

2023 Scenathon results

# Pathways for food and land-use systems in China







### **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

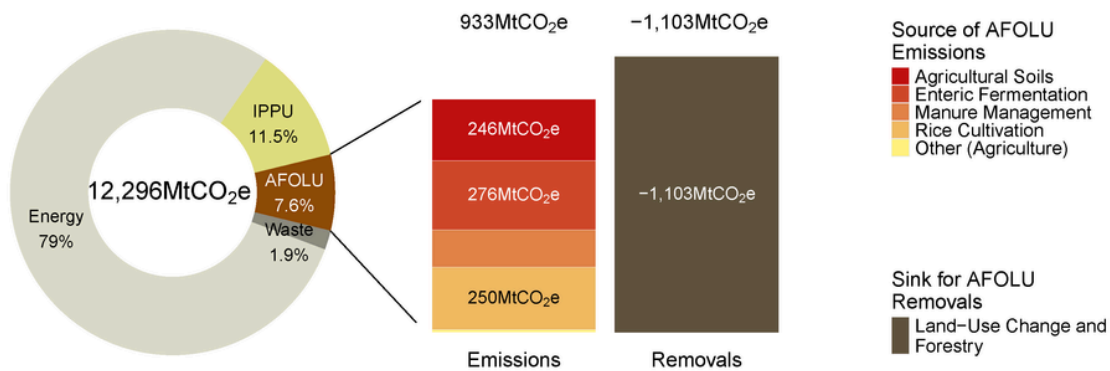
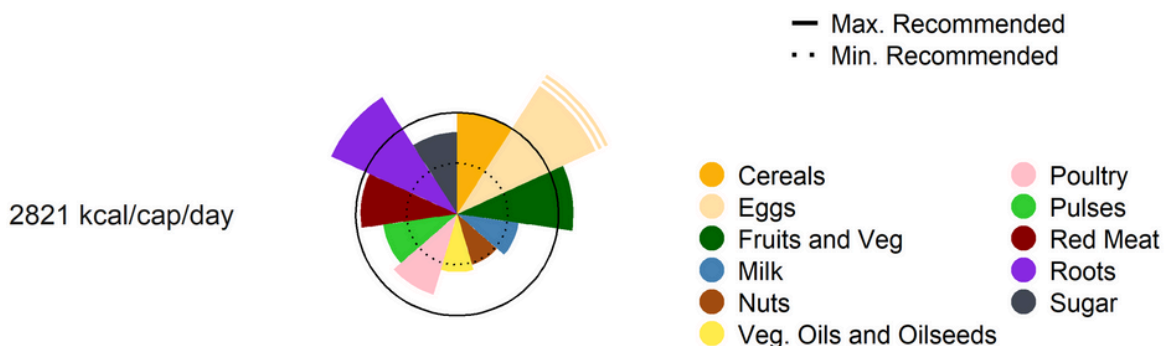


Figure 2. Daily average kilocalorie intake per capital per food category in 2020



## Model

Using the open-access [FABLE Calculator](#) and the FABLE decentralized modelling infrastructure, we have developed two alternative pathways —Current Trends 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.

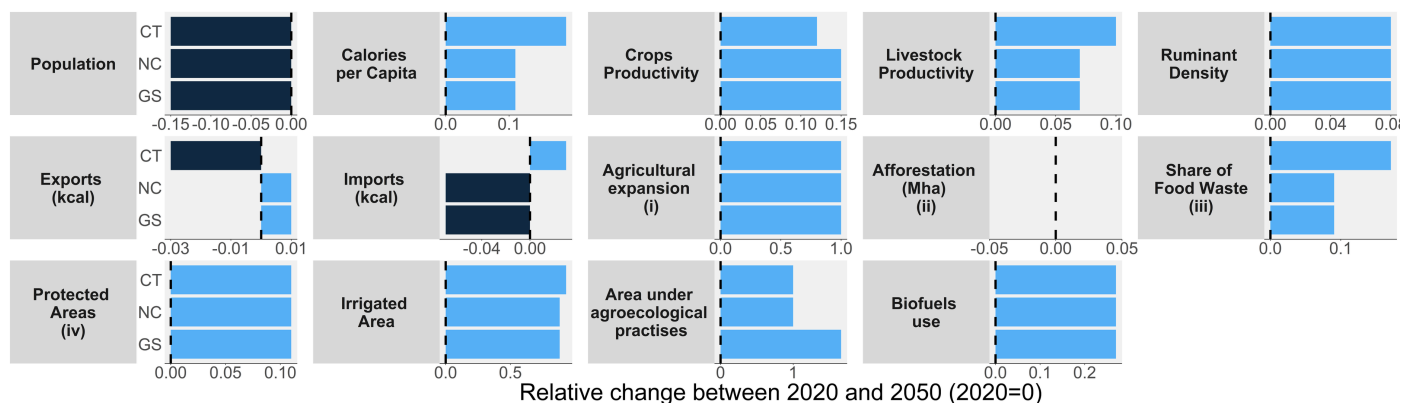
## Pathway narratives

**Current Trends:** This pathway 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:** This pathway identifies additional actions to help close the gap between the collective outcome of the National Commitments pathway and the global sustainability targets. In the Global sustainability pathway, we assume an increase in the use of agroecological practices.

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

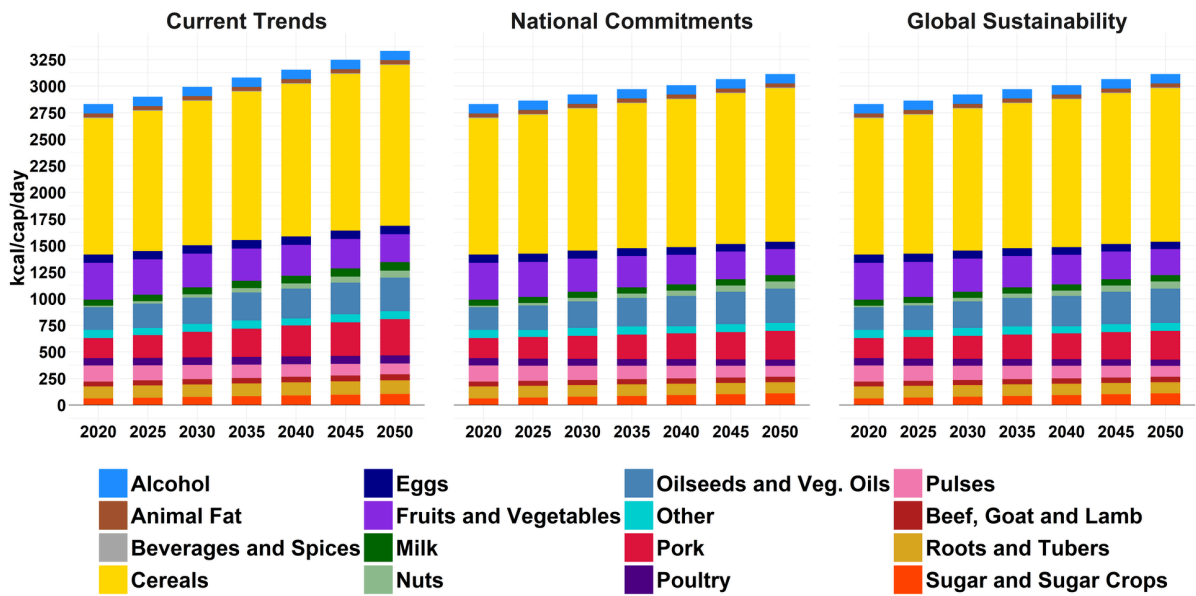


Figure 5. Comparison of the computed daily average kilocalorie intake per capital per food category across the three pathways and the prevalence of undernourishment in 2050

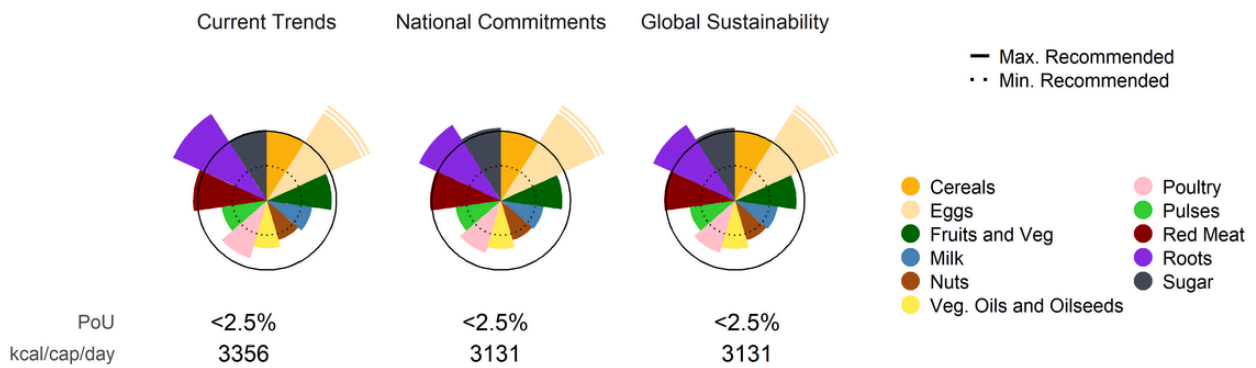




Figure 6. Evolution of land cover 2000-2050

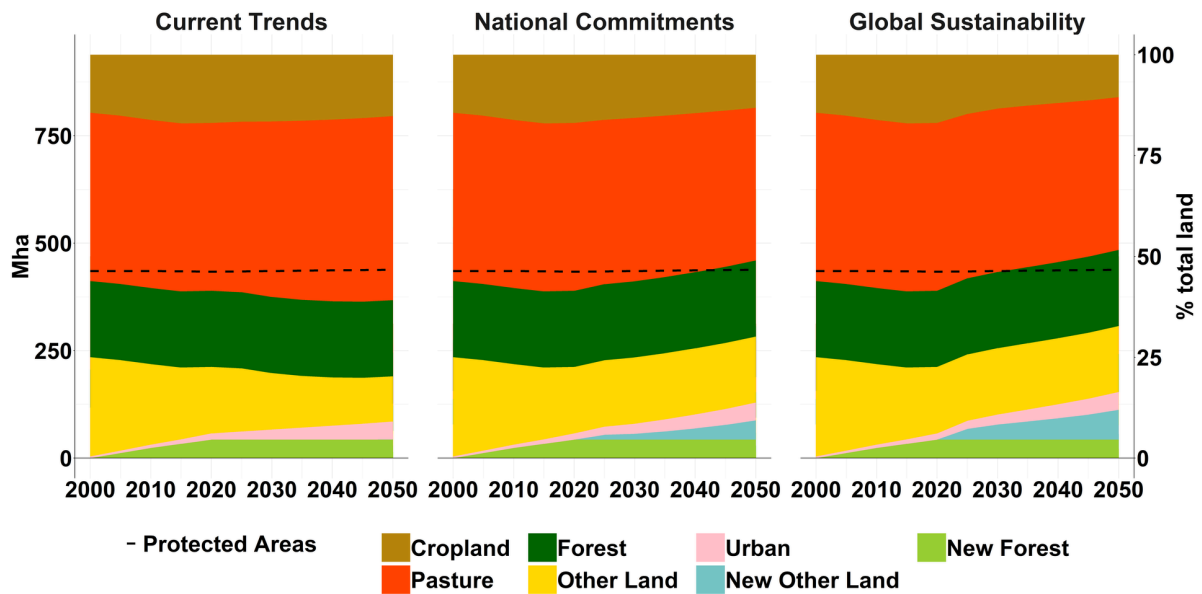


Figure 7. Evolution of the cropland composition 2000-2050

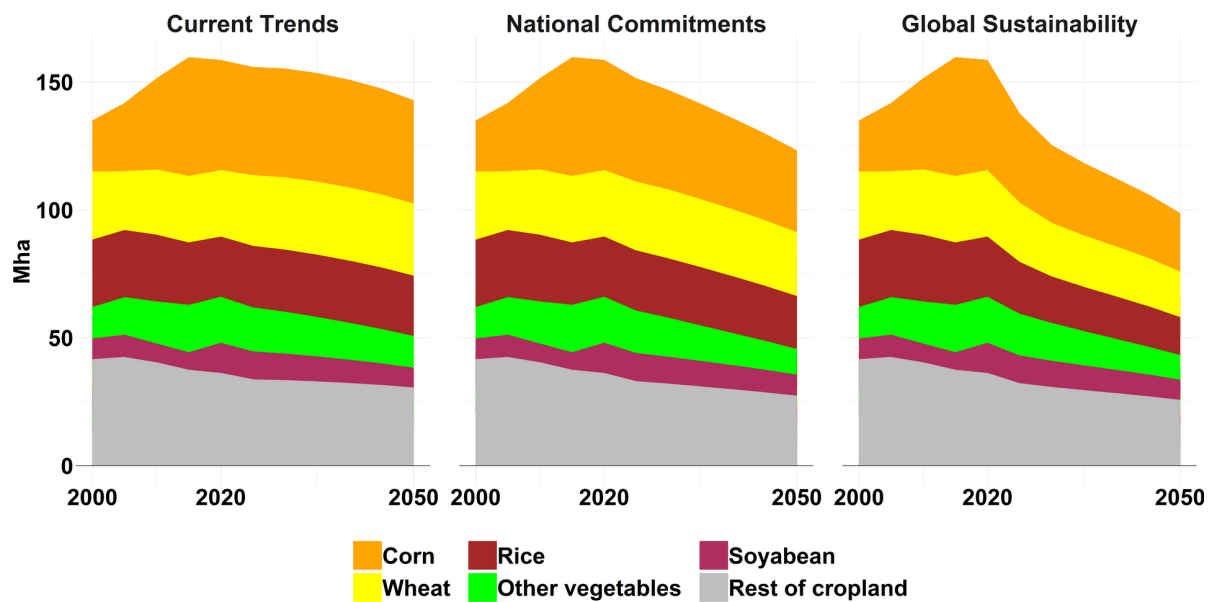




Figure 8. Projected AFOLU emissions and removals between 2020 and 2050 by main sources and sinks across pathways

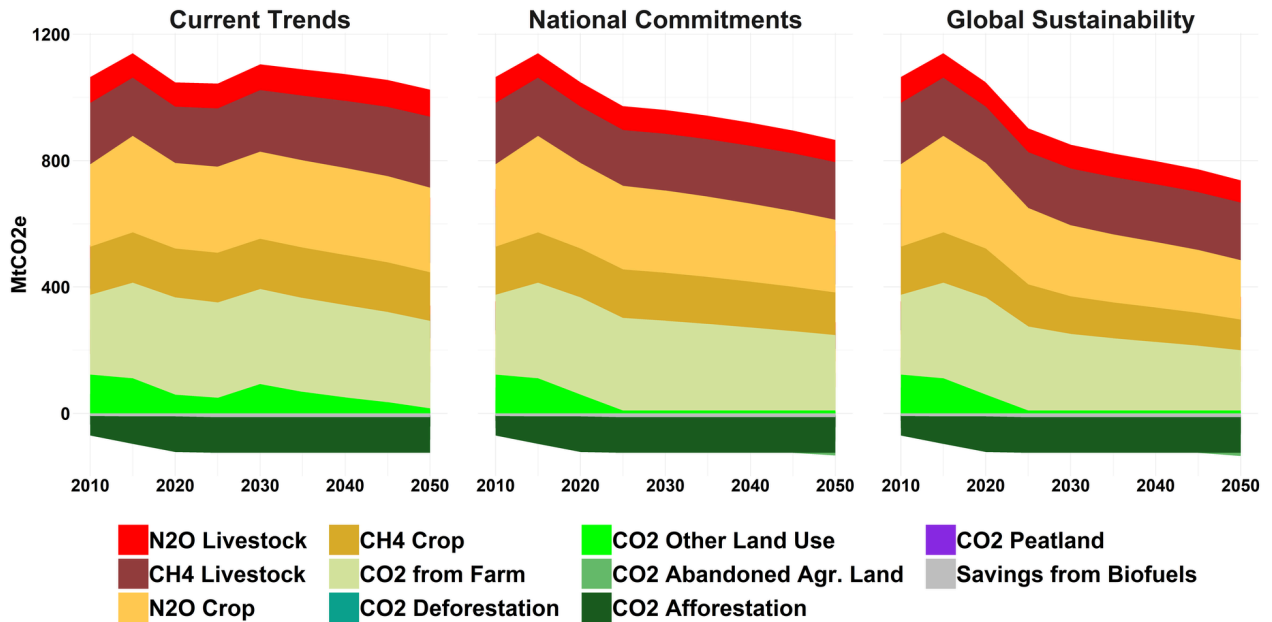


Figure 9. Share of cropland under agroecological practices

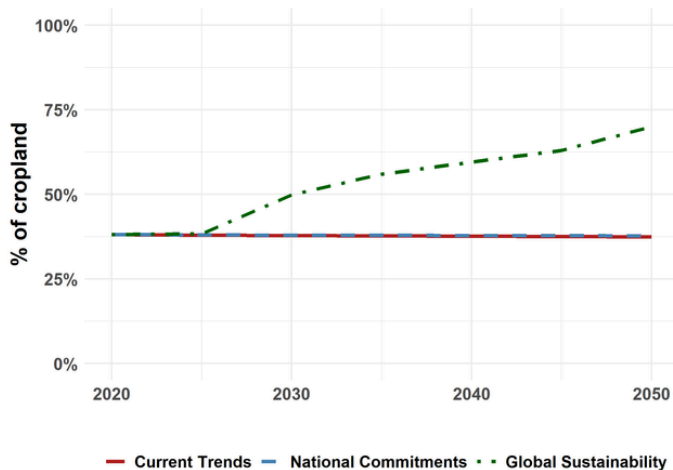
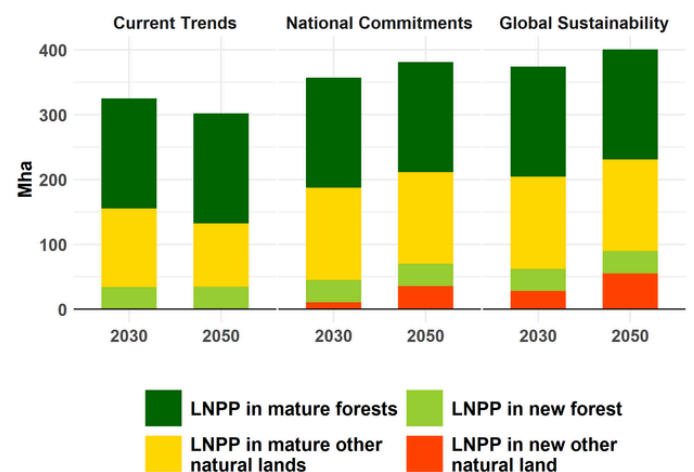


Figure 10. Total area of land where natural processes predominate (LNPP)



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



Figure 11. Nitrogen application

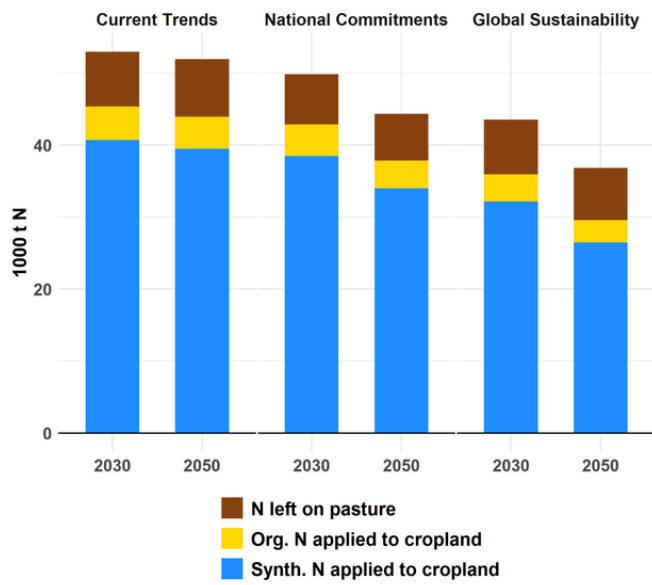
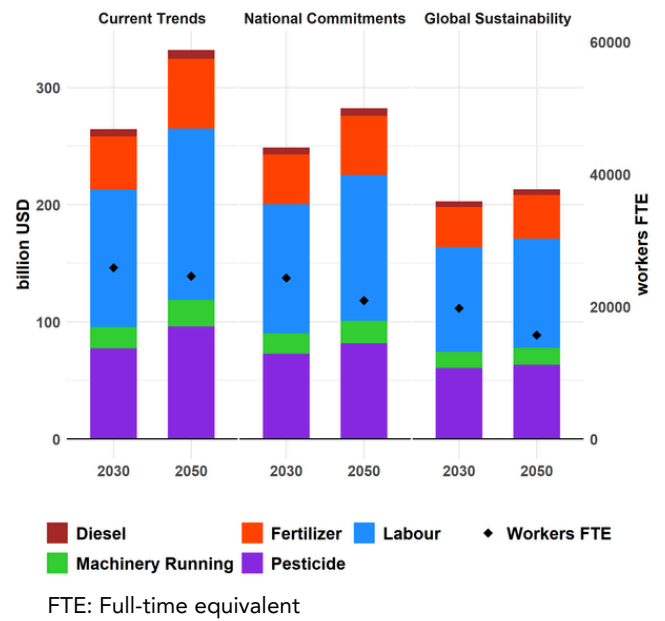


Figure 12. On-farm production costs



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

# Scenarios and assumptions

		<b>A) CURRENT TRENDS</b>	<b>C) GLOBAL SUSTAINABILITY</b>	<b>Justification</b>
<b>1. Macroeconomics</b>	<b>1.1)</b> GDP per capita	Remain unchanged between 2020 and 2050 (SSP2)	Remain unchanged between 2020 and 2050 (SSP2)	GLOBIOM-China
	<b>1.2)</b> Population	From 1379.23 million inhabitants in 2020 to 1263.14 million inhabitants in 2050 (SSP2)	From 1379.23 million inhabitants in 2020 to 1263.14 million inhabitants in 2050 (SSP2)	GLOBIOM-China
	<b>1.3)</b> Inflation	Increase by 592.7% between 1978 and 2021	Increase by 592.7% between 1978 and 2021	<a href="#">National Bureau of Statistics of China</a>
	<b>1.4)</b> Inequalities	0.466, Gini coefficient, 2021	0.466, Gini coefficient, 2021	<a href="#">National Bureau of Statistics of China</a>
<b>2. Land</b>	<b>2.1)</b> Constraints on agricultural expansion/deforestation	1. No constraint on the expansion of the agricultural land beyond protected areas 2. The total amount of occupied forest land is monitored to ensure that it is not reduced.	1. No constraint on the expansion of the agricultural land beyond protected areas 2. The total amount of occupied forest land is monitored to ensure that it is not reduced.	<a href="#">Forest Law of the People's Republic of China</a>
	<b>2.2)</b> Afforestation, and forest plantations targets	China plans to afforestation 18 Mha from 2021 to 2025. By 2050 forest area can reach 250 Mha	China plans to afforestation 18 Mha from 2021 to 2025. By 2050 forest area can reach 250 Mha	<a href="#">Outline of the "14th Five-Year Plan" Forestry and Grassland Protection and Development Plan</a>
	<b>2.3)</b> Urban and settlements area	From 17.81 Mha in 2008 to 18.83 Mha in 2021	From 17.81 Mha in 2008 to 18.83 Mha in 2021	<a href="#">National Bureau of Statistics of China</a>
	<b>2.4)</b> Protected areas	7.98% (74.40 Mha) of total area by 2030	7.98% (74.40 Mha) of total area by 2030	GLOBIOM-China
<b>3. Productivity and management</b>	<b>3.1)</b> Crop productivity for the key crops	Between 2020 and 2050, crop productivity increases: -from 4.11 t/ha to 4.81 t/ha for barley -from 1.74 t/ha to 2.06 t/ha for Beans -from 17.16 t/ha to 17.95 t/ha for cassava -from 6.43 t/ha to 7.46 t/ha for corn -from 3.56 t/ha to 6.12 t/ha for cotton -from 3.89 t/ha to 4.35 t/ha for groundnut -from 2.46 t/ha to 2.81 t/ha for mill -from 13.23 t/ha to 13.52 t/ha for Oil Palm -from 18.15 t/ha to 19.90 t/ha for potato -from 2.11 t/ha to 2.35 t/ha for rapeseed -from 7.24 t/ha to 8.23 t/ha for rice	Between 2020 and 2050, crop productivity increases: -from 4.11 t/ha to 5.04 t/ha for barley -from 1.74 t/ha to 2.15 t/ha for Beans -from 17.16 t/ha to 17.92 t/ha for cassava -from 6.43 t/ha to 7.53 t/ha for corn -from 3.56 t/ha to 6.41 t/ha for cotton -from 3.89 t/ha to 4.44 t/ha for groundnut -from 2.46 t/ha to 2.86 t/ha for mill -from 13.23 t/ha to 13.61 t/ha for Oil Palm -from 18.15 t/ha to 20.66 t/ha for potato -from 2.11 t/ha to 2.39 t/ha for rapeseed -from 7.24 t/ha to 8.66 t/ha for rice	GLOBIOM-China



# Scenarios and assumptions

		<b>A) CURRENT TRENDS</b>	<b>C) GLOBAL SUSTAINABILITY</b>	<b>Justification</b>
		-from 1.96 t/ha to 2.39 t/ha for soybean -from 5.05 t/ha to 5.38 t/ha for sorghum -from 76.39 t/ha to 82.22 t/ha for sugar crops -from 2.76 t/ha to 3.26 t/ha for Sunflower -from 21.99 t/ha to 24.92 t/ha for sweet potato -from 5.45 t/ha to 6.25 t/ha for wheat	-from 1.96 t/ha to 2.50 t/ha for soybean -from 5.05 t/ha to 5.58 t/ha for sorghum -from 76.39 t/ha to 83.69 t/ha for sugar crops -from 2.76 t/ha to 3.55 t/ha for Sunflower -from 21.99 t/ha to 26.94 t/ha for sweet potato -from 5.45 t/ha to 6.18 t/ha for wheat	
	<b>3.2) Cropland under agroecological practices</b>	4% (5 Mha) of cropland in 2020 and no planning for the future development	4% (5 Mha) of cropland in 2020 and no planning for the future development	
	<b>3.3) Livestock productivity for the key livestock products</b>	Between 2020 and 2050, the productivity per head changes: -from 1.57 kg/head to 1.82 kg/head for chicken -from 89.63 kg/head to 99.10 kg/head for pig -from 15.15 kg/head to 15.94 kg/head for goat -from 144.54 kg/head to 133.32 kg/head for cow -from 1.70 L/day by dairy cow to 1.54 L/day	Between 2020 and 2050, the productivity per head changes: -from 1.57 kg/head to 1.70 kg/head for chicken -from 89.63 kg/head to 99.40 kg/head for pig -from 15.15 kg/head to 16.19 kg/head for goat -from 144.54 kg/head to 129.30 kg/head for cow -from 1.70 L/day by dairy cow to 1.63 L/day	GLOBIOM-China
	<b>3.4) Pasture stocking rate</b>	Increase from 1.20 animal units per ha to 1.28 animal units per ha pasture between 2020 and 2050	Increase from 1.20 animal units per ha to 1.31 animal units per ha pasture between 2020 and 2050	GLOBIOM-China
	<b>3.5) Forest management</b>	Its area increases from 77.83 Mha in 2020 to 89.61 Mha in 2050	Its area increases from 77.83 Mha in 2020 to 87.10 Mha in 2050	GLOBIOM-China
<b>4. Trade</b>	<b>4.1) Share of consumption which is imported for key imported products (%)</b>	The share of total consumption that is imported is: -from 97.92% in 2020 to 98.03% in 2050 for palm oil -from 88.29% in 2020 to 88.33% in 2050 for soybean -from 74.25% in 2020 to 92.18% in 2050 for barley -from 48.94% in 2020 to 46.74% in 2050 for cassava -from 21.06% in 2020 to 27.80% in 2050 for	The share of total consumption that is imported is: -from 97.92% in 2020 to 98.09% in 2050 for palm oil -from 88.29% in 2020 to 86.84% in 2050 for soybean -from 74.25% in 2020 to 92.34% in 2050 for barley -from 48.94% in 2020 to 40.25% in 2050 for cassava -from 21.06% in 2020 to 18.90% in 2050 for	GLOBIOM-China

# Scenarios and assumptions

		<b>A) CURRENT TRENDS</b>	<b>C) GLOBAL SUSTAINABILITY</b>	<b>Justification</b>
		rapeseed -from 20.53% in 2020 to 21.54% in 2050 for sugarcane -from 15.84% in 2020 to 21.40% in 2050 for cotton -from 3.25% in 2020 to 7.00% in 2050 for Sunflower -from 0.78% in 2020 to 5.69% in 2050 for sorghum -from 11.62% in 2020 to 18.51% in 2050 for Beef -from 5.49% in 2020 to 10.22% in 2050 for S&G meat -stays constant for the other products	rapeseed -from 20.53% in 2020 to 13.44% in 2050 for sugarcane -from 15.84% in 2020 to 11.98% in 2050 for cotton -from 3.25% in 2020 to 4.42% in 2050 for Sunflower -from 0.78% in 2020 to 5.60% in 2050 for sorghum -from 11.62% in 2020 to 24.31% in 2050 for Beef -from 5.49% in 2020 to 9.40% in 2050 for S&G meat -stays constant for the other products	
	<b>4.2) Evolution of exports for key exported products (1000 tons)</b>	The exported quantity: -increases from 5563.08 in 2020 to 7784.40 in 2050 for sugar crops -increases from 738.72 in 2020 to 959.11 in 2050 for Beans -increases from 445.58 in 2020 to 751.56 in 2050 for groundnut -increases from 678.79 in 2020 to 1221.95 in 2050 for wheat	The exported quantity: -increases from 5563.08 in 2020 to 7502.39 in 2050 for sugar crops -increases from 738.72 in 2020 to 957.52 in 2050 for Beans -increases from 445.58 in 2030 to 847.63 in 2050 for groundnut -increases from 678.79 in 2020 to 1217.16 in 2050 for wheat	GLOBIOM-China
<b>5. Food</b>	<b>5.1) Average dietary composition</b>	By 2050, the average daily calorie consumption per capita is 3218.64 kcal and composed of: 46.02% cereals, 2.54% dairy, 1.88% ruminant meat, 11.00% pig meat, 2.42% poultry meat, 2.62% Eggs, 9.77% oil and fat, 3.33% sugar, 8.12% fruits and vegetables, 3.17% pulses, 3.99% roots and tubers, 2.08% nuts, 2.33% aquatic food, 0.75% others.	By 2050, the average daily calorie consumption per capita is 3194.97 kcal and composed of: 47.64% cereals, 2.01% dairy, 1.84% ruminant meat, 9.16% pig meat, 1.98% poultry meat, 2.49% Eggs, 10.76% oil and fat, 3.78% sugar, 8.10% fruits and vegetables, 3.42% pulses, 3.50% roots and tubers, 2.25% nuts, 2.32% aquatic food, 0.77% others.	GLOBIOM-China
	<b>5.2) Share of food consumption which is wasted at household level</b>	It remains unchanged compared to the 2020 level.	Reduces by 50% compared to 2020 level.	GLOBIOM-China



# Scenarios and assumptions

		<b>A) CURRENT TRENDS</b>	<b>C) GLOBAL SUSTAINABILITY</b>	<b>Justification</b>
<b>6. Biofuels</b>	<b>6.1)</b> Targets on biofuel and/or other bioenergy use	Biofuel demand accounts for 0.01% of total corn production by 2030 and 0.07% of total sugarcane production by 2020	Biofuel demand accounts for 0.01% of total corn production by 2030 and 0.09% of total wheat production by 2020	GLOBIOM-China
	<b>6.2)</b> Targets on other non-food use	The demand for cotton that is for other non-food use is multiplied by 1.10 between 2020 and 2050	The demand for cotton that is for other non-food use is multiplied by 1.04 between 2020 and 2050	GLOBIOM-China
<b>7. Water</b>	<b>7.1)</b> Irrigated crop area	Decrease by 7.38% between 2020 and 2050	Decrease by 12.07% between 2020 and 2050	GLOBIOM-China