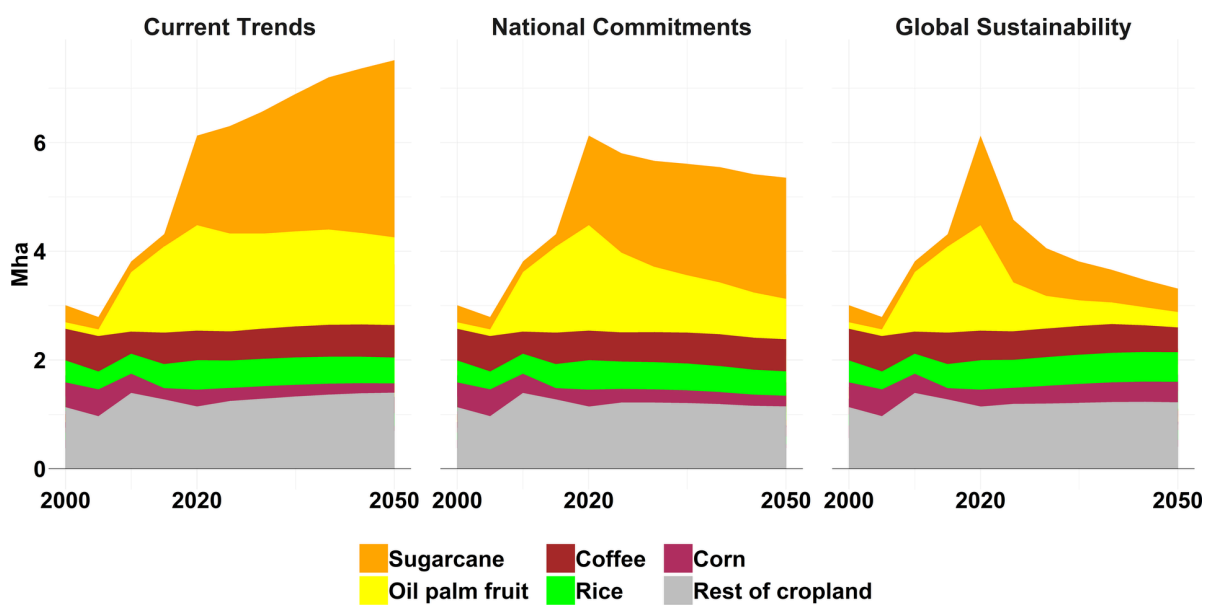


Figure 8. Projected AFOLU emissions and removals between 2020 and 2050 by main sources and sinks across pathways

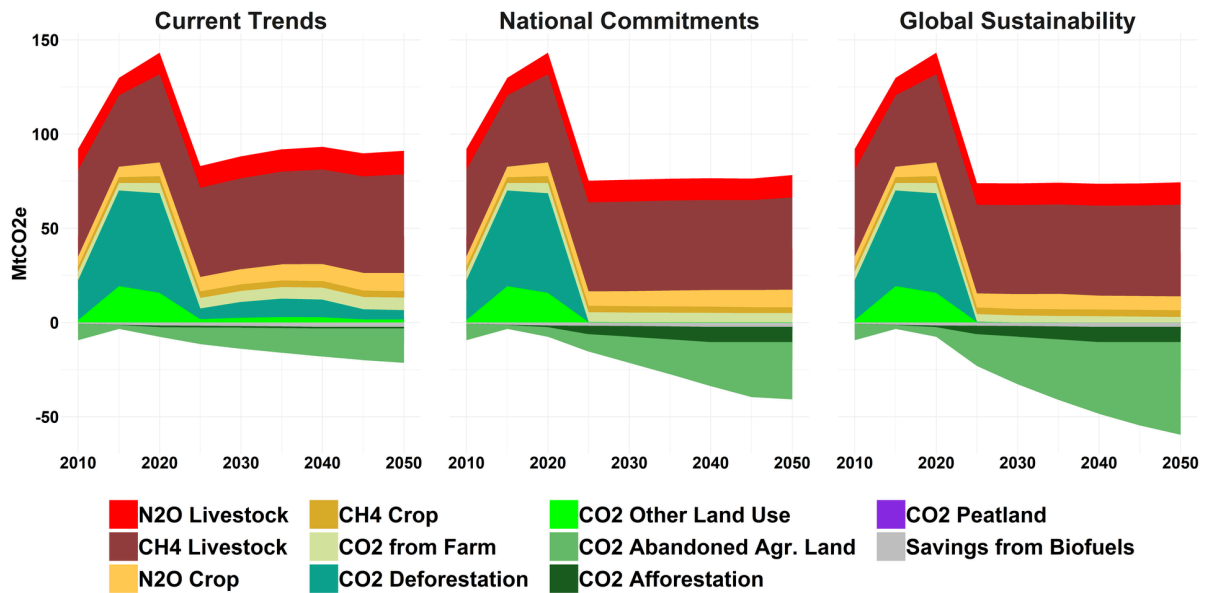


Figure 9. Share of cropland under agroecological practices

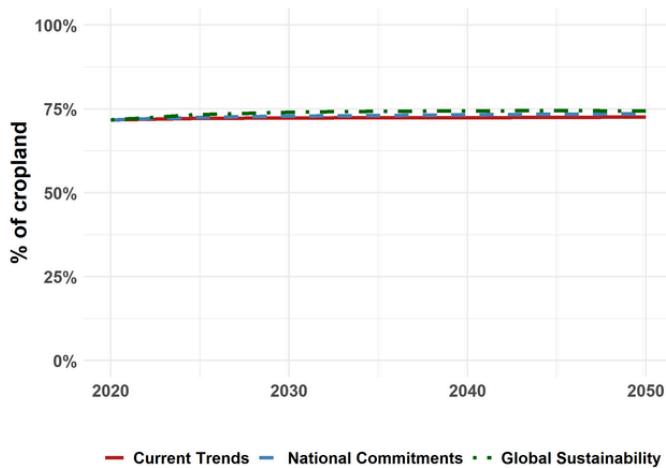
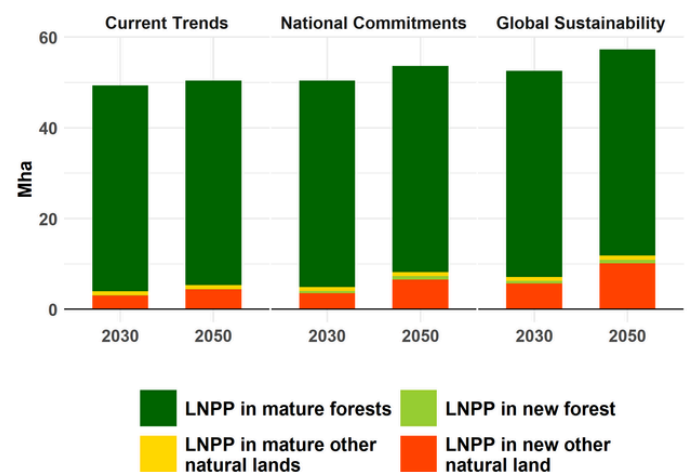


Figure 10. Total area of land where natural processes predominate (LNPP)



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

Figure 11. Nitrogen application

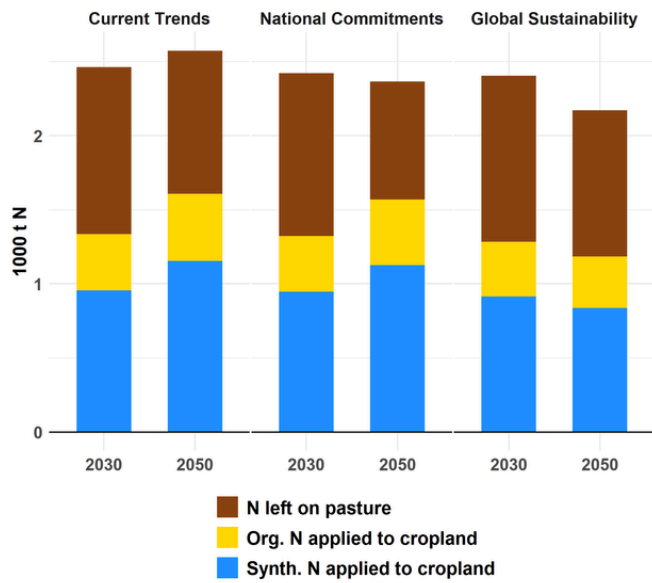
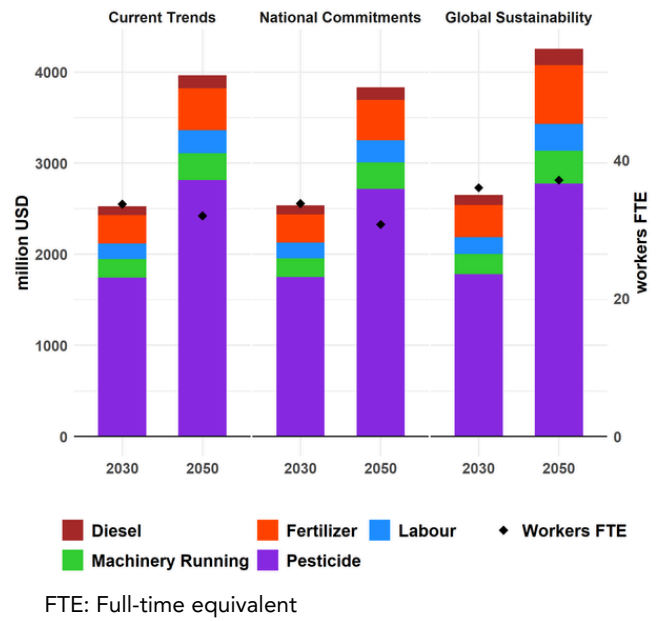


Figure 12. On-farm production costs



For more detailed results and visual data, visit www.scenathon.org

Scenarios and assumptions

		A) CURRENT TRENDS	B) NATIONAL COMMITMENTS	C) GLOBAL SUSTAINABILITY	Justification
1. Macroeconomics	1.1) GDP per capita	Over the past decade (2010-2019), the annual GDP Growth (%) has demonstrated a declining trend. Given this pattern, we project a decrease of 2% in GDP by the year 2030. (SSP 1)	Increase by 4% between 2020 and 2030. (SSP 2)	Same as NC	World Bank National Development Plan (2022-2026)
	1.2) Population	By 2050 Colombia's Total Population will reach 57,7 million (UN_medium)	Same as CT	Same as CT	DANE (2000) - Total Population 39,140,080 (2030) - Total Population 54,705,567 - (1.40) (2050) - Total Population 57,713,467 - (1.47)
	1.3) Inflation	Increase by 257% between 2020 and 2050	Increase by 200% between 2020 and 2050	Increase by 144% between 2020 and 2050	National Development Plan (2022-2026) Monetary Policy Report (Bank Of Republic, July, 2023)
	1.4) Inequalities	To be determined	To be determined	To be determined	
2. Land	2.1) Constraints on agricultural expansion/deforestation	No constraint on the expansion of the agricultural land beyond protected areas	Reduce national deforestation by 20%, which is equivalent to about 35,000 fewer hectares compared to 2021 (limit of 140.000 Ha by 2026). Reduce net deforestation of natural forest to 0 hectares/year by 2030, based on the implementation of both policy tools and cooperative and market measures.	Same as NC	Ley 2169 Del 22 De Diciembre De 2021 National Development Plan (2022-2026) Climate Action Law (2169/2021) Delimitación Frontera Agrícola, UPRA, 2018
	2.2) Afforestation, and forest plantations targets	Afforestation/reforestation target in line with Bonn Challenge commitment	By 2030, increase by 100,000 hectares the areas in the process of	By 2030, Colombia will expand the areas in the process of restoration,	Ley 2169 Del 22 De Diciembre De 2021

Scenarios and assumptions

		A) CURRENT TRENDS	B) NATIONAL COMMITMENTS	C) GLOBAL SUSTAINABILITY	Justification
			rehabilitation, recovery, or restoration in the areas of the National Park System and its zones of influence.	recovery, and rehabilitation of degraded ecosystems to 1.7 million hectares. That is, 750,000 more than in 2022.	National Development Plan (2022-2026) Climate Action Law (2169/2021)
	2.3) Urban and settlements area	Current Trend of urban land use change	Increase by 10% between 2020 and 2050	Increase by 5% between 2020 and 2050	National Development Plan (2022-2026) Regulation and implementation of the determinants for the protection of rural land as a guarantee of the right to food
	2.4) Protected areas	No expansion of protected areas beyond current.	Increase by 5% between 2020 and 2030	Increase by 15% between 2020 and 2030	National Development Plan (2022-2026) Participatory restoration of ecosystems, protected areas and other environmentally strategic areas
3. Productivity and management	3.1) Crop productivity for the key crops	<p>The top 10 key products in Colombia between 2005 and 2020 were coffee, Rice (Irrigated, Rainfed, Mechanized), Oil Palm, Corn, Plantain, Sugar Cane (Industrialized and traditional), Cocoa, Cassava, and Potato. These crops represented 81.12% of the total planted area in 2020.</p> <p>By 2050, crop productivity will continue growth at a low level according to the last 15 years trends.</p> <ul style="list-style-type: none"> - From 1.1 Ton/Ha to 1.3 Ton/Ha for Coffee - From 4.5 Ton/Ha to 4.7 Ton/Ha for Rice - From 3.2 Ton/Ha to 3.3 	<p>Between 2020 and 2050, crop productivity increases:</p> <ul style="list-style-type: none"> - From 1.1 Ton/Ha to 1.4 Ton/Ha for Coffee - From 4.5 Ton/Ha to 5.9 Ton/Ha for Rice - From 3.2 Ton/Ha to 4.2 Ton/Ha for Palm Oil - From 2.1 Ton/Ha to 2.7 Ton/Ha for Corn - From 7.6 Ton/Ha to 10 Ton/Ha for Plantain - From 113.7 Ton/Ha to 149.1 Ton/Ha for Sugar Cane - From 0.7 Ton/Ha to 0.9 Ton/Ha for Cocoa - From 5.1 Ton/Ha to 6.6 Ton/Ha for Sugar Cane (Traditional) - From 11 Ton/Ha to 14.5 	<p>Between 2020 and 2050, crop productivity increases:</p> <ul style="list-style-type: none"> - From 1.1 Ton/Ha to 1.6 Ton/Ha for Coffee - From 4.5 Ton/Ha to 7.5 Ton/Ha for Rice - From 3.2 Ton/Ha to 8 Ton/Ha for Palm Oil - From 2.1 Ton/Ha to 5 Ton/Ha for Corn - From 7.6 Ton/Ha to 15 Ton/Ha for Plantain - From 113.7 Ton/Ha to 150 Ton/Ha for Sugar Cane - From 0.7 Ton/Ha to 1.5 Ton/Ha for Cocoa - From 5.1 Ton/Ha to 12 Ton/Ha for Sugar Cane (Traditional) - From 11 Ton/Ha to 16 	<p>UPRA-Minagricultura Agronet Statistics EVA, 2007-2020</p> <p>UPRA - MINAGRICULTURA PRODUCTIVE REGULATION PLANS (POP) For Rice, Meat, Dairy, Forestry, Corn, Potato and Sugar Cane (Traditional)</p> <p>National Development Plan (2022-2026) Participatory restoration of ecosystems, protected areas and other environmentally strategic areas</p>

Scenarios and assumptions

		A) CURRENT TRENDS	B) NATIONAL COMMITMENTS	C) GLOBAL SUSTAINABILITY	Justification
		Ton/Ha for Palm Oil - From 2.1 Ton/Ha to 2.2 Ton/Ha for Corn - From 7.6 Ton/Ha to 8 Ton/Ha for Plantain - From 113.7 Ton/Ha to 118.8 Ton/Ha for Sugar Cane - From 0.7 Ton/Ha to 0.9 Ton/Ha for Cocoa - From 11 Ton/Ha to 11.7 Ton/Ha for Cassava - From 17.3 Ton/Ha to 19.5 Ton/Ha for Potato	Ton/Ha for Yucca - From 17.3 Ton/Ha to 22.7 Ton/Ha for Potato We also include new crops according to the new National Development Plan (2022-2026): - From 1.6 Ton/Ha to 2.1 Ton/Ha for Beans - From 9.2 Ton/Ha to 12.1 Ton/Ha for Avocado - From 10.7 Ton/Ha to 14.1 Ton/Ha for Banana - From 2.6 Ton/Ha to 3.4 Ton/Ha for Soybean	Ton/Ha for Yucca - From 17.3 Ton/Ha to 25.1 Ton/Ha for Potato - From 1.6 Ton/Ha to 2.5 Ton/Ha for Beans - From 9.2 Ton/Ha to 15 Ton/Ha for Avocado - From 10.7 Ton/Ha to 15 Ton/Ha for Banana - From 2.6 Ton/Ha to 6 Ton/Ha for Soybean	
	3.2) Cropland under agroecological practices	No Change	10% of total cropland under agroecological practices by 2030	16.4% of total cropland under agroecological practices by 2030	National Development Plan (2022-2026) Productive Transformation, Internationalization and Climate Action: Productive economy through reindustrialization and bioeconomy Sustainable and regenerative production models in Agriculture and Livestock
	3.3) Livestock productivity for the key livestock products	Same productivity growth as over 2010-2020	Between 2015 and 2050, the productivity per head increases: - From 32 kg/head to 46 kg/head for Cattle - From 6.36L/day by dairy cow to 10.65 L/day - For Chicken and Pork to be determined	Between 2015 and 2050, the productivity per head increases: - From 32 kg/head to 60 kg/ha for Cattle - From 6.36L/day by dairy cow to 12.5 L/day - For Chicken and Pork to be determined	UPRA - Minagricultura Productive Regulation Plans (POP) For Meat and Dairy
	3.4) Pasture stocking rate	Same ruminant density as 2020	Increase from 1.1 heads per Ha to 1.5 heads per Ha between 2020 and 2050	Increase from 1.1 heads per Ha to 2 heads per Ha between 2020 and 2050	UPRA - Minagricultura Productive Regulation Plans (POP) For Meat and Dairy

Scenarios and assumptions

		A) CURRENT TRENDS	B) NATIONAL COMMITMENTS	C) GLOBAL SUSTAINABILITY	Justification
	3.5) Forest management	To be determined	To be determined	To be determined	
4. Trade	4.1) Share of consumption which is imported for key imported products (%)	<p>In 2021, Colombia imported \$59.6B, making it the number 52 trade destination in the world. During the last five reported years the imports of Colombia changed by \$15.6B from \$44B in 2016 to \$59.6B in 2021.</p> <p>By 2020, vegetable and animal products imports of Colombia are led by <u>Cereals</u> (\$ 1.78B), <u>Animal or vegetable fats, oils, & waxes</u> (\$ 0.54B), <u>Oils seeds, oleaginous fruits, grains, straw & fodder</u> (\$ 0.28B), <u>Meat & edible offal</u> (\$ 0.27B), <u>Edible fruits, nuts & fruit peels</u> (\$ 0.21B) and <u>Fish, crustaceans, & molluscs</u> (\$ 0.21B).</p> <p>In fact, the trend is increasing the share of total consumption which is imported reach 100%</p>	<p>The share of total consumption which is imported is:</p> <ul style="list-style-type: none"> - from 85% in 2020 to 50% in 2050 for Corn, Wheat, Barley, and sorghum - stays constant for the other products 	<p>The share of total consumption which is imported is:</p> <ul style="list-style-type: none"> - from 85% in 2020 to 35% in 2050 for Corn, Wheat, Barley and sorghum - stays constant for the other products 	<p>Gaulier, G. and Zignago, S. (2010) BACI: International Trade Database at the Product-Level. The 1994-2007 Version. CEPII Working Paper, N°2010-23</p> <p>DANE</p> <p>National Development Plan (2022-2026)</p> <p>Productive transformation, internationalization and climate action</p> <p>FENALCE</p> <p>Cereal Indicator</p>
	4.2) Evolution of exports for key exported products (1000 tons)	<p>In 2021, Colombia exported a total of \$42.5B, making it the number 60 exporter in the world. During the last five reported years the exports</p>	<p>Increases by 150% in 2050 related to 2020 (<i>Projections for each product to be determined</i>)</p>	<p>Increases by 220% in 2050 related to 2020 (<i>Projections for each product to be determined</i>)</p>	<p>Gaulier, G. and Zignago, S. (2010) BACI: International Trade Database at the Product-Level. The 1994-2007 Version. CEPII Working Paper, N°2010-23</p> <p>DANE</p>

Scenarios and assumptions

		A) CURRENT TRENDS	B) NATIONAL COMMITMENTS	C) GLOBAL SUSTAINABILITY	Justification
		<p>of Colombia have changed by \$10.2B from \$32.4B in 2016 to \$42.5B in 2021.</p> <p>The most recent exports are led by Crude Petroleum (\$11.3B), Coal Briquettes (\$5.11B), Coffee (\$3.22B), Gold (\$2.61B), and Refined Petroleum (\$2.14B). The most common destination for the exports of Colombia are United States (\$11.7B), China (\$3.69B), Panama (\$2.4B), India (\$2.27B), and Brazil (\$2.07B).</p> <p>According to data from DANE, the exports from the agricultural sector, including livestock, hunting, and forestry, grew by 136% between the year 2000 and the year 2020. (Key Products: Coffe, Flowers, Plantain, Palm Oil, Banana, Raw and Processed Sugar, Fruits, Cocoa, Soybean Oil and Wood).</p> <p>By 2050, export products increase by 136%.</p>			<p>National Development Plan (2022-2026) Human Right to Food: Goal 04 Production for Life</p>
5. Food	5.1) Average dietary composition	By 2030 the average daily calorie consumption per capita will be 2986.6 Kcal	Same as CT	Same as CT	ICBF Food Balance Sheet of Colombia 2014

Scenarios and assumptions

		A) CURRENT TRENDS	B) NATIONAL COMMITMENTS	C) GLOBAL SUSTAINABILITY	Justification
					CISAN-ICBF Roadmap - Colombia Advances towards equitable, healthy, sustainable and resilient Food Systems 2021 MINSALUD Law 2120/2021
	5.2) Share of food consumption which is wasted at household level	By 2030, Colombians wasted about 15.6% of their household production at the household level.	By 2030, Reduces by 5% compared to 2010 level	By 2030, the total losses and waste are 3%.	DNP Estudio de Perdidas y Desperdicio de Alimentos en Colombia Minagricultura - Cisan Comprehensive Public Policy for the prevention and reduction of food loss and waste. With the aim of contributing to the Sustainable Development Goals (SDGs) and in response to Law 1990 of 2019, CISAN proceeded with the formulation of the policy for the prevention of food loss and waste, which is adopted through Decree 375 of 2022 . This decree adds Part 22 to Book 2 of Decree 1071 of 2015 , the Unified Regulatory Decree of the Agricultural, Fisheries, and Rural Development Administrative Sector, related to the reduction of food loss and waste.
6. Biofuels	6.1) Targets on biofuel and/or other bioenergy use	By 2030, Biofuel demand accounts for 26.1% of total Palm Oil production and 18.3% of total sugarcane production.	Same as CT	Same as CT	Fedepalma Minagricultura Fedebiocombustibles
	6.2) Targets on other non-food use	NA	NA	NA	

Scenarios and assumptions

		A) CURRENT TRENDS	B) NATIONAL COMMITMENTS	C) GLOBAL SUSTAINABILITY	Justification
7. Water	7.1) Irrigated crop area	Same irrigated harvested area as in 2020	Increase by 15.8% between 2020 and 2050	Increase by 25% between 2020 and 2050	National Development Plan (2022-2026) Irrigation National Plan (2020-2039)