2023 Scenathon results

Pathways for food and land-use systems in Mexico

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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National context

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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

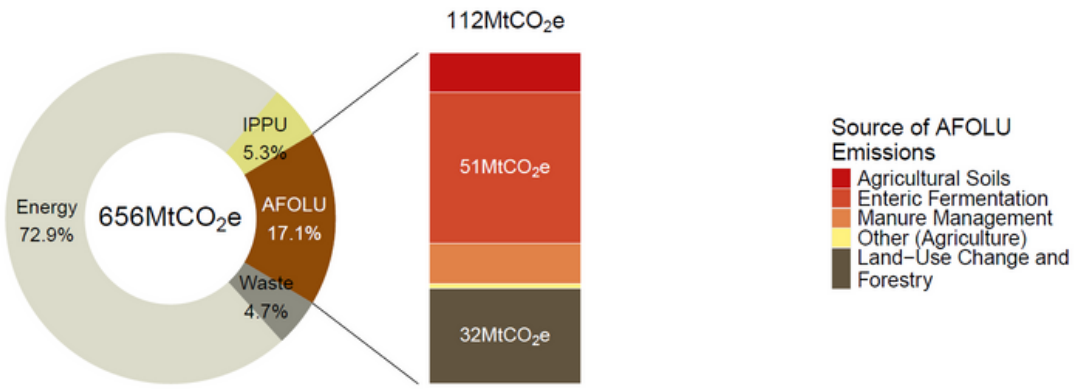
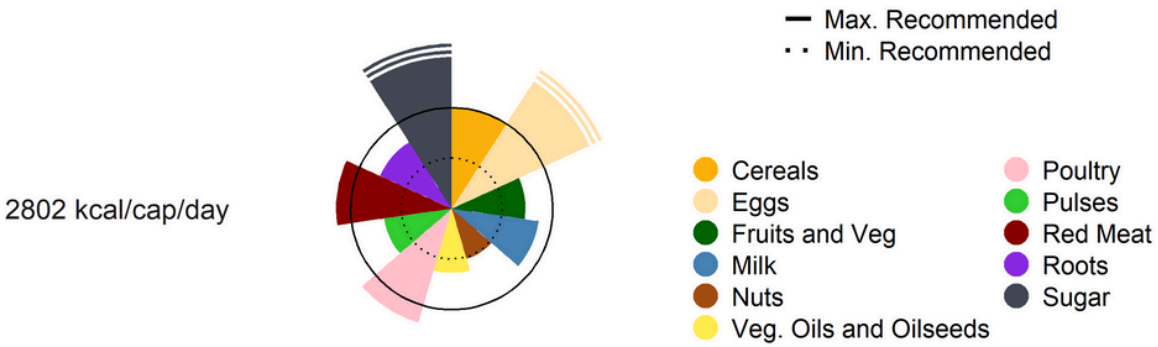


Figure 2. Daily average kilocalorie intake per capital per food category in 2020



National context

Mexico

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
2 ZERO HUNGER	Self-sufficiency	Increase food self-sufficiency by reducing imports to no more than 14% on corn, rice, and beans. Increasing yields in corn, beans, coffee, sugar cane, cocoa, nopal, honey and milk.
	Diet-relared diseases	Reduction on children obesity from 17% to 12% by 2030.
	Other food-related targets	Reduction in diet-related deaths from 0.15% to 0.14% by 2030.
13 CLIMATE ACTION	Total GHG emissions reduction	35% reduction by 2030, up to 40% conditional to international financing and tech transfer. Black carbon emissions reduction target of 51% unconditionally in 2030 and 70% conditionally by 2030.
	Land use and land use change GHG emissions reduction	Net zero AFOLU after 2040
	Reduce or halt deforestation	Reduction of deforestation by 30% in 2024 (95,111,604 ha) from the 2018 baseline. By 2030, halt deforestation in carbon-rich ecosystems
	Other climate mitigation related targets	Reduction of methane emissions of 15% from 2020 levels by 2030.
15 LIFE ON LAND	Expand protected areas or 'Other effective area-based conservation measures'	Preserve 30% of land and ocean area by 2030
	Promote afforestation	A reforestation program reaching 9.1 Mha by 2050.
	Expand cropland area under agroecological practices	100 % of agricultural area under at least one agroecological practice by 2030. This is a 20% increase from the 2018 baseline.
8 DECENT WORK AND ECONOMIC GROWTH	Farmers' income	Federal Government fertilizer subsidy: up to 450 kilograms of fertilizer per hectare, not to exceed 3 hectares per producer.

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.

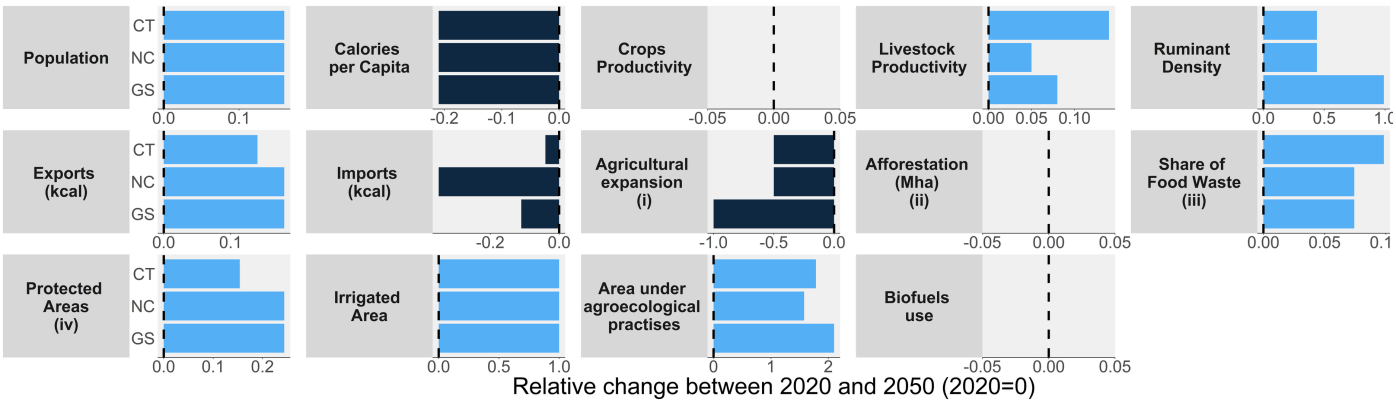
Pathway narratives

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: Identifies additional actions to help closing the gap between the collective outcome of the National Commitments pathway and the global sustainability targets. There may be large overlaps between the 'National commitments' pathway and the Global Sustainability pathway, depending on how ambitious country teams and local stakeholders think the current national commitments are.

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.

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

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

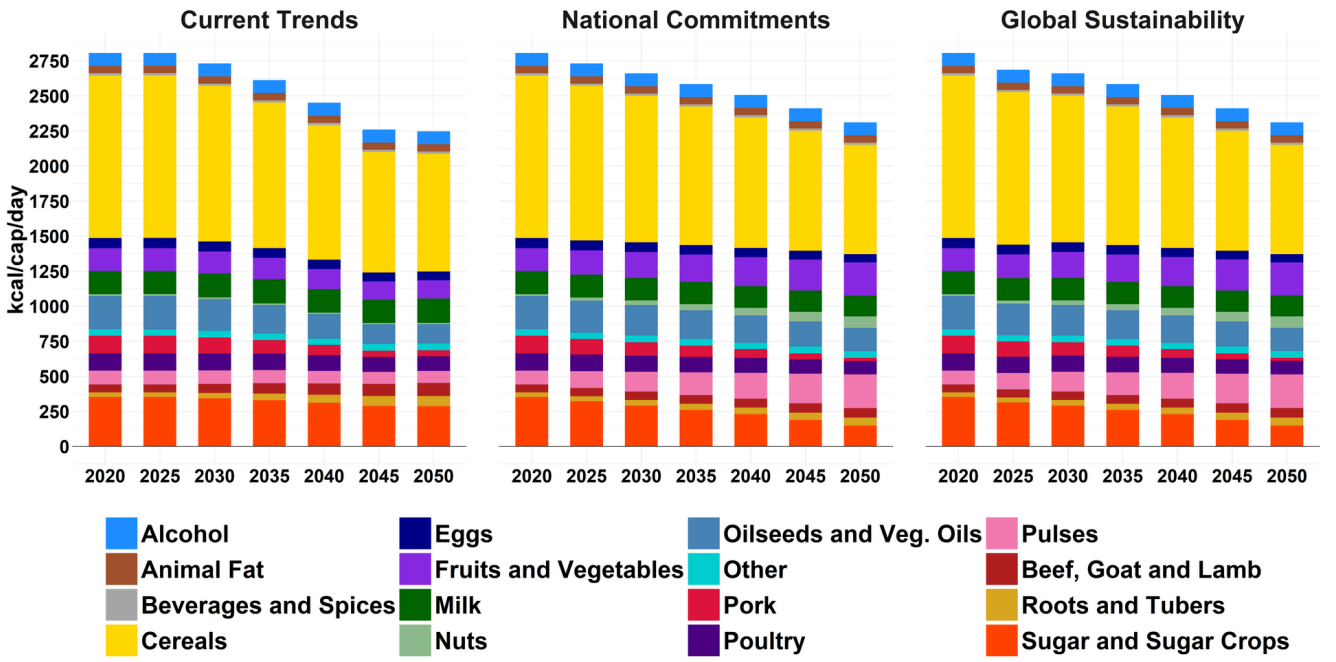


Figure 5. Comparison of the computed daily average kilocalorie intake per capital per food category across the three pathways and the prevalence of undernourishment in 2050

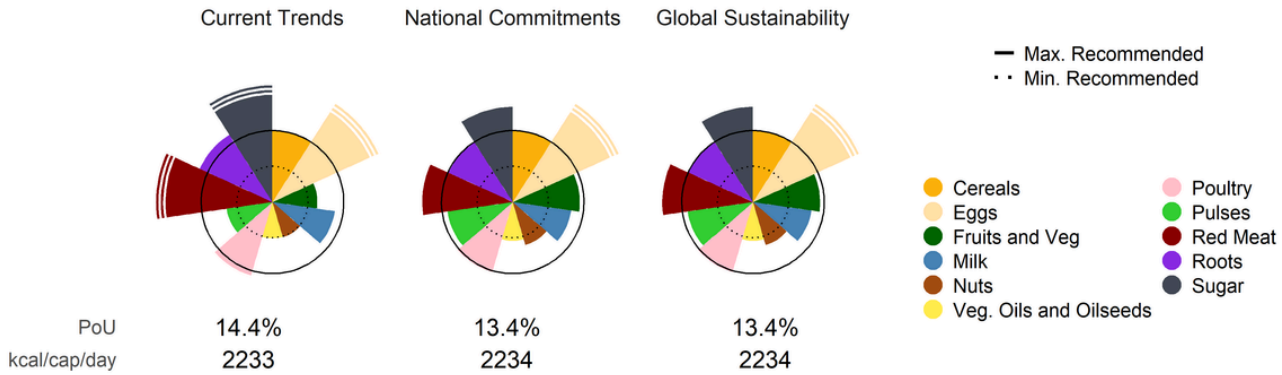


Figure 6. Evolution of land cover 2000-2050

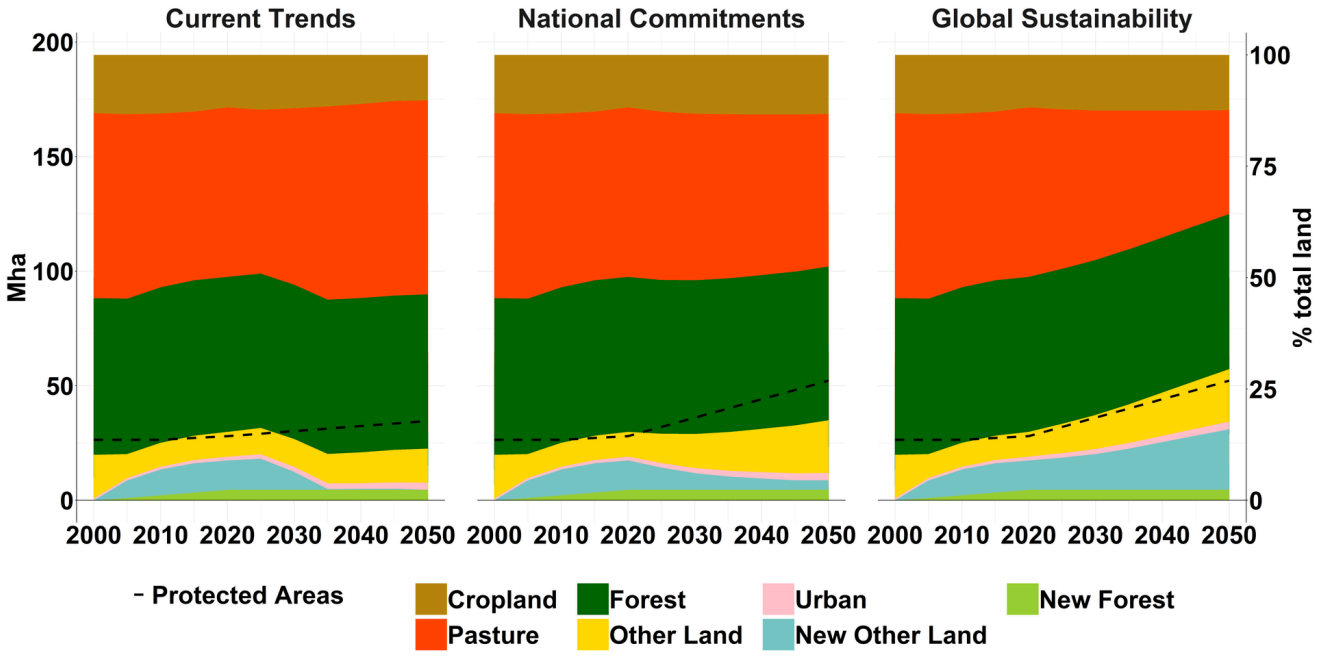


Figure 7. Evolution of the cropland composition 2000-2050

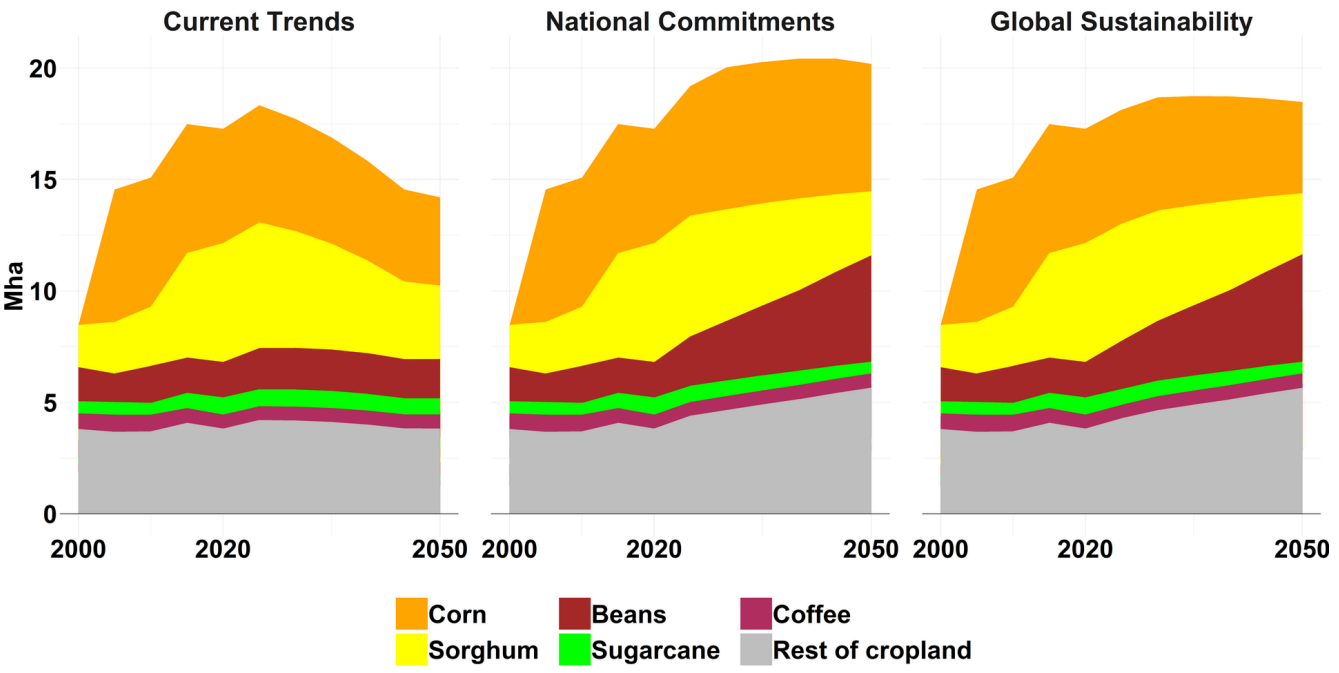


Figure 8. Projected AFOLU emissions and removals between 2020 and 2050 by main sources and sinks across pathways

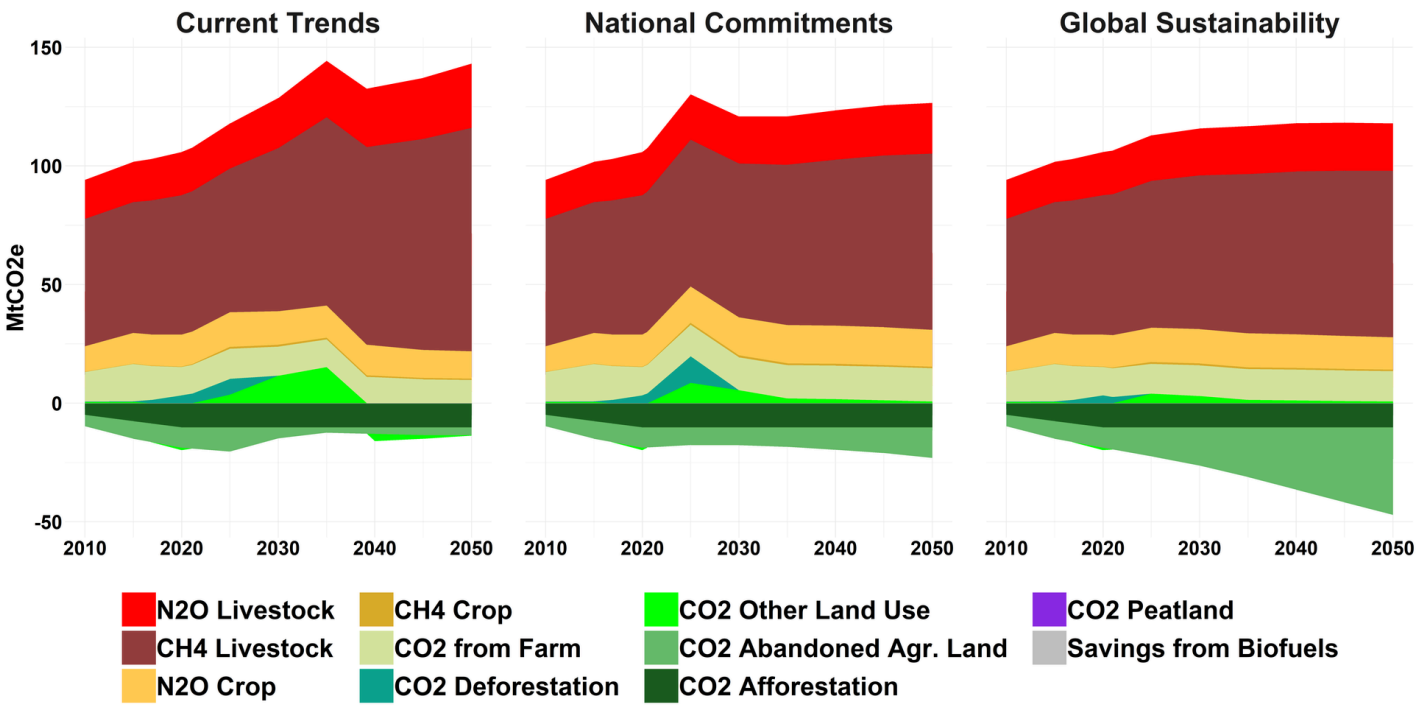


Figure 9. Share of cropland under agroecological practices

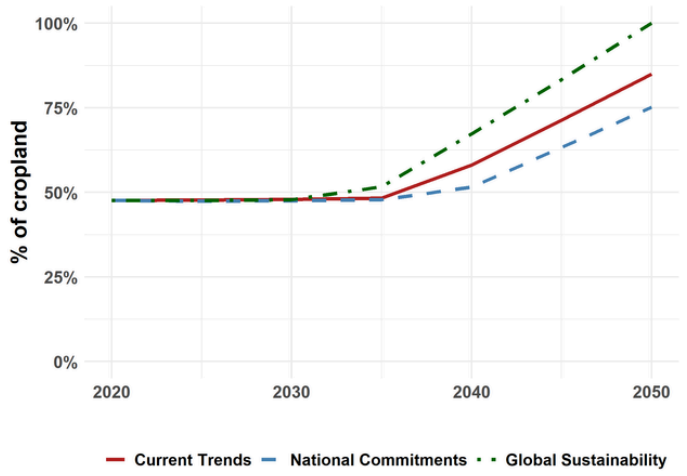
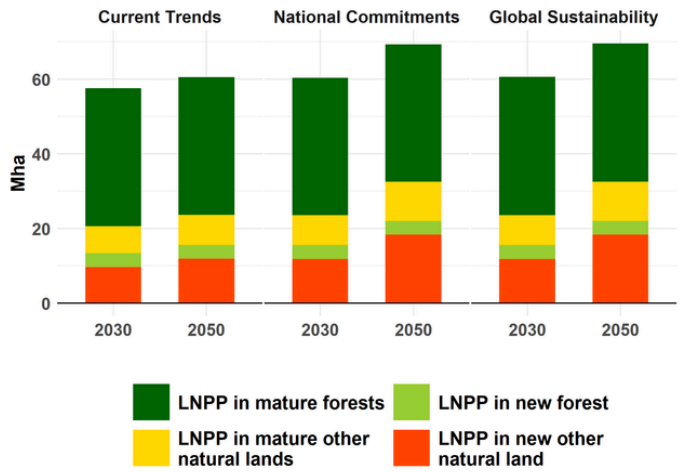


Figure 10. Total area of land where natural processes predominate (LNPP)



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

Figure 11. Nitrogen application

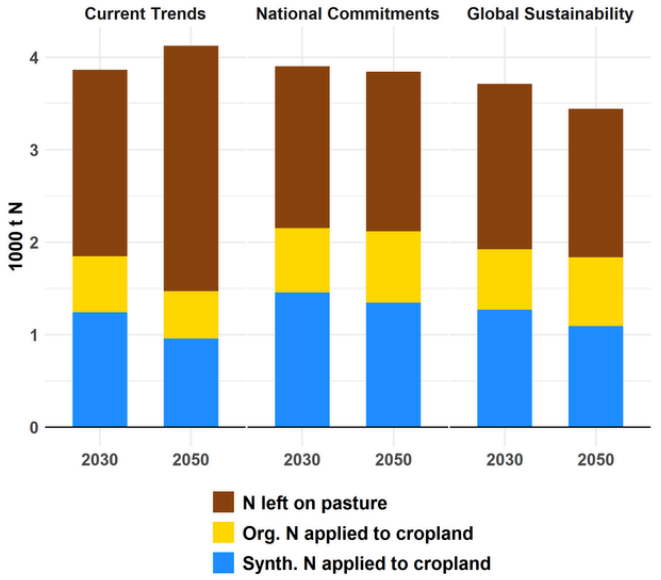
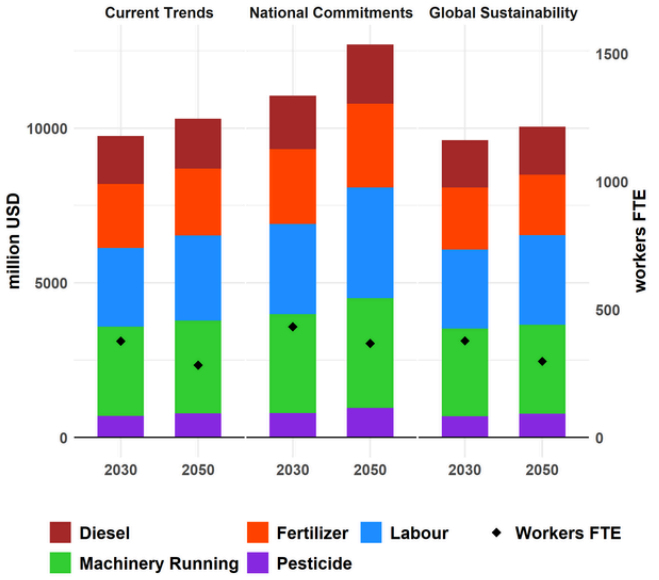


Figure 12. On-farm production costs



FTE: Full-time equivalent

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	**SSP2.** "***Middle of the Road***" - Medium speed of economic growth for most advanced countries and medium speed of convergence for other countries.	**SSP2. "Middle of the Road"** - Medium speed of economic growth for most advanced countries and medium speed of convergence for other countries.	**SSP2. "Middle of the Road"** - Medium speed of economic growth for most advanced countries and medium speed of convergence for other countries.	
	1.2) Population	Closest is UN_constantFertility. Mexican projections estimate 148209 million people by 2050.	Closest is UN_constantFertility. Mexican projections estimate 148209 million people by 2050.	Closest is UN_constantFertility. Mexican projections estimate 148209 million people by 2050.	Proyecciones de la población de México y de las entidades federativas 2016-2050
	1.3) Inflation	No Target	No Target	No Target	
	1.4) Inequalities	No Target	No Target	No Target	
2. Land	**2.1)** Constraints on agricultural expansion/deforestation	Net zero deforestation by 2030	Net zero deforestation by 2030. By 2024, a reduction of 30% in deforestation and then a linear descent. The baseline is deforestation for the 2017-2018 years.	Halt of agricultural expansion and net zero deforestation by 2030. By 2024 a reduction of 30% of deforestation and then a linear descent. The baseline is deforestation for the 2017-2018 years.	Deforestation in National Commitments and Global Sustainability Constrains on ag expansion for Global Sustainability
	2.2) Afforestation, and forest plantations targets	9128 Mha by 2050	9128 Mha by 2050	10418 Mha by 2050	Sembrando vida and projections of reforestation following historical trends from 2024 up to 2050
	2.3) Urban and settlements area	Current trends reaching 3328 Mha by 2050	Current trends reaching 3328 Mha by 2050	Current trends reaching 3328 Mha by 2050	No policy or commitment that we could find
	2.4) Protected areas	Calculating	North American Leaders Summit: the goal is to preserve 30% of land and ocean area by 2030	North American Leaders Summit: the goal is to preserve 30% of land and ocean area by 2030	Fact sheet: Key Deliverables for the 2023 North American Leaders' Summit Estrategia Nacional sobre Biodiversidad de México plan de acción 2016 - 2030

Scenarios and assumptions

		A) CURRENT TRENDS	B) NATIONAL COMMITMENTS	C) GLOBAL SUSTAINABILITY	Justification
3. Productivity and management	**3.1)** Crop productivity for the key crops	Close 50% of the maize yield gap by following the historical trend from 2000 to 2020.	Close 20% of the maize yield gap, due to the use of fertilizers provided by the federal program of "Fertilizantes para el Bienestar". This program targets small producers and gives them 450kg of fertilizer per ha in no more than 3 ha per farmer.	Close 80% of the maize yield gap, due to the widespread implementation of the MASAGRO program in the rain-fed regions.	Maíz, proyecto al 2030 del CIMMYT Fertilizantes para el Bienestar
	3.2) Cropland under agroecological practices	In 2018, 80% of farmers used at least one agroecological practice. No change by 2050	In 2018, 80% of farmers used at least one agroecological practice (cover crops or reduced till). This practice would include the program Sembrando Vida as agroforestry and milpa system. We are assuming that the area corresponds to the small and medium farmer that comprise 75% of the total agricultural area. We adapted the time frame of the Ministry of Agriculture planning program where it intends to increase this number to 100% by 2024. We are setting it to 2030 as there is no evidence of success by 2024.	By 2050 100 % of farmers will use agroecological practices. Farmers with an area of less than 5 ha (80% of farmers corresponding to a 75% of total national agricultural area) will use two agroecological practices, cover crops and reduced till. The remaining 20% of farmers (25% of total ag area) will use mixed practices and correspond to farmers and agricultural industries with more than 5 ha.	Secretaría de Agricultura y Desarrollo Rural: Programa sectorial derivado del plan nacional de desarrollo 2019-2024

Scenarios and assumptions

		A) CURRENT TRENDS	B) NATIONAL COMMITMENTS	C) GLOBAL SUSTAINABILITY	Justification
	3.3) Livestock productivity for the key livestock products	Same productivity growth as over 2000-2010	Same productivity growth as over 2000-2010	Mix of Traditional cattle ranching mixed with Modern Silvopastoral systems, cattle productivity per head in 2050 will be 79 kg and 7718 L.	1. Lara JA, Guevara-Sanginés A, Torres-Rojo JM (2021) Análisis económico para la transición a sistemas de producción ganadera regenerativa de bovinos en Chiapas, Chihuahua, Jalisco y Verac- ruz, México. FMCN, Ciudad de México 2. Guevara Sanginés A, Torres Rojo JM, Betancourt López R (2020) Parametrización y análisis costo beneficio de modelos tec- nológico-financieros de ganadería sustentable, cero deforest- ación y baja en emisiones e identificación de fuentes de finan- ciamiento. The Nature Conservancy, Ciudad de México
	3.4) Pasture stocking rate	Same productivity growth as over 2000-2010	Same productivity growth as over 2000-2010	70% Traditional system, 10% Modern Silvopastoral & Intensive Systems for cattle 20%.	1. Lara JA, Guevara-Sanginés A, Torres-Rojo JM (2021) Análisis económico para la transición a sistemas de producción ganadera regenerativa de bovinos en Chiapas, Chihuahua, Jalisco y Verac- ruz, México. FMCN, Ciudad de México 2. Guevara Sanginés A, Torres Rojo JM, Betancourt López R (2020) Parametrización y análisis costo beneficio de modelos tec- nológico-financieros de ganadería sustentable, cero deforest- ación y baja en emisiones e identificación de fuentes de finan- ciamiento. The Nature Conservancy, Ciudad de México
	3.5) Forest management	No Target	No Target	No Target	
4. Trade	**4.1)** Share of consumption which is imported for key imported products (%)	Following historic trend	14 % for key products (corn, beans, rice)	54% corn (represents white corn used for animal feed not for human consumption), 40% milk and 18% beef. Double than 2010 in the rest of the products.	For National Commitments goal

Scenarios and assumptions

		A) CURRENT TRENDS	B) NATIONAL COMMITMENTS	C) GLOBAL SUSTAINABILITY	Justification
	4.2) Evolution of exports for key exported products (1000 tons)	Exports are multiplied by 1.5 by 2050	Exports are multiplied by 1.5 by 2050	Exports are multiplied by 1.5 by 2050	With a lack of clear policy we defaulted to increasing trend of exports.
5. Food	**5.1)** Average dietary composition	**"Mexican Current Diet"** the calories per day are 2288 and rely strongly on cereals. There is a high % of sugar, oilseeds, vegetable oils, and milk intake. Developed by the National Institute of Public Health.	According to the Mexican food guidelines, the energy distribution should be: Cereals and tubers 34.2%, vegetables 4.9%, fruits 6.1%, dairy 8%, nuts and seeds 4.9%, Oils and fats 11%, legumes 12.1%, egg 3.4%, Poultry 4%, beef 1.1%, other red meat 1.1%, fish 0.8%. The energy requirements change by age and sex group, considering a sedentary or low physical activity (1400-2000 kcal for women, and 1960-2560 kcal/d for men).	**Recommendation by the EAT-Lancet Commission.** Cereals and tubers 32.4%, vegetables3.12%, fruits 5.0%, dairy 6.1%, nuts and seeds 11.6%, Oils 14.2%, saturated fats 3.84%, legumes 11.36%, egg 0.76%, Poultry 2.5%, red meat 1.2%, fish 1.6%. The level of activity is Medium.	Mexican Government - ¿Qué son las guías alimentarias?
	5.2) Share of food consumption which is wasted at household level	30 to 35% (FAO Data)	Reduction of 50% by 2030	Reduction of 80% but lack of policies to back it up	FACT SHEET: Key Deliverables for the 2023 North American Leaders' Summit
6. Biofuels	**6.1)** Targets on biofuel and/or other bioenergy use	No Target	No Target	No Target	

Scenarios and assumptions

		A) CURRENT TRENDS	B) NATIONAL COMMITMENTS	C) GLOBAL SUSTAINABILITY	Justification
	6.2) Targets on other non-food use	No Target	No Target	No Target	
7. Water	**7.1)** Irrigated crop area	High growth	No growth	No growth	Comisión nacional del agua programa especial derivado del plan nacional de desarrollo 2019-2024 Programa Nacional Hídrico 2020-2024 Programa especial derivado del plan nacional de desarrollo 2019-2024