Key Insights from the Food, Agriculture, and Forests (FAF) Climate Scenario Tool

February 2023 Update

wbcsd

With supporting analysis from Vivid Economics

Purpose and overview

Purpose

This document guides users of the Food, Agriculture, and Forests Climate Scenario Tool with underlying insights on drivers and trends across scenarios.

We offer an overview of the **production and price outputs** for **select regions and commodities**, where trends may not be easily discerned.

Prices are indexed, with 2020 = 100

Production is shown in megatons dry matter / year

This document is based on modeling and supporting analysis by Vivid Economics, among other sources.

Overview

1. **Scenarios and scope**
   - Scenario narratives and drivers
   - Key input assumptions and outputs
   - Overview of input variables and commodities coverage

2. **Trends and insights**
   - Key trends, including global and regional insights, for each commodity group, and specific commodities where relevant
     - Cereals
     - Oil Crops
     - Sugar Crops
     - Animal Products
     - Forest Products

Content

Scenarios and scope

Commodities Overview

- Cereals
- Oil Crops
- Sugar Crops
- Animal Products
- Forest Products

The Food, Agriculture, and Forests Climate Scenario Tool reports business variables across 23 commodities and 18 regions between 2020-2050 under five scenarios

Coverage

Types

Regions
18 regions, including 6 large individual countries

Timeframe
Reported between 2020 – 2050, in 5-years intervals. Model runs up to 2100 to define carbon budget

Scenario Drivers

Fixed across scenarios
GDP, Population and trade

Varying across five scenarios
GHG prices, bioenergy production, area protection, diet shifts, food waste, innovation

Outputs

Commodities

- Crops
- Animal products
- Forestry products

Business variables

Market sizing
Production and prices, market size, production share

Land use
Yields growth, land use change

Environmental variables

Emissions, deforestation, and forest-based mitigation

Crops

- Maize, rice, temperate cereals, tropical cereals
- Sunflower, soybean, and other oilseeds
- Oil palm
- Cotton seed, groundnuts
- Sugar cane, sugar beet
- Fruits, vegetables, nuts
- Potatoes, pulses
- Tropical roots (e.g., cassava)

Animal products

- Beef, sheep, and goat
- Pork
- Poultry
- Dairy
- Eggs

Forest products

- Timber
- Pulpwood

The Food, Agriculture, and Forests Climate Scenario Tool provides outputs for five sector-specific scenarios that would each present a different set of risks and opportunities

Scenario	Scenario description
>3°C Historic Trends Scenario	>3°C **Historic Trends** represents a scenario in which climate **action remains stable at current levels** creating limited transition risks, but the world fails to limit global warming to manageable levels, resulting in substantial future physical risks. This scenario has low levels of transition risk.
<2°C Forecast Policy Scenario (IPR)	Under <2°C **Forecast Policy Scenario (IPR)**, Climate action starts abruptly and late, around 2030, resulting in limited transition risk in early years. After 2030, transition risks ramp up significantly due to the sudden implementation of greenhouse gas (GHG) prices, area protection regulation, and a scale-up of bioenergy with carbon capture and storage (BECCS) capacity. This scenario has varying levels of transition risk over time.
<2°C Coordinated Policy Scenario	<2°C **Coordinated Policy Scenario** is a scenario where **timely policy and regulation** work to curb emissions in an orderly fashion, decreasing the physical risk of climate change but increasing the transition risk. This scenario has moderate levels of transition risk.
1.5°C Societal Transformation Scenario	1.5°C **Societal Transformation Scenario** represents **strong, coordinated and prompt global policy action**, as well as **market responses** (e.g. diet shifts and lower food waste) that result in widespread carbon pricing and land protection to enable decarbonization and limited physical impacts of climate change. This scenario has high levels of transition risk.
1.5°C Innovation Scenario	Under 1.5°C **Innovation Scenario,** large **demands** from the energy system for **BECCS, coupled with greater-than-historic yield growth** in agriculture and government support for R&D, enables early decarbonization and limited physical impacts of climate change. This scenario has high levels of transition risk, but may be muted by technological progress.

Ten key drivers characterize the five scenarios and their narratives

Level of action (low to high)

Types of drivers: Policy action; Tech-driven action; Demand-side action

Input assumptions	>3ºC Historic Trends	<2ºC Forecast Policy (IPR)[2]	<2ºC Coordinated Policy	1.5ºC Societal Transformation	1.5ºC Innovation
GDP & Pop/Trade	**Medium:** IPCC Shared Socioeconomic Pathway 2 (SSP2), a 'middle of the road' scenario: Population grows from 7bn at 0.6% p.a. before slowing, 2070 peak at 9.5 bn. GDP doubles by 2050 **Current patterns:** Maintains current trade policy regime, without systematic liberalisation or de-liberalisation				
GHG Prices $/ton of CO_2e	**Current prices** $4/ton CO_2e by 2050	**Disorderly** ~$115/ton CO_2e by 2050[3]	**Medium** $100/ton CO_2e by 2050	**High** $153/ton CO_2e by 2050	
Bioenergy pathway Exajoules (EJ)	**Current levels** 8.8 EJ/year in 2050 (no 2nd generation bioenergy crops)	**Disorderly** Demand reaches moderate levels only after 2040 (72 EJ/yr 2nd generation)	**Moderate** 90 EJ/year by 2050 (72 EJ/yr 2nd generation)	**Ambitious** 100 EJ/year by 2050 (82 EJ/yr 2nd generation bioenergy crops)	**High** 130 EJ/year by 2050 (112 EJ/yr 2nd generation bioenergy crops)
Diet shifts Caloric Shift between 2020 and 2050	**No diet shift** +18% demand for livestock products between 2020 and 2050	**Medium diet shift** -2% demand for livestock products between 2020 and 2050		**High diet shift** -12% demand for livestock products between 2020 and 2050	**Medium diet shift** -2% demand for livestock products between 2020 and 2050
Protected areas[1]	**WDPA** current protection 13% of terrestrial land surface	**WDPA + Biodiversity hotspots** (After 2025, limited to a subset of countries)	**WDPA + Biodiversity hotspots**	**Meets 50x50 targets** 50% terrestrial area by 2030	**WDPA + Biodiversity hotspots**
Input efficiency Nitrogen Uptake Efficiency (NUE), %	**No change** Global average <60% by 2050	**Medium** Global average ~65% by 2050			**High** NUE global average 70% by 2050
Yield-enhancing tech Per annum growth crop yields	**Low** Crop yields grow < 1%p.a.	**Medium** Crop yields grow at ~1% p.a.			**High** Yields grow >1% p.a.
Food waste reductions % of food wasted	**No reduction** 33% food is wasted by 2050	**Medium reduction** 20% by 2050 (faster reduction from 2030 to 2050)	**Medium reduction** 20% by 2050 (smooth reduction)	**High reduction** 16.5% by 2050 (UN Sustainable Develop Goal 12.3)	**Medium reduction** 20% by 2050
Other climate policies	**Nationally determined policies on reforestation/ avoided deforestation**	**Adjusted land-use Nationally Determined Contributions (NDCs)** Lower forest NDC for China			
Timber demand pathways	**Low demand**. Demand for timber in construction remains low (~0.5%)	**Medium demand.** Demand for timber in construction of new builds grows to 10%.			**High demand.** Demand for timber in construction of new builds grows to 50%.

1. "Protected areas" refers to Cat I, VI World Database for Protected Areas.
2. Action starts between 2025 and 2030.
3. Starting 2025, high-income regions begin to experience higher GHG prices than emerging and low-income economics

Content

Commodities overview

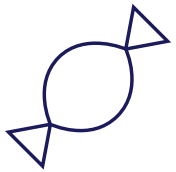
The following section introduces how key drivers impact production and prices across five commodity groups under historical trends and climate transition scenarios.

Cereals

Temperate cereals like wheat and tropical cereals, such as maize.

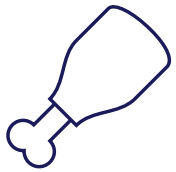
Oil crops

Tropical oil crops, such as oil palm and soybean, and temperate oil crops, such as rapeseed.



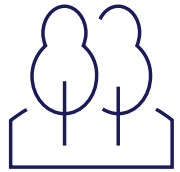
Sugar crops

Sugar cane (tropical) and sugar beet (temperate).



Animal products

Poultry, eggs, pork, beef, sheep, and goat.



Forest products

Timber and pulpwood.

Content

Cereals

Cereals

Potential risk Future opportunity

Key Drivers

Food waste reductions

- By 2050, food waste reduces by 40-50% under climate transition scenarios, leading to a substantial decrease in food demand, particularly in high income economies

Reduces land competition

Reduces food demand

GHG prices

- GHG pricing increases the cost of producing cereals, particularly in scenarios and regions with high GHG prices

Increases agricultural production costs

Bioenergy usage

- Bioenergy crops production will shift completely from first to second generation crops by 2050, decreasing demand for cereals, like maize for fuel use

Reduces demand for maize and other first gen bioenergy corps

Yield growth

- By 2050, average crop yields could increase up to 69% globally under climate transition scenarios. Yield growth could reduce land competition and prices for cereals, particularly in high income economies

Reduces land competition

Key Trends

Prices

- Under climate transitions, cereal prices increase above Historic Trends in the first decade as climate policies increase pressure on the land use system

Production

- Under climate transitions, *temperate* cereal production stabilizes as significant food waste reductions dampen growth
- *Tropical* cereal production faces relatively fewer demand headwinds from further food waste decline since food waste is already limited in these regions

Maize: Food waste and corn ethanol demand reductions result in maize production stabilizing or declining under climate transitions

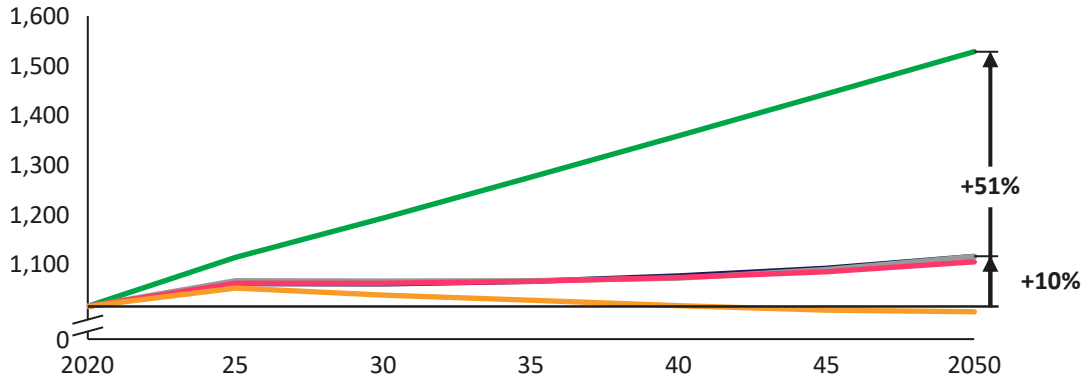
Cereals

>3ºC Historic Trends | <2ºC IPR Forecast Policy | 1.5ºC Societal Transformation | <2ºC Coordinated | 1.5ºC Innovation

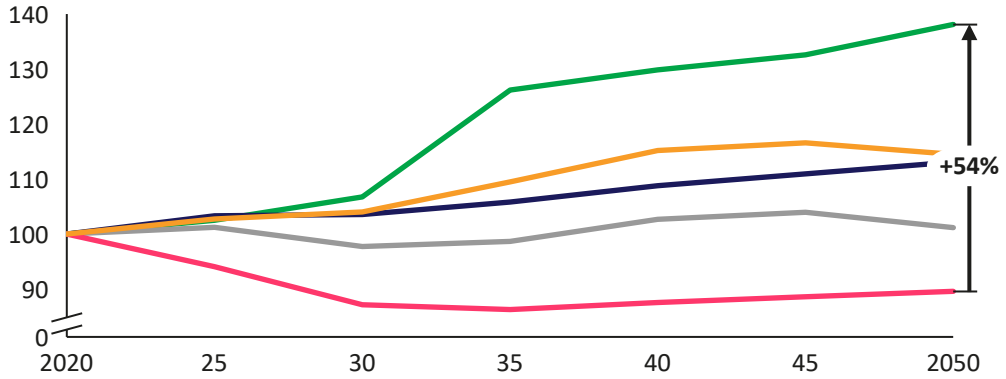
Protected areas | Food waste reductions | GHG Prices | Input efficiency | Bioenergy pathway | Diet shifts | Yield-enhancing tech

Maize, Global, Production (Mt DM yr.) and Indexed Prices (2020=100)

Global Production



Global Prices



Scenario-specific values and rationale

Scenarios	Rationale
>3ºC Historic Trends	Global production increases linearly from 2020-2050 as populations and incomes grow, leading to higher demand for food, feed, and fuel. Initially cheap, cropland expansion becomes more costly around 2030 as land scarcity increases competition. The cost increase is passed through to farmgate prices.
Climate Transition Scenarios	Production remains flat across most transition scenarios after 2025 as food waste and demand for first generation biofuels and feed decline, thus reducing need for maize. Prices under climate transition scenarios remain below historical trends, as maize demand remains close to 2020 levels.
<2ºC Forecast Policy (IPR)	Prices are lower in 2ºC IPR than 2ºC Coordinated because climate action is less ambitious in Brazil, Greater China, and Tropical Africa, where maize is largely produced, reducing land competition.
<2ºC Coordinated	2ºC Coordinated has the second highest prices as climate action is orderly and moderately ambitious, but there is no land use mechanism strong enough to fully offset its effect on land competition (e.g., productivity increase / demand reductions)
1.5ºC Societal Transformation	1.5ºC Social Transformation has the highest prices due to additional land constraints from ambitious area protections. Production decreases due to greater food waste reductions.
1.5ºC Innovation	1.5ºC Innovation has the lowest price as high yield growth offsets the increase in land competition from ambitious area protections, which are not as strong as under 1.5ºC Societal Transformation relative to 1.5ºC Innovation

Maize: production trends by region

Cereals

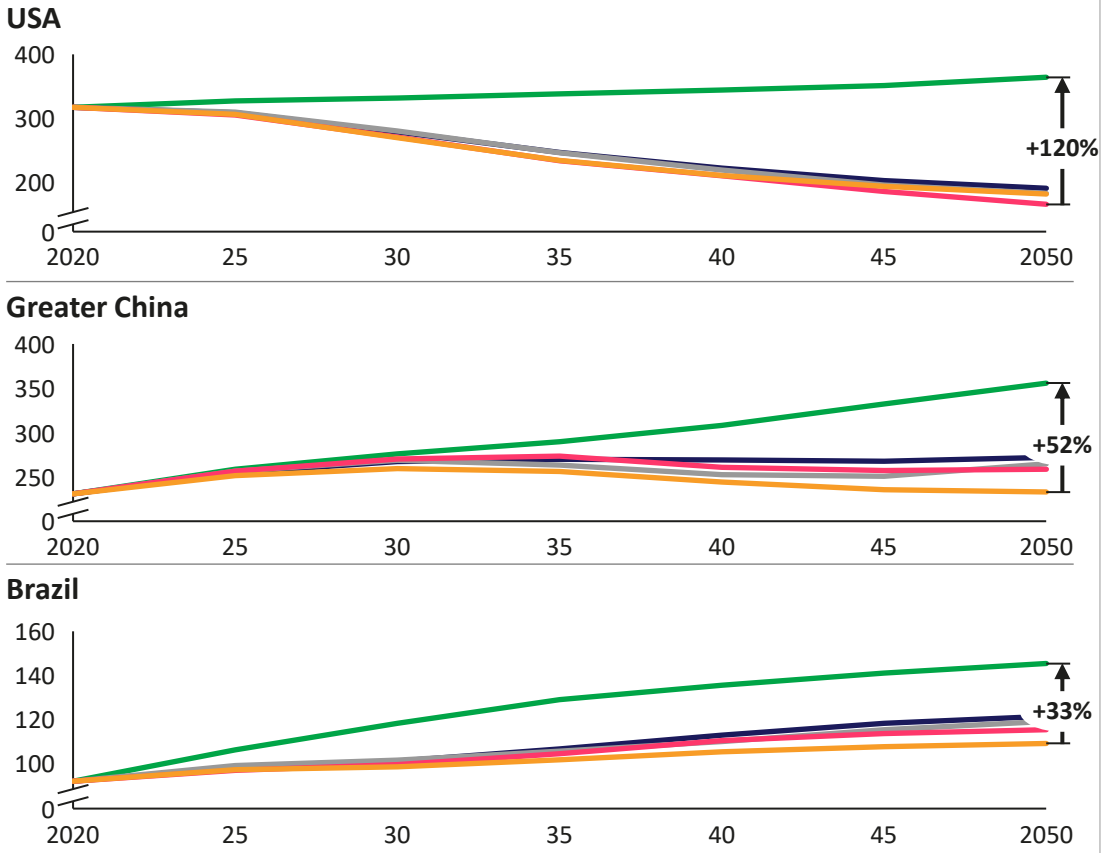
Maize is mostly used to produce food and fuel

>3ºC Historic Trends | <2ºC IPR Forecast Policy | 1.5ºC Societal Transformation | <2ºC Coordinated | 1.5ºC Innovation

Protected areas | Food waste reductions | GHG Prices | Input efficiency | Bioenergy pathway | Diet shifts | Yield-enhancing tech

Maize in selected markets, Production (Mt DM yr.)

Maize is mostly used for feed production, particularly for ruminants and poultry in China and Brazil



Scenario-specific values and rationale

Scenarios	Rationale
>3ºC Historic Trends	Growth in livestock production increases maize demand (as feed) across all regions. In Brazil, a large share of total maize production in 2020 is exported
Climate Transition Scenarios	**USA and Greater China:** Food waste reductions, declining first- generation bioenergy demand, and diet shifts toward alternative proteins all lower maize production under climate transitions. In the USA, production declines substantially below 2020 levels, as dietary shifts reduce feed demand. In Greater China, production peaks between 2030 and 2035 as the population starts declining.
	Brazil: Land protection and high deforestation costs push Brazil to reduce its maize exports, halving production growth. Across all three scenarios, Brazil becomes a net importer between 2030 and 2040. Additionally, the medium diet shift (or high diet shift in the 1.5 Societal Transformation scenario) and food waste reduction decreases overall demand for feed production from maize.

Maize: price trends by region

Cereals

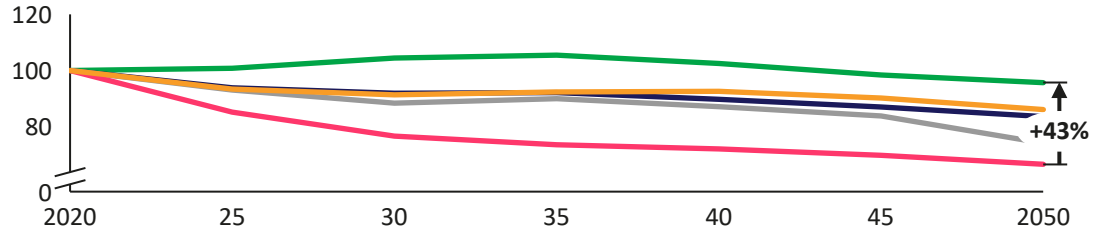
Maize is mostly used to produce food and fuel

>3ºC Historic Trends | <2ºC IPR Forecast Policy | 1.5ºC Societal Transformation | <2ºC Coordinated | 1.5ºC Innovation

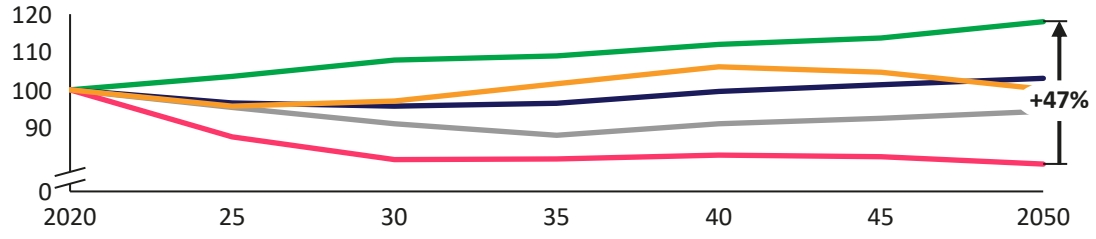
Protected areas | Food waste reductions | GHG Prices | Input efficiency | Bioenergy pathway | Diet shifts | Yield-enhancing tech

Price of Maize in selected markets, Indexed Prices (2020=100)

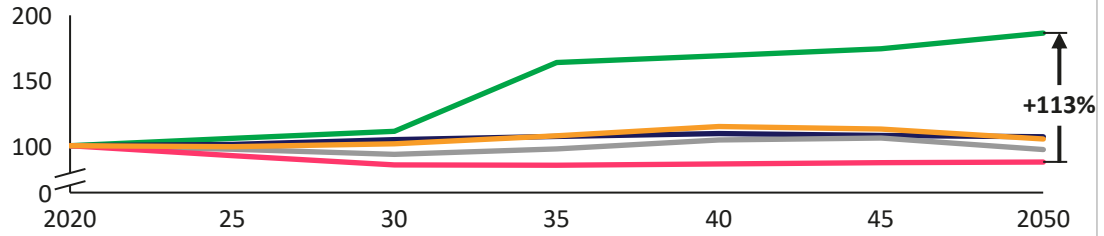
Greater China



USA



Brazil



Scenario-specific values and rationale

Scenarios	Rationale
>3ºC Historic Trends	**USA & Brazil:** Growth in fuel, feed and food increases demand and thus increases prices. **Greater China:** Population decline starting in 2025 decreases maize demand, thereby decreasing prices
Climate Transition Scenarios	**All regions:** The decline in demand in combination with limited climate policy action and transition costs reduces prices below Historic Trends.
1.5ºC Innovation	**All regions:** Substantial productivity growth leads to lower prices, relative to all other scenarios. This effect is stronger in Greater China, a country that is particularly land constrained under all transition scenarios and where increases in productivity can help reduce pressure on the production system substantially.

Rice: Production growth slows under climate transitions as food waste declines, while prices fluctuate depending on policies in producing regions

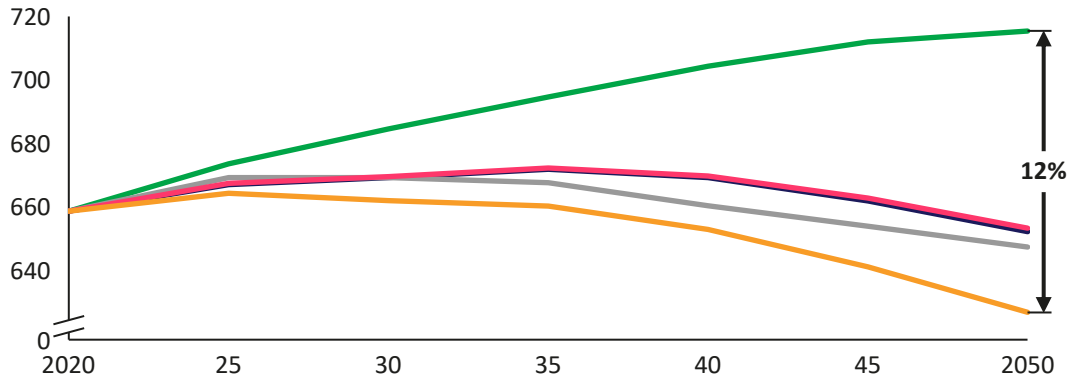
Cereals

>3ºC Historic Trends | <2ºC IPR Forecast Policy | 1.5ºC Societal Transformation | <2ºC Coordinated | 1.5ºC Innovation

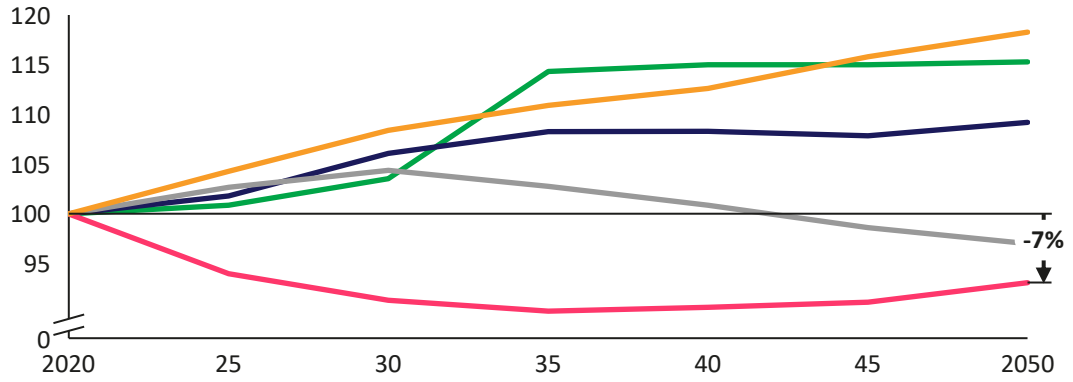
Protected areas | Food waste reductions | GHG Prices | Input efficiency | Bioenergy pathway | Diet shifts | Yield-enhancing tech

Rice, Global, Production (Mt DM yr.) and Indexed Prices (2020=100)

Global Production



Global Prices



Scenario-specific values and rationale

Scenarios	Rationale
>3ºC Historic Trends	Global production increases as population and income grow, leading to higher demand for food. The decline in Greater China's population after 2030 curbs demand growth. Initially cheap, cropland expansion becomes more costly around 2030 as land scarcity increases competition. The cost increase is passed through to farmgate prices.
Climate Transition Scenarios	Production remains flat across most transition scenarios after 2025 and 2030 as food waste reductions reduce need for rice. Food waste reductions weaken the relationship between food demand and income growth, lowering the impact of population changes on demand and production for rice. Hence, China's population dynamics drive the shape of the production curve across all transition scenarios.
1.5ºC Societal Transformation	Key rice exporters are particularly land constrained due to both area protections and national climate commitments. Historically net-importing countries, like India, must produce rice domestically at higher costs and these costs are passed through to farm gate prices.
1.5ºC Innovation	Prices decline as yields increase, reducing price impacts from land competition and protection policies. This is particularly true in Greater China and other key rice producing regions.

Rice: production trends by region

Cereals

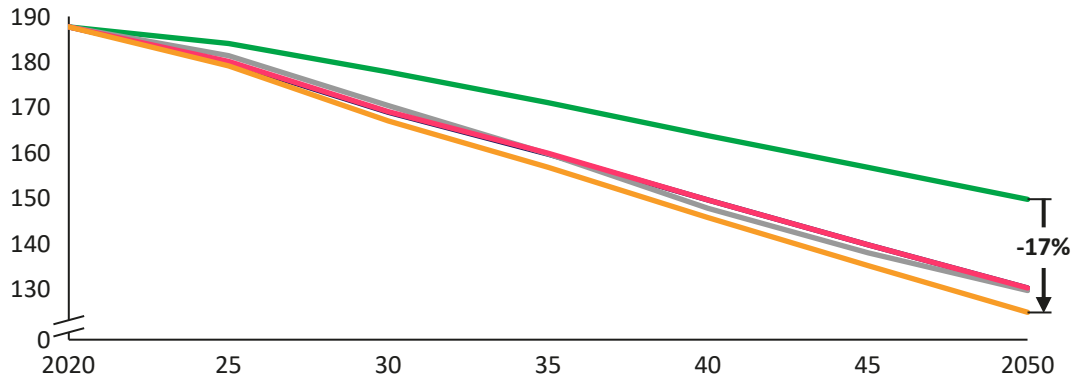
Rice is mostly used to produce food

>3ºC Historic Trends | <2ºC IPR Forecast Policy | 1.5ºC Societal Transformation | <2ºC Coordinated | 1.5ºC Innovation

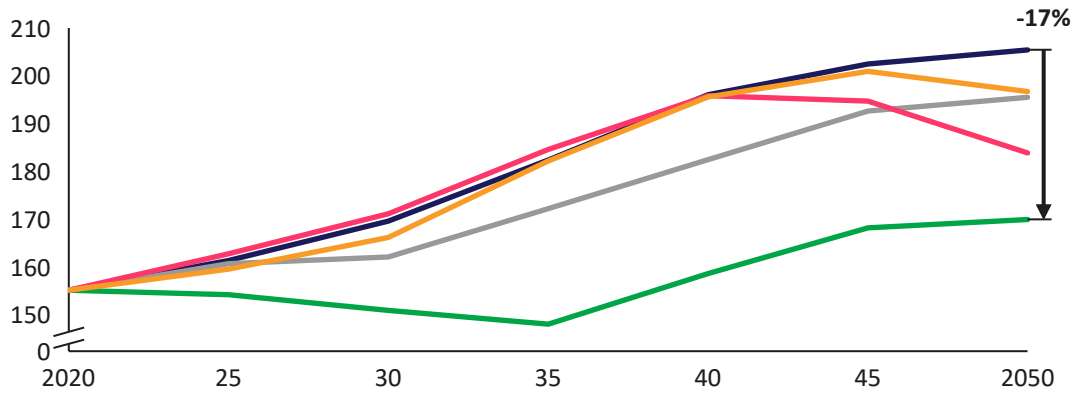
Protected areas | Food waste reductions | GHG Prices | Input efficiency | Bioenergy pathway | Diet shifts | Yield-enhancing tech

Rice in selected markets, Production (Mt DM yr.)

Greater China



India



Scenario-specific values and rationale

Scenarios	Rationale
>3ºC Historic Trends	**Greater China:** Production remains stable until 2025 and then declines following demographic trends. **India:** As demand for rice grows with population, India increases its imports from Southeast Asia.
<2ºC Forecast Policy (IPR) **<2ºC Coordinated**	**Greater China:** Production declines linearly as population declines and food waste is reduced. **India:** As demand for rice grows with population, production increases to meet demand. India cannot meet the entire additional demand with imports because neighboring economies in Southeast Asia face increasing land constraints due to climate policy and regulation. Hence, domestic production increases above Historic Trends across all transition scenarios. In the **Forecast Policy** scenario, domestic demand is lower because climate policies are delayed and less stringent in low-income economies in Southeast Asia, allowing India to meet rice demand with a larger share of imports.
1.5ºC Innovation	**Greater China:** Production declines linearly as population declines and food waste is reduced. **India:** Rice production increases until 2040 to accommodate the increase in demand. Close to 2050, high yield growth in neighbouring regions makes it simpler to import rice rather than producing it domestically, reducing production around the end of the century.
1.5ºC Societal Transformation	**Greater China:** Production declines linearly as population declines and food waste is reduced. **India:** as demand for rice grows with population, production increases to meet demand. India cannot meet the additional demand with imports because neighboring economies in Southeast Asia face increasing land constraints due to climate policy and regulation. Hence, domestic production increases above Historic Trends across all transition scenarios. In the Societal Transformation scenario, rice production drops drop after 2045 following the effects of the additional food waste reduction on demand.

Rice: price trends by region

Cereals

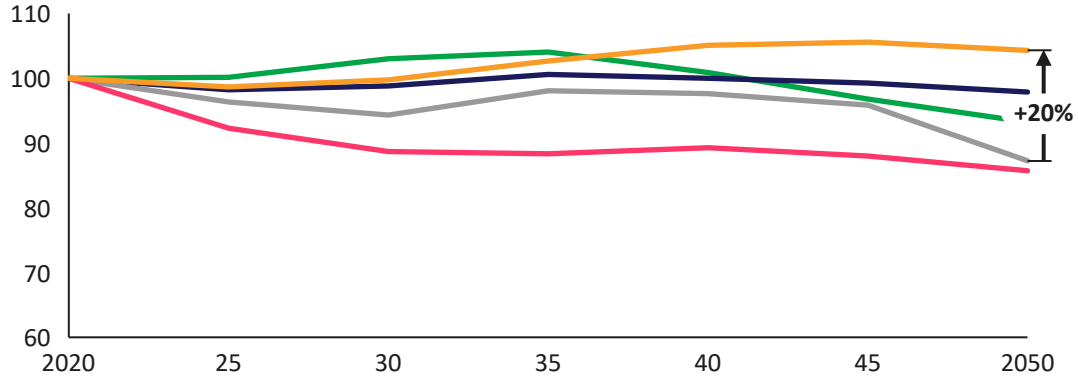
Rice is mostly used to produce food

>3ºC Historic Trends | <2ºC IPR Forecast Policy | 1.5ºC Societal Transformation | <2ºC Coordinated | 1.5ºC Innovation

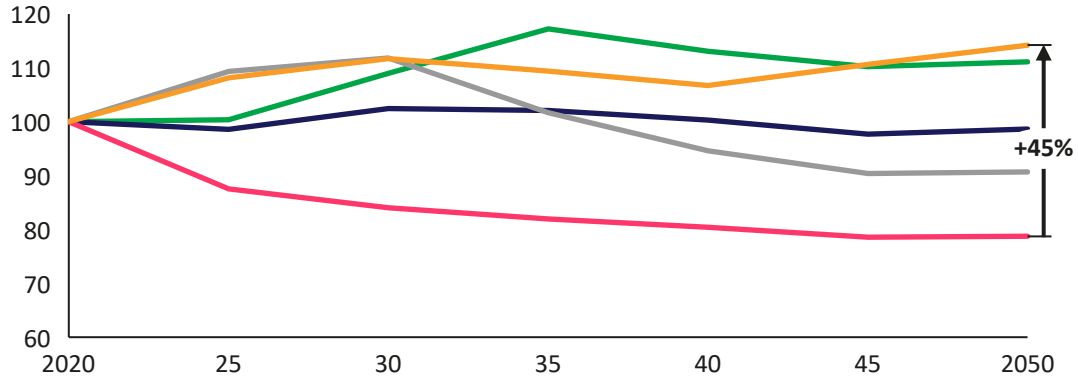
Protected areas | Food waste reductions | GHG Prices | Input efficiency | Bioenergy pathway | Diet shifts | Yield-enhancing tech

Rice in selected markets, Indexed Prices (2020=100)

Greater China



India



Scenario-specific values and rationale

Scenarios	Rationale
>3ºC Historic Trends	**Greater China:** Population decline starting in 2025 decreases rice demand, thereby decreasing the price **India:** Prices increase as population and income growth increase demand for all commodities, increasing land competition
<2ºC Forecast Policy (IPR)	Moderate increases in input efficiency and yield-enhancing technology decrease prices. **India:** under the Forecast Policy scenario prices are further reduced using cheap external imports to meet rice demand.
<2ºC Coordinated	**Greater China:** Prices stabilize below 2020 levels, as decline in demand more than offsets the small increase in production costs due to mild climate action. **India:** Prices increase as population and income growth increase demand for all commodities, increasing land competition
1.5ºC Innovation	High increases in input efficiency and yield-enhancing technology decrease prices, despite a high GHG price.
1.5ºC Societal Transformation	High GHG prices, area protection and a shift away from animal products increase the price of rice, despite moderate gains to input efficiency and yield-enhancing tech.

Temperate Cereals: Production growth slows under climate transitions as food waste declines; ambitious climate policies exacerbate this trend

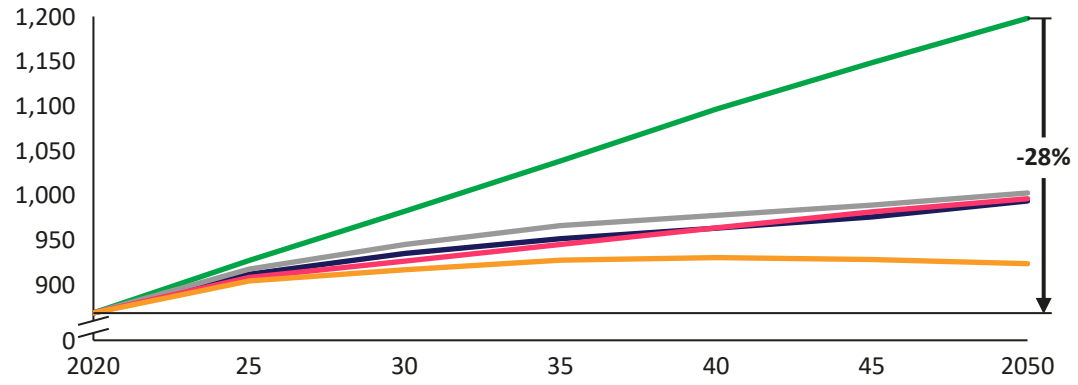
Cereals

>3ºC Historic Trends | <2ºC IPR Forecast Policy | 1.5ºC Societal Transformation | <2ºC Coordinated | 1.5ºC Innovation

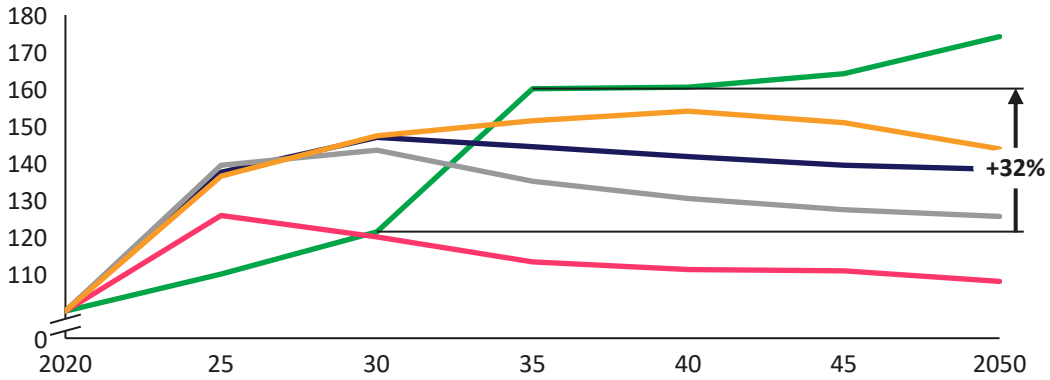
Protected areas | Food waste reductions | GHG Prices | Input efficiency | Bioenergy pathway | Diet shifts | Yield-enhancing tech

Temperate Cereals, Global, Production (Mt DM yr.) and Indexed Prices (2020=100)

Global Production



Global Prices



Scenario-specific values and rationale

Scenarios	Rationale
>3ºC Historic Trends	Global production increases linearly from 2020-2050 as population and income grow, leading to higher demand for food. Initially cheap, cropland expansion becomes more costly around 2030 as land scarcity increases competition. The cost increase is passed through to farmgate prices
Climate Transition Scenarios	Production remains flat across most transition scenarios after 2035 as food waste reductions reduces need for temperate cereals. Prices under transition scenarios increase above historical trends in the first decade, as climate policies and regulation increase pressure on the land use system
<2ºC Forecast Policy (IPR)	2ºC IPR is lower than 2ºC Coordinated because climate action is less ambitious in large producing regions, such as: India, Greater China, and Russia, reducing land competition
<2ºC Coordinated	2ºC Coordinated has the second highest prices, as climate action is orderly and moderately ambitious, but there is no land use mechanism strong enough to fully offset its effect on land competition (e.g. productivity increase / demand reductions)
1.5ºC Societal Transformation	1.5ºC Societal Transformation has the highest prices due to additional land constraints from ambitious area protection in high-income economies. Production decreases due to increased food waste reduction
1.5ºC Innovation	1.5ºC Innovation has the lowest price as the yield growth offsets the increase in land competition brought on by ambitious climate action and area protections not as strong as under 1.5ºC Societal Transformation

Tropical cereals: Production rises across all scenarios as food demand in tropical regions outpace demand headwinds from food waste reductions

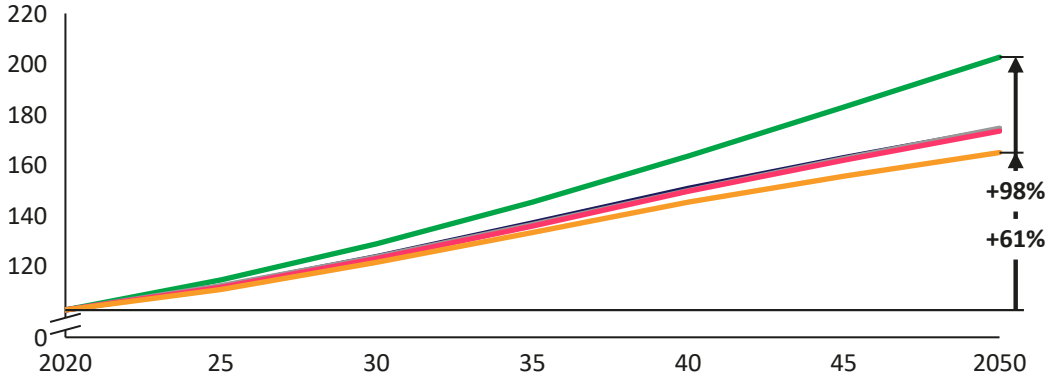
Cereals

>3ºC Historic Trends | <2ºC IPR Forecast Policy | 1.5ºC Societal Transformation | <2ºC Coordinated | 1.5ºC Innovation

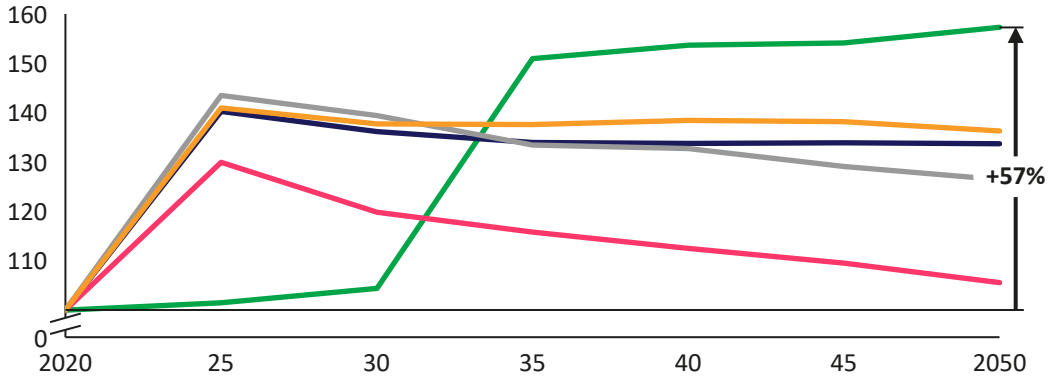
Protected areas | Food waste reductions | GHG Prices | Input efficiency | Bioenergy pathway | Diet shifts | Yield-enhancing tech

Tropical Cereals, Global, Production (Mt DM yr.) and Indexed Prices (2020=100)

Global Production



Global Prices



Scenario-specific values and rationale

Scenarios	Rationale
>3ºC Historic Trends	Global production increases linearly from 2020-2050 as population and income grow, leading to higher demand for food. Initially cheap, cropland expansion becomes more costly around 2030 as land scarcity increases competition, although land is not as constrained in tropical regions. The cost increase is passed through to farmgate prices.
Climate Transition Scenarios	Production increases across climate transition scenarios after 2020 as tropical regions are not as land constrained. Prices under climate transition scenarios increase above historical trends in the first decade, as climate policies and regulation increase pressure on the land use system
<2ºC Forecast Policy (IPR)	2ºC IPR is lower than 2ºC Coordinated because climate action is less ambitious in large producing regions, such as: India and Tropical Africa, reducing land competition
<2ºC Coordinated	2ºC Coordinated has the second highest prices, as climate action is orderly and moderately ambitious, but there is no land use mechanism strong enough to fully offset its effect on land competition (e.g. productivity increase / demand reductions)
1.5ºC Societal Transformation	1.5ºC Social Transformation has the highest prices because of the additional land constraints coming from ambitious area protection. Production decreases due to increased food waste reduction
1.5ºC Innovation	1.5ºC Innovation has the lowest price as the yield growth offsets the increase in land competition brought on by ambitious climate action and area protections not as strong as under 1.5ºC Societal Transformation

Content

Scenarios and scope

Commodities Overview

- Cereals
- **Oil Crops**
- Sugar Crops
- Other Crops
- Animal Products
- Forest Products

Oil Crops

Oil crops

Potential risk Future opportunity

Key Drivers

Diet shifts

- Shifts in diets away from animal proteins will increase the use of vegetable oils to produce alternatives, and reduce the use of oil crops for feed production

Increases demand for vegetable oils

Reduces feed demand

GHG prices

- GHG pricing will increase the cost of producing oil crops, particularly in scenarios/regions with high GHG prices. In tropical regions GHG prices drive land competition

Increase agricultural production costs and land competition

Bioenergy

- Bioenergy crops production will shift from first to second generation crops by 2050, limiting the demand for oil crops like soybean for fuel use

Reduces demand for soybean and other first gen bioenergy corps

Yield growth

- By 2050, average crop yields could increase up to 69% globally under climate transition scenarios. Yield growth may reduce land competition and prices for temperate oil crops, increasing their competitive advantage

Reduces land competition and increases the competitive advantage of temperate oil crops

Key Trends

Prices

- Oil crop prices rise under transition scenarios as climate policies increase pressures on the land use system, raising production costs. For some commodities like soybean, diet shifts and substitution lead to varying price trends

Production

- Production varies under transition scenarios, depending on how climate action affects land scarcity in temperate and tropical regions. For example, production of temperate oil crops will be relatively higher under 1.5°C Innovation, where higher productivity reduces production costs in Europe

Sunflower: Food waste declines alongside policy-driven costs reduce sunflower oil demand under climate transitions

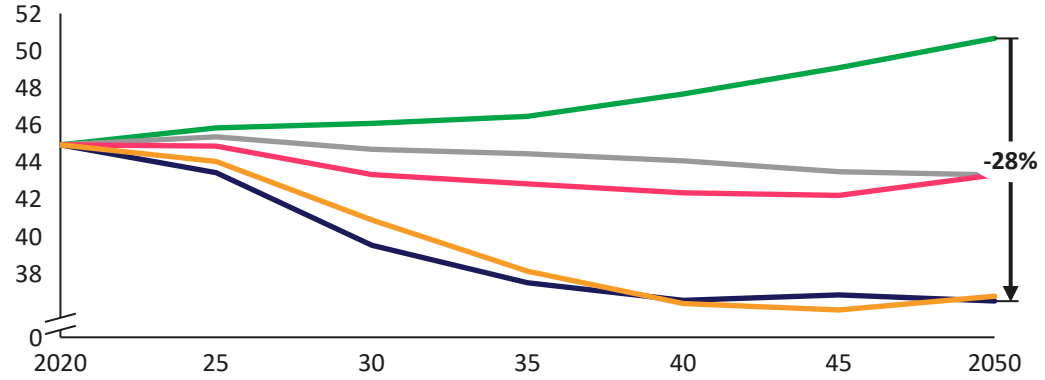
Oil crops

>3ºC Historic Trends | <2ºC IPR Forecast Policy | 1.5ºC Societal Transformation | <2ºC Coordinated | 1.5ºC Innovation

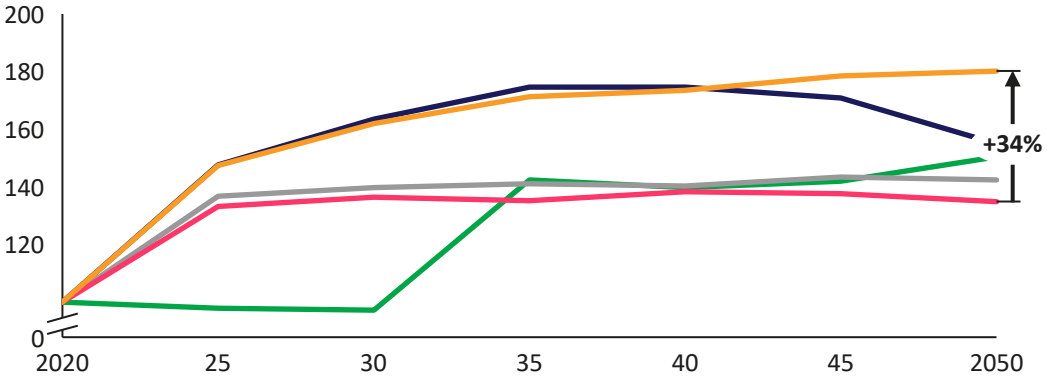
Protected areas | Food waste reductions | GHG Prices | Input efficiency | Bioenergy pathway | Diet shifts | Yield-enhancing tech

Sunflower, Global, Production (Mt DM yr.) and Indexed Prices (2020=100)

Global Production



Global Prices



Scenario-specific values and rationale

Scenarios	Rationale
>3ºC Historic Trends	Demand for vegetable oils for food and fuel production keeps growing with population. Initially cheap, cropland expansion becomes more costly around 2030 as land scarcity increases competition. The cost increase is passed through to farmgate prices.
Climate Transition Scenarios	Prices increase above historic trends in the first decade, as climate policies and regulation increase pressure on the land use. Food waste reduction reduces sunflower demand. A shift away from livestock products increases demand.
<2ºC Forecast Policy (IPR)	Prices fall as biodiversity protection and GHG prices are less ambitious in Russia and Former Soviet Union (regions covering over half of total production).
1.5ºC Societal Transformation	Key producers (such as Russia) face substantial land competition due to ambitious climate policies, so sunflower oil is less competitive than other vegetable oils and gets substituted for alternatives, thus decreasing production.
1.5ºC Innovation	Food waste reduction decreases sunflower demand. High investments in yield-enhancing technologies result in yield growth lowering prices, particularly in Russia and Europe.

Sunflower: production trends by region

Oil crops

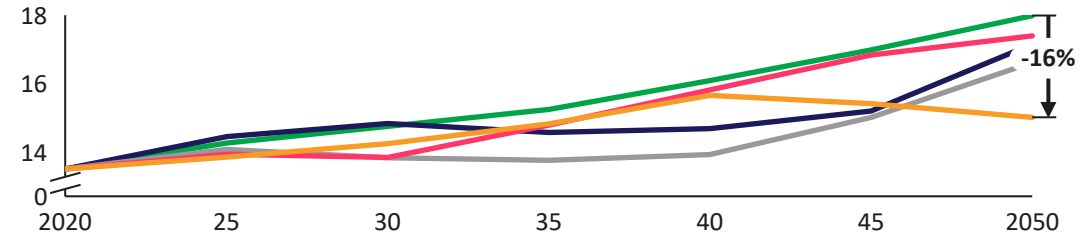
Sunflower can be used to produce edible vegetable oil as well as fuel

>3ºC Historic Trends | <2ºC IPR Forecast Policy | 1.5ºC Societal Transformation | <2ºC Coordinated | 1.5ºC Innovation

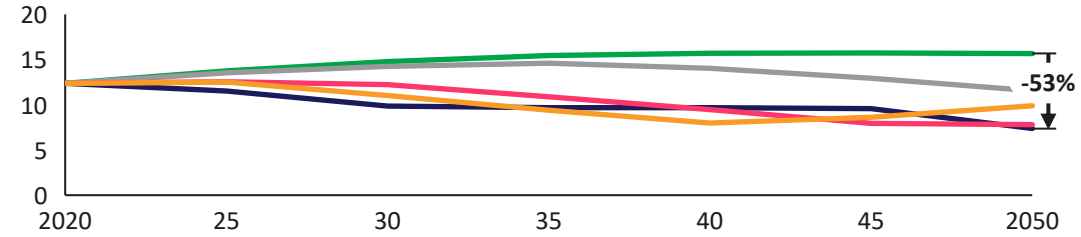
Protected areas | Food waste reductions | GHG Prices | Input efficiency | Bioenergy pathway | Diet shifts | Yield-enhancing tech

Sunflower in selected markets, Production (Mt DM yr.)

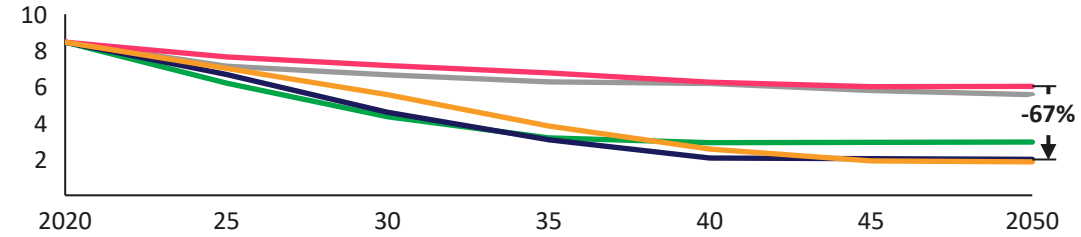
Former Soviet Union (Excl. Russia)



Russia



EU & UK



Scenario-specific values and rationale

Scenarios	Rationale
>3ºC Historic Trends	Generally, production increases with demand (population and income). **EU & UK:** Production declines following a reduction in demand for vegetable oils from sunflower in favor of other tropical oil crops.
<2ºC Forecast Policy (IPR) **<2ºC Coordinated**	**Former Soviet Union, excluding Russia:** Imports for sunflower remain high until the effect of climate policies in neighboring regions increases prices, making domestic production competitive with imports. **Russia:** Across all transition scenarios production declines following an increase in land competition in Russia, increasing agricultural production costs. The exception is the **Forecast Policy** scenario where lower levels of area protection and slower policy uptake keep domestic production competitive in the first decade. **EU & UK: Coordinated -** Production declines following a reduction in demand for vegetable oils from sunflower in favor of other tropical oil crops. **Forecast Policy -** lower levels of land protection in Europe increase available space for agricultural production and reduce the need to meet demand for vegetable with imports.
1.5ºC Innovation	**Former Soviet Union:** As yields grow, demand is progressively met with domestic production increases with demand (population and income). **EU & UK:** Greater yield improvements in Europe increase available space for agricultural production and reduce the need for imports to meet vegetable oil demand
1.5ºC Societal Transformation	**Former Soviet Union:** As land competition increases due to a ramp-up to in area protection, the region starts importing sunflower from neighboring countries after 2040. **EU & UK:** Production declines following a reduction in demand for vegetable oils from sunflower in favor of other tropical oil crops.

Sunflower: price trends by region

Oil crops

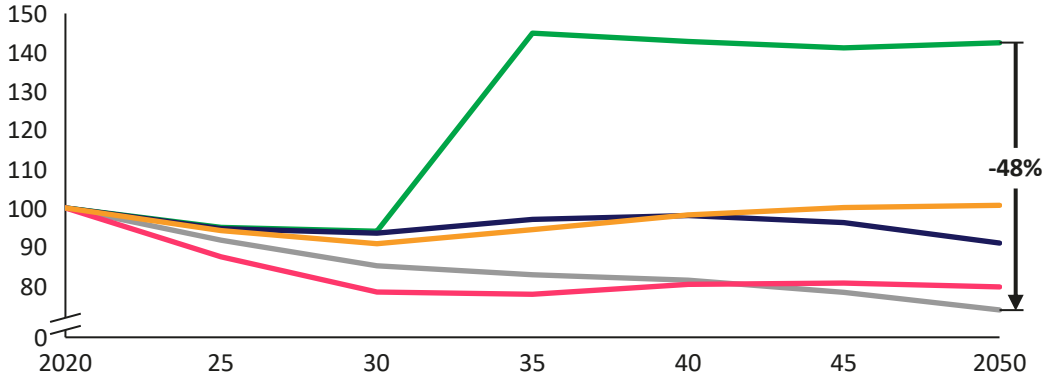
Sunflower can be used to produce edible vegetable oil as well as fuel

>3ºC Historic Trends | <2ºC IPR Forecast Policy | 1.5ºC Societal Transformation | <2ºC Coordinated | 1.5ºC Innovation

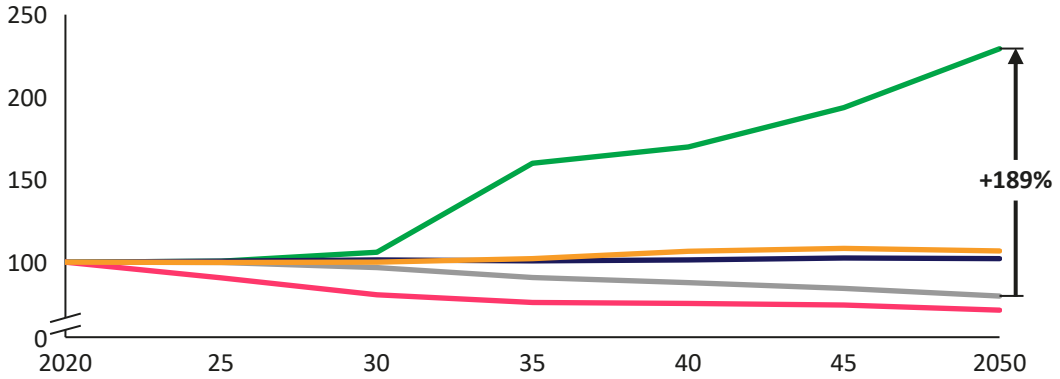
Protected areas | Food waste reductions | GHG Prices | Input efficiency | Bioenergy pathway | Diet shifts | Yield-enhancing tech

Sunflower in selected markets, Indexed Prices (2020=100)

Former Soviet Union (Excl. Russia)



EU and UK



Scenario-specific values and rationale

Scenarios	Rationale
>3ºC Historic Trends	**All regions:** Initially cheap, cropland expansion becomes more costly around 2030 as land scarcity increases competition. **EU and UK:** As land availability is lower in this region, prices rise after 2035.
<2ºC Forecast Policy (IPR)	**Former Soviet Union:** Moderate increases in technological innovation decrease prices, coupled with low GHG prices **EU & UK:** Moderate increases in technological innovation and stagnating demand decrease prices
<2ºC Coordinated	**Former Soviet Union and EU & UK:** Moderate increases in technological innovation, coupled with a medium diet shift and food waste reductions offset the medium increase in environmental policy and regulation, keeping price close 2020 levels
1.5ºC Innovation	**Former Soviet Union and EU & UK:** High increases in innovation decrease prices through 2050, despite high GHG prices
1.5ºC Societal Transformation	**Former Soviet Union and EU & UK:** Moderate increases in technological innovation, coupled with a strong diet shift and food waste reductions, decrease land competition, keeping price stable at 2020 levels

Soybean: Production rises but growth slows under climate transitions as food waste declines, climate policy costs rise, and diets shift to alternative proteins

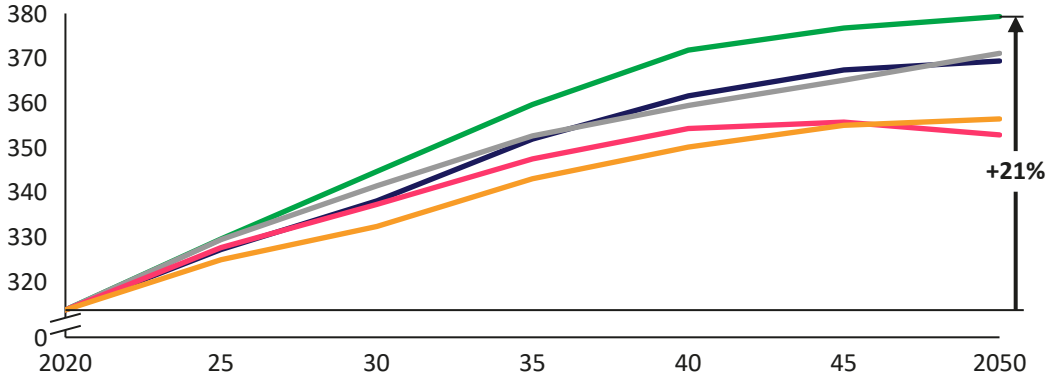
Oil crops

>3ºC Historic Trends | <2ºC IPR Forecast Policy | 1.5ºC Societal Transformation | <2ºC Coordinated | 1.5ºC Innovation

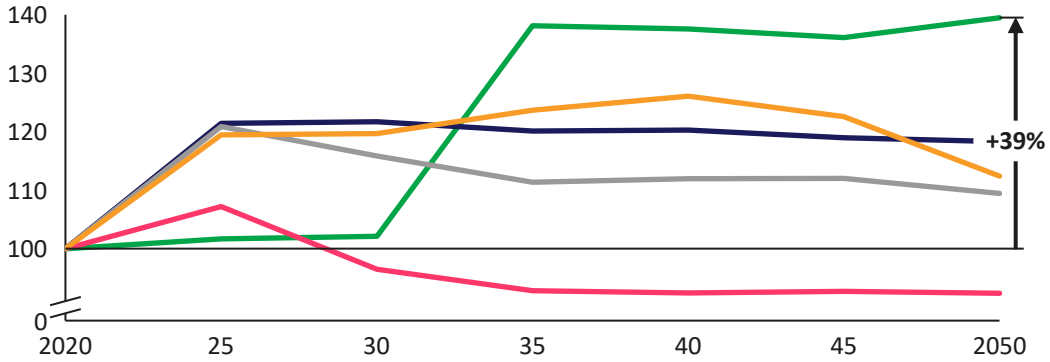
Protected areas | Food waste reductions | GHG Prices | Input efficiency | Bioenergy pathway | Diet shifts | Yield-enhancing tech

Soybean, Global, Production (Mt DM yr.) and Indexed Prices (2020=100)

Global Production



Global Prices



Scenario-specific values and rationale

Scenarios	Rationale
>3ºC Historic Trends	Global production increases linearly from 2020-2050 as population and income grow, leading to higher demand for food. Initially cheap, cropland expansion becomes more costly around 2030 as land scarcity increases competition. The cost increase is passed through to farmgate prices.
Climate Transition Scenarios	Production increases from 2020-2050 under climate transition scenarios as population and income grow.
1.5ºC Societal Transformation	Diet shift is higher, leading to less feed for animals. The effect is not offset by higher use for human diets as a substitute to animal proteins. Prices decrease as other commodities are substituted for vegetable-based oils
1.5ºC Innovation	**Former Soviet Union and EU & UK:** High increases in innovation decrease prices through 2050, despite high GHG prices

Soybean: production trends by region

Oil crops

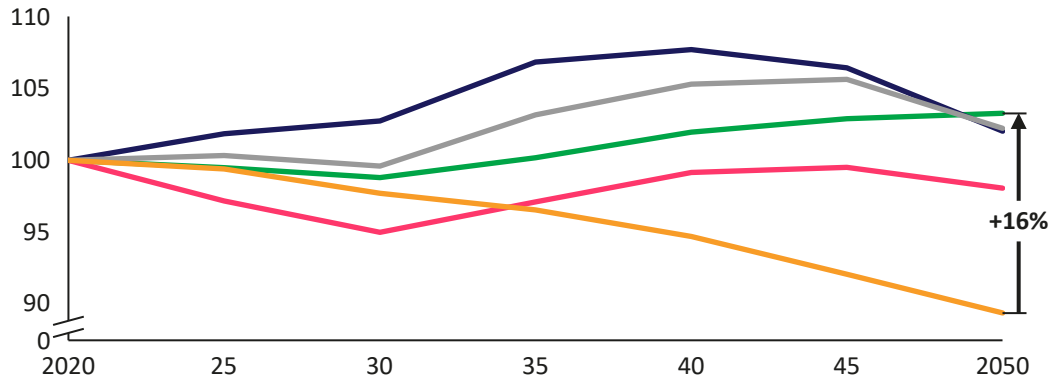
Soybean can be used to produce animal feed, food (alt proteins), and biofuel

>3ºC Historic Trends | <2ºC IPR Forecast Policy | 1.5ºC Societal Transformation | <2ºC Coordinated | 1.5ºC Innovation

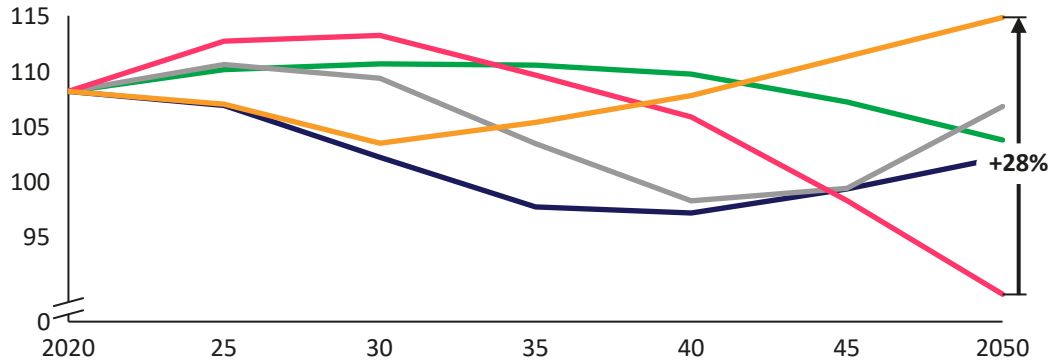
Protected areas | Food waste reductions | GHG Prices | Input efficiency | Bioenergy pathway | Diet shifts | Yield-enhancing tech

Soybean in selected markets, Production (Mt DM yr.)

USA



Brazil



Scenario-specific values and rationale

Scenarios	Rationale
>3ºC Historic Trends	**USA:** Production remains like today's trends due to soybeans' versatile use for both feed and food. **Brazil:** Production increases due to increases in feed demand for meat production
<2ºC Forecast Policy (IPR) **<2ºC Coordinated**	**USA & Brazil:** The increase in soy demand for vegetable oils and alternative proteins offsets the decrease in soy demand for animal feed and fuel, stabilizing demand around today's levels by 2050.
1.5ºC Innovation	**Brazil:** Production falls due to a shift towards 2nd generation bioenergy production and a slight decline in demand for animal feed. Additionally, the increase competitive advantage from temperate oils reduces exports of tropical oils to Europe and Russia. **USA:** Production remains constant as an increase in biofuel production and alt. proteins balances a decrease in animal feed production
1.5ºC Societal Transformation	**USA:** Production decreases substantially as land protection policies in the US decrease exports. **Brazil:** Though Brazil faces strict area protection regulations, higher productivity and reduced demand for animal products free-up enough land to increase production for exports.

Soybean: price trends by region

Oil crops

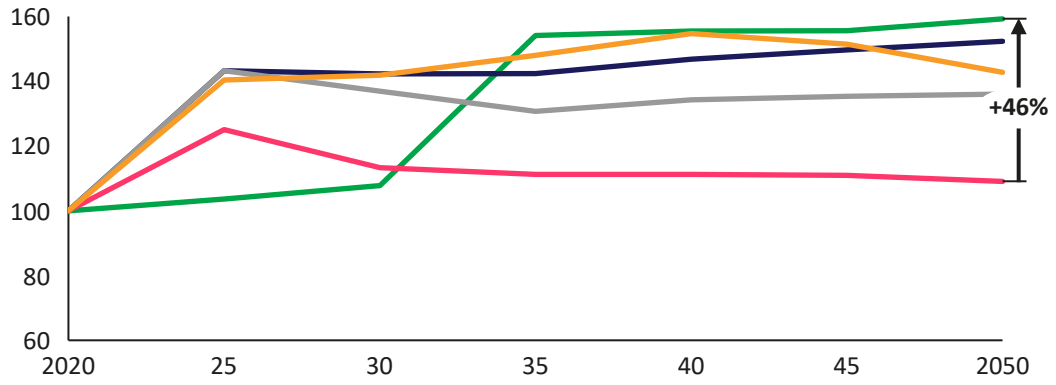
Soybean can be used to produce food (alt proteins) as well as fuel

>3ºC Historic Trends | <2ºC IPR Forecast Policy | 1.5ºC Societal Transformation | <2ºC Coordinated | 1.5ºC Innovation

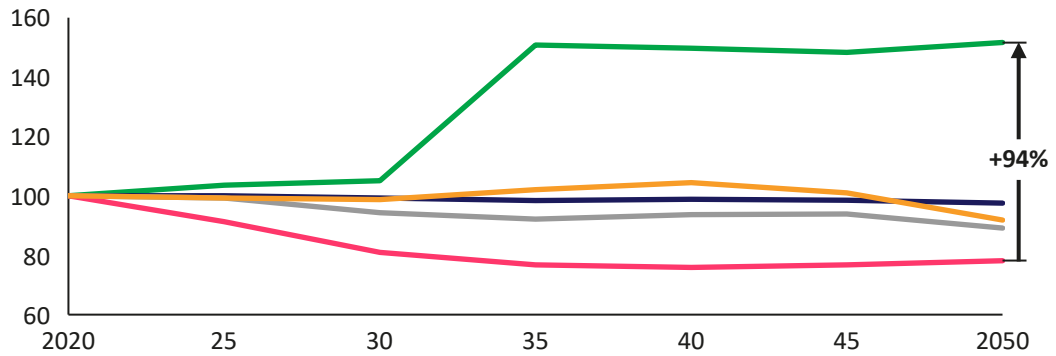
Protected areas | Food waste reductions | GHG Prices | Input efficiency | Bioenergy pathway | Diet shifts | Yield-enhancing tech

Soybean in selected markets, Indexed Prices (2020=100)

USA



Brazil



Scenario-specific values and rationale

Scenarios	Rationale
>3ºC Historic Trends	**USA & Brazil:** Initially cheap, cropland expansion becomes more costly around 2030 as land scarcity increases competition. The cost increase is passed through to farmgate prices
<2ºC Forecast Policy (IPR) **<2ºC Coordinated**	**USA:** Climate action increases prices across all scenarios between 2020 and 2025. After 2025, yield growth and input efficiency offset the effect of GHG price growth, leading to a stabilization in commodity prices **Brazil:** Moderate increases in input efficiency and yield-enhancing technology decrease prices are not enough to offset the increase in GHG prices which remain stable through to 2050 Prices are lower in the **Forecast Policy** scenario because Brazil doesn't set ambitious climate policies
1.5ºC Innovation	**USA:** After 2025, innovation in input efficiency and yield-enhancing technology reduces input and land costs, pushing down prices despite the high emission costs **Brazil:** Prices decline as innovation in yield enhancing technologies reduce land competition
1.5ºC Societal Transformation	**USA & Brazil:** Moderate increases in input efficiency and yield-enhancing technology reduces pressures on the land use system, but high GHG prices raise and strict area protection regulation increase costs for the agricultural sector. These opposing forces cause a slight increase in price 2030-2040, when area protection increases are concentrated

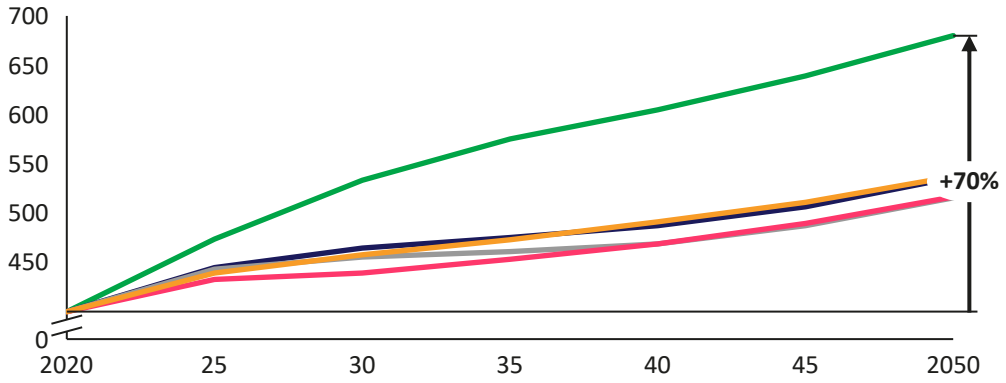
Oil Palms: Production rises but food waste declines alongside reduced demand for first generation biofuels slow growth under climate transitions

Oil crops

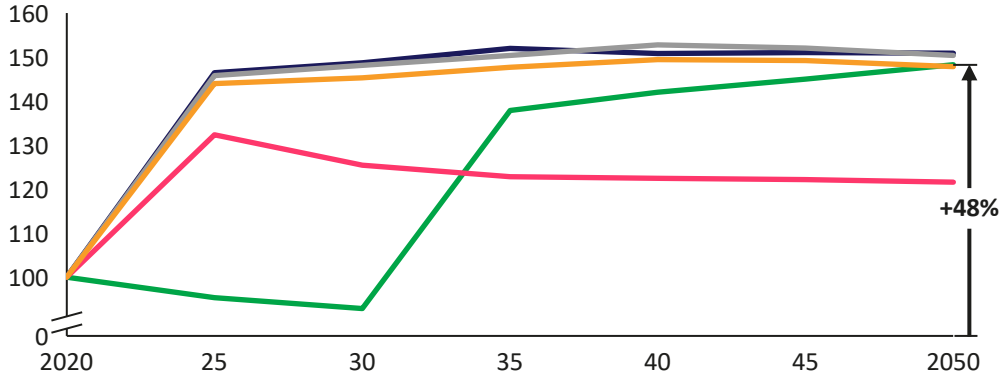
>3ºC Historic Trends <2ºC IPR Forecast Policy 1.5ºC Societal Transformation
<2ºC Coordinated 1.5ºC Innovation

Oil Palms, Global, Production (Mt DM yr.) and Indexed Prices (2020=100)

Global Production



Global Prices



Scenario-specific values and rationale

Scenarios	Rationale
>3ºC Historic Trends	Demand for vegetable oils for food and fuel production keeps growing with population.
Climate Transition Scenarios	Prices increase above historic trends in the first decade, as climate policies and regulation increase pressure on the land use system in SEA, where most palm oil is produced.
<2ºC Forecast Policy (IPR)	Food waste reduction reduces palm oil demand. A shift away from livestock products increases demand.
<2ºC Coordinated	
1.5ºC Societal Transformation	Demand from plant-based products keeps palm oil demand high, until it is eventually offset by lower food waste.
1.5ºC Innovation	Food waste reduction decreases palm oil demand. High GHG prices reduce production incentives for palm oil around tropical rainforests. High investments in yield-enhancing technologies result in yield growth lowering prices

Oil palm: production trends by region

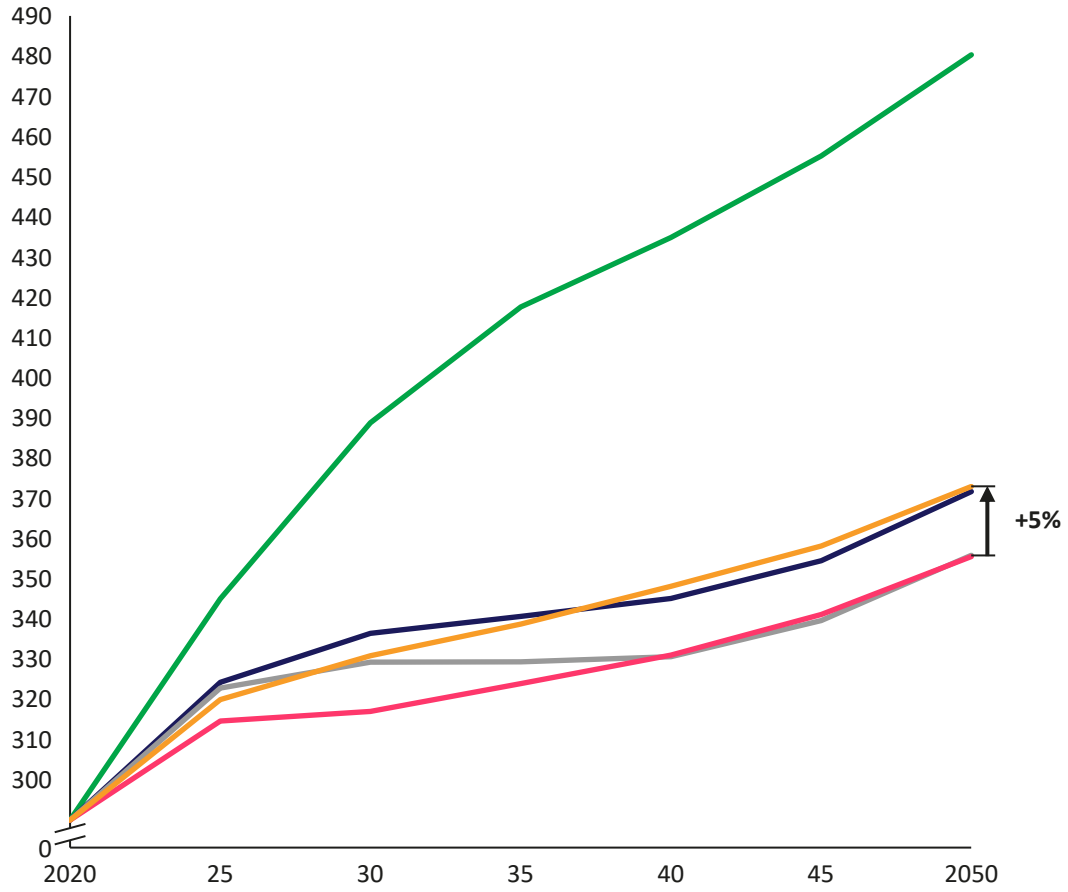
Oil crops

Oil palm is used to produce palm oil, a vegetable edible oil often used in plant-based products as a substitute for animal fat

>3°C Historic Trends | <2°C IPR Forecast Policy | 1.5°C Societal Transformation | <2°C Coordinated | 1.5°C Innovation

Protected areas | Food waste reductions | GHG Prices | Input efficiency | Bioenergy pathway | Diet shifts | Yield-enhancing tech

Oil palm in Southeast Asia, Production (Mt DM yr.)



Scenario-specific values and rationale

Scenarios	Rationale
>3°C Historic Trends	Demand for vegetable oils for food and fuel production keeps growing with population.
<2°C Forecast Policy (IPR)	Food waste reduction reduces palm oil demand. A shift in demand away from livestock products increases demand for plant-based products.
<2°C Coordinated	Due to differences in protected areas, in the 2°C Coordinated Scenario, the EU and UK substitute oil palm for rapeseed in vegetable oil production, causing a slightly higher demand for oil palm from Southeast Asia under the 2°C Coordinated Scenario relative to the 2°C Forecast Policy (IPR) Scenario.
1.5°C Societal Transformation	Demand from plant-based products keeps palm oil demand high, until it is eventually offset by lower food waste.
1.5°C Innovation	Food waste reduction decreases palm oil demand. High GHG prices reduce production incentives for palm oil around tropical rainforests. High investments in yield-enhancing technologies result in yield improvements in high-income countries like in Europe. The increase in production from the additional yield increases the use of local oil crops (e.g. rapeseed) to produce vegetable oils and reduces the demand for tropical oil crops.

Oil palm: price trends by region

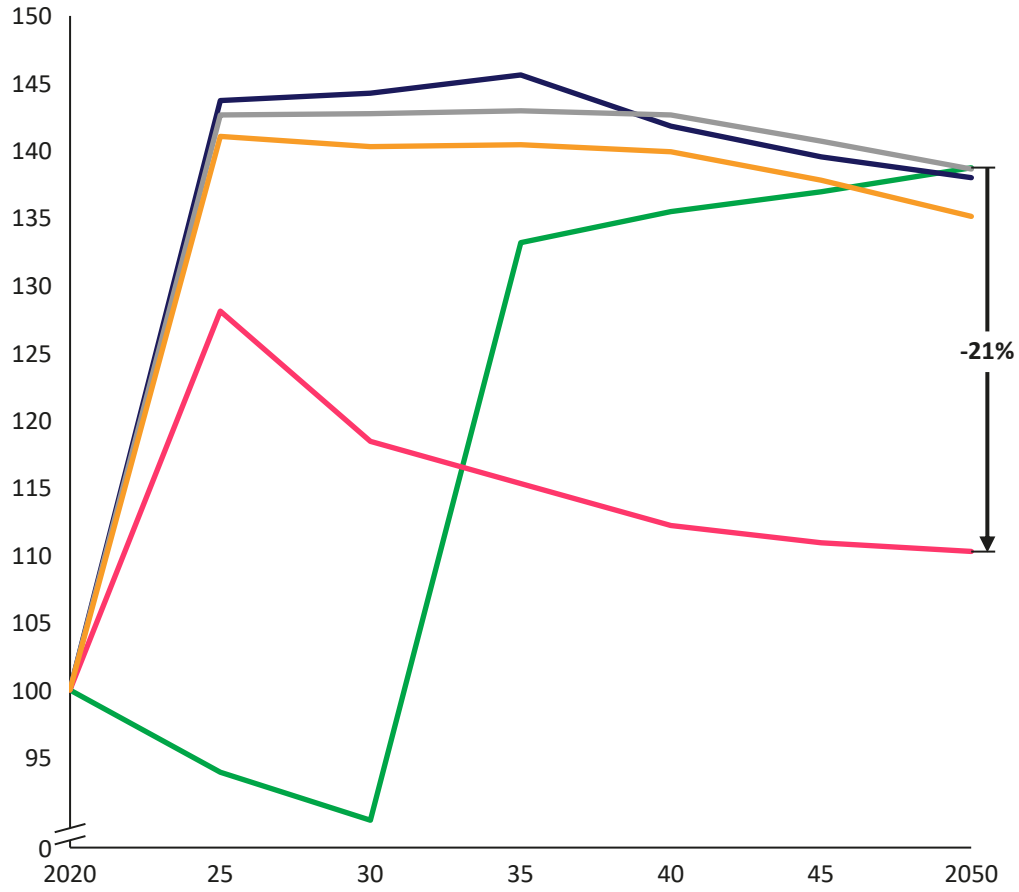
Oil crops

Oil palm is used to produce palm oil, a vegetable edible oil often used in plant-based products as a substitute for animal fat

>3ºC Historic Trends | <2ºC IPR Forecast Policy | 1.5ºC Societal Transformation | <2ºC Coordinated | 1.5ºC Innovation

Protected areas | Food waste reductions | GHG Prices | Input efficiency | Bioenergy pathway | Diet shifts | Yield-enhancing tech

Oil palm in Southeast Asia, Indexed Prices (2020=100)



Scenario-specific values and rationale

Scenarios	Rationale
>3ºC Historic Trends	Initially cheap, cropland expansion becomes more costly around 2030 as land scarcity increases competition. The cost increase is passed through to farmgate prices.
Climate Transition Scenarios	Climate action increases prices through 2025, across all transition scenarios. In 2025, technological innovation coupled with lower, relative, demand stabilizes prices through 2050.
1.5ºC Innovation	Prices are lowest due to increased yields reducing land competition and related production costs.

Cotton Seed: Production growth rate slows from a decline in food waste and demand for feed, in which cotton seed is a key input

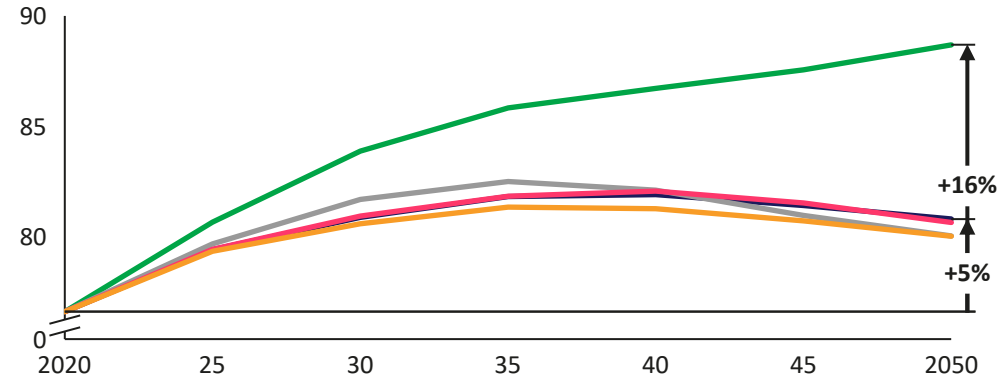
Oil crops

Cotton Seed is mostly used to produce feed and fiber

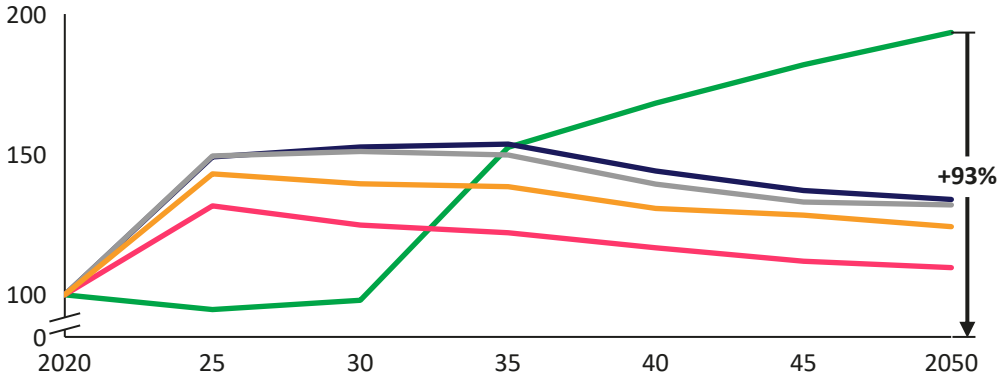
>3ºC Historic Trends <2ºC IPR Forecast Policy 1.5ºC Societal Transformation
<2ºC Coordinated 1.5ºC Innovation

Cotton Seed, Global, Production (Mt DM yr.) and Indexed Prices (2020=100)

Global Production



Global Prices



Scenario-specific values and rationale

Scenarios	Rationale
>3ºC Historic Trends	Global production increases linearly from 2020-2050 as population and income grow, leading to higher demand for food, feed and fiber. Initially cheap, cropland expansion becomes more costly around 2030 as land scarcity increases competition. The cost increase is passed through to farmgate prices.
Climate Transition Scenarios	In the first decades, prices under the transition scenarios increase above Historic trends as climate policies and regulation increase pressure on the land use system. As the effect of food waste reductions and diet shifts puts downward pressure on demand for feed, both prices and production stabilize.
1.5ºC Innovation	Prices are lowest under due to increased yields reducing land competition.

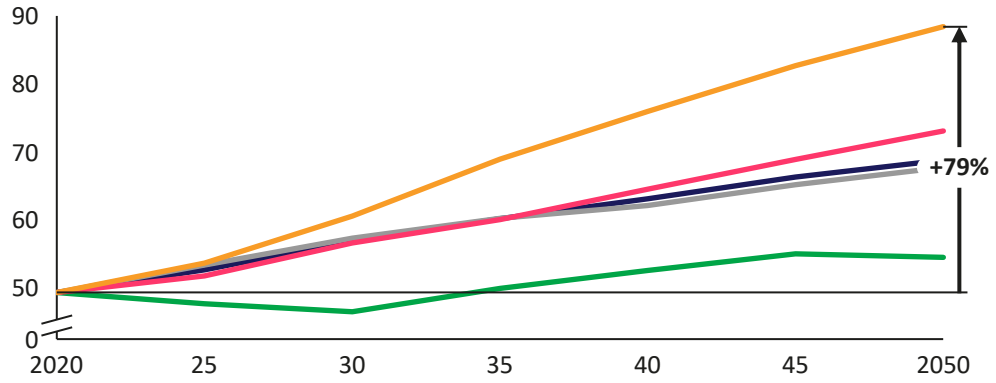
Groundnuts: Production growth rises under climate transitions as diets shift towards plant-based proteins in which groundnuts are a key ingredient

Oil crops

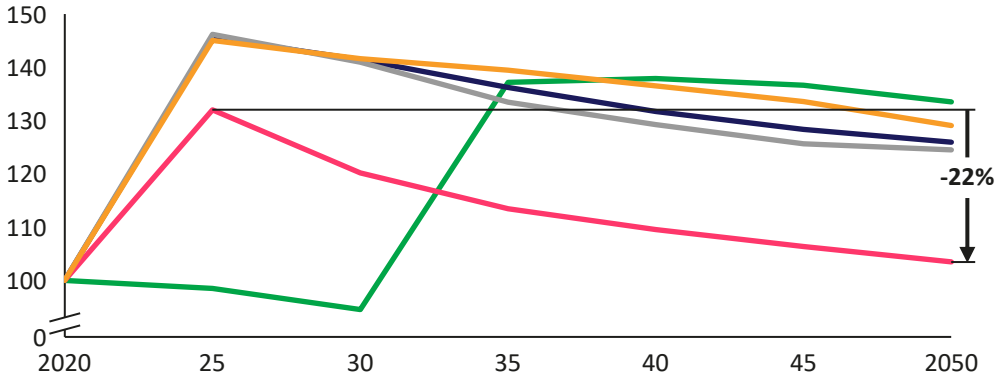
>3ºC Historic Trends <2ºC IPR Forecast Policy 1.5ºC Societal Transformation
<2ºC Coordinated 1.5ºC Innovation

Groundnuts, Global, Production (Mt DM yr.) and Indexed Prices (2020=100)

Global Production



Global Prices



Scenario-specific values and rationale

Scenarios	Rationale
>3ºC Historic Trends	Production growth is small due to lack of diet shifts. Initially cheap, cropland expansion becomes more costly around 2030 as land scarcity increases competition. The cost increase is passed through to farmgate prices.
Climate Transition Scenarios	Prices under the transition scenarios increase above Historic Trends in the first decades as climate policies and regulation increase pressure on the land use system. Groundnuts are a key commodity for shifts in diet, raising their prices through 2050.
1.5ºC Societal Transformation	Production is high as this is a key commodity for shifts in diets. Prices are higher due to additional land constraints from area protection
1.5ºC Innovation	Prices are lowest, relative to other scenario, due to increased yield growth

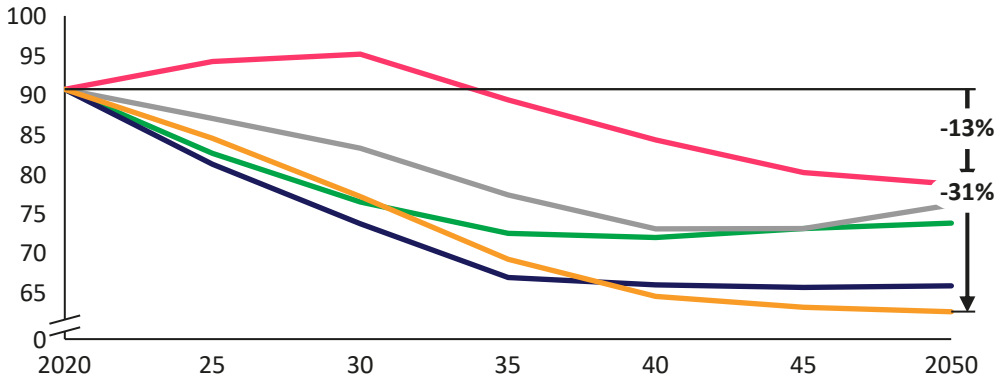
Other Oil Crops (incl. Rapeseed): Production decreases across all scenarios due to increasing demand and cost competitiveness for tropical substitutes

Oil crops

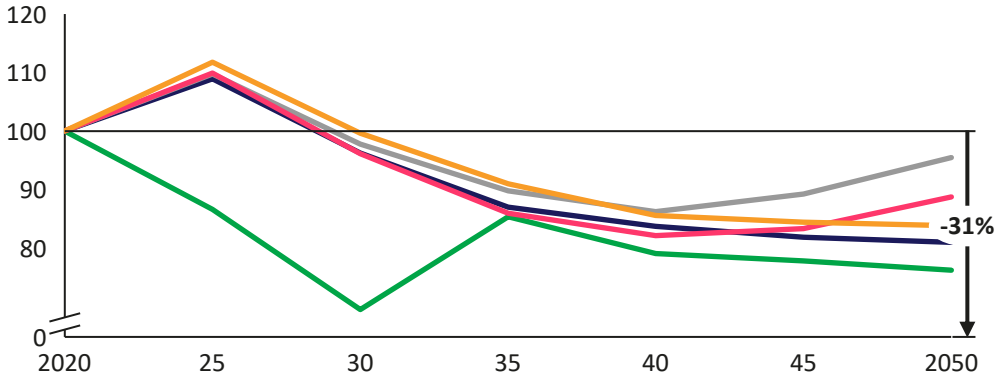
>3ºC Historic Trends <2ºC IPR Forecast Policy 1.5ºC Societal Transformation
<2ºC Coordinated 1.5ºC Innovation

Groundnuts, Global, Production (Mt DM yr.) and Indexed Prices (2020=100)

Global Production



Global Prices



Scenario-specific values and rationale

Scenarios	Rationale
>3ºC Historic Trends	Production declines, as lack of climate action and biodiversity protection makes the use of tropical oil crops relatively cheaper. Prices fluctuate following changes in land competition and land conversion costs in temperate regions: land conversion costs increase with land competition, leading to higher prices after 2030.
<2ºC Forecast Policy (IPR)	Production remains at or above Historic Trends through 2050, as lack of climate action and conservation in Eastern Europe and Russia reduces land competitions in temperate regions. This increases the competitive advantage of oils produced using temperate oil crops, such as rapeseed, increasing demand for these crops. The additional demand increased both production and prices above historic trends.
<2ºC Coordinated **1.5ºC Societal Transformation**	Under 2ºC Coordinated and 1.5ºC Societal Transformation, temperate regions face increasing land competition as climate action intensifies and yield growth remains at historic levels.
1.5ºC Innovation	Production is relatively higher as yield enhancing technologies increase the competitiveness of “Temperate” oil crops, by reducing land competition in Europe.

Content

Sugar Crops

Sugar crops

Potential risk Future opportunity

Key Drivers

Diet shifts

- Shifts in diets away from animal proteins will reduce the use of sugarcane for feed production

Increases demand for vegetable oils

Reduces feed demand

Food waste reductions

- By 2050, food waste will be reduced by 40-50% under climate transitions, leading to a substantial decrease in demand, particularly in high-income regions

Reduces land competition

Reduces food demand

Population and Income Growth

- Population and income growth causes increased demand, which leads to production increases across all scenarios

Increase demand for sugar crops

Yield growth

- By 2050, average crop yields could increase up to 69% globally. Yield growth will reduce land competition and prices for sugar crops

Reduces land competition due to higher yield crops

Key Trends

Prices

- Prices for sugar crops are 20%-60% higher under Historic Trends because food waste reductions cause demand growth to slow under transition scenarios

Production

- Sugar crop production increases with rising incomes and populations, but remains 11%-18% below Historic Trends in all climate transition scenarios due to food waste reductions and diet shifts

Sugar Cane: Reductions in food waste and first-generation bioenergy demand slow production growth under climate transitions

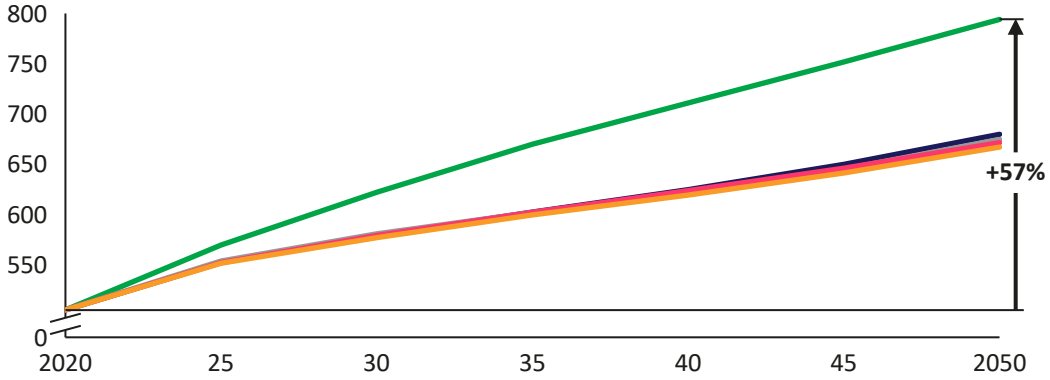
Sugar crops

>3ºC Historic Trends | <2ºC IPR Forecast Policy | 1.5ºC Societal Transformation | <2ºC Coordinated | 1.5ºC Innovation

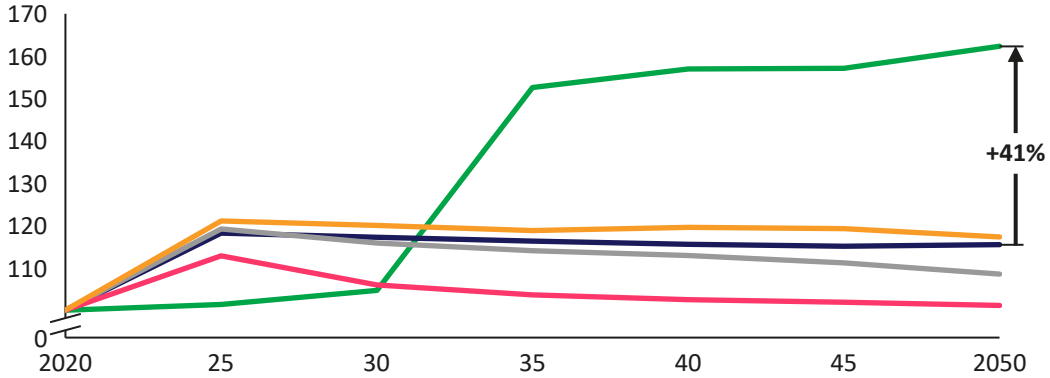
Protected areas | Food waste reductions | GHG Prices | Input efficiency | Bioenergy pathway | Diet shifts | Yield-enhancing tech

Sugar Cane, Global, Production (Mt DM yr.) and Indexed Prices (2020=100)

Global Production



Global Prices



Scenario-specific values and rationale

Scenarios	Rationale
>3ºC Historic Trends	Global production increases linearly from 2020-2050 as population and incomes grow, leading to higher demand for food. Initially cheap, cropland expansion becomes more costly around 2030 as land scarcity increases competition, although land is not as constrained in tropical regions. The cost increase is passed through to farmgate prices.
Climate Transition Scenarios	Production increases across most transition scenarios after 2020 as tropical regions are not as land constrained. Prices under transition scenarios increase above historical trends in the first decade, as climate policies and regulation increase pressure on the land use system.
<2ºC Forecast Policy (IPR)	2ºC IPR is lower than 2ºC Coordinated because climate action is less ambitious in Brazil, India, Tropical Africa, and Southeast Asia, where sugar cane is largely produced.
<2ºC Coordinated	2ºC Coordinated has the second highest prices, as climate action is orderly and moderately ambitious, but there is no land use mechanism strong enough to fully offset its effect on land competition (e.g. productivity increase / demand reductions).
1.5ºC Societal Transformation	1.5ºC Social Transformation has the highest prices because of the additional land constraints coming from ambitious area protection.
1.5ºC Innovation	1.5ºC Innovation has the lowest price as the yield growth offsets the increase in land competition brought on by ambitious climate action and area protections not as strong as under 1.5ºC Societal Transformation.

Sugar Cane: production trends by region

Sugar crops

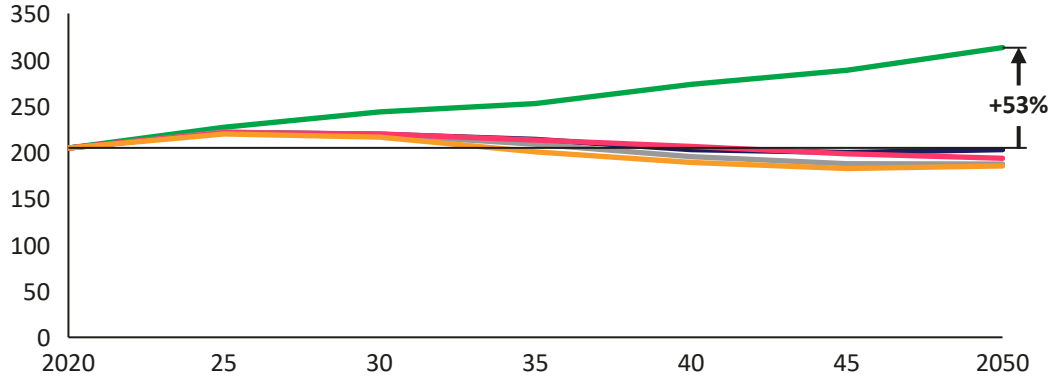
Sugar cane can be used to produce sugar and biofuels

>3ºC Historic Trends | <2ºC IPR Forecast Policy | 1.5ºC Societal Transformation | <2ºC Coordinated | 1.5ºC Innovation

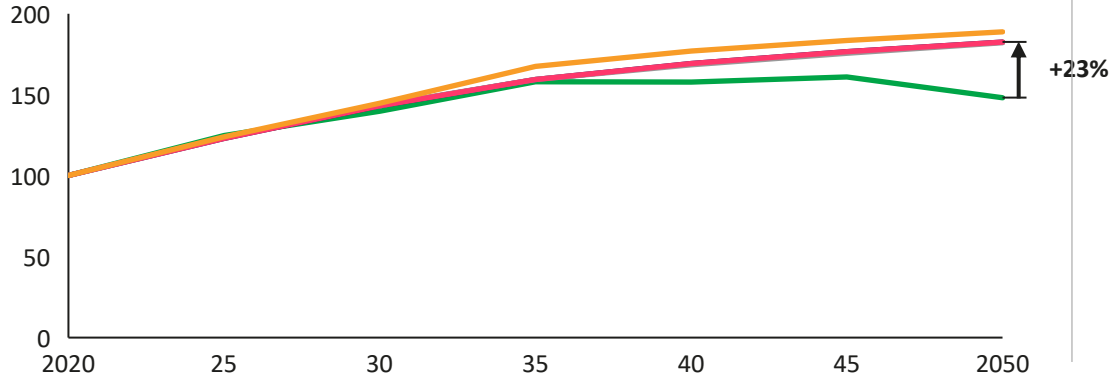
Protected areas | Food waste reductions | GHG Prices | Input efficiency | Bioenergy pathway | Diet shifts | Yield-enhancing tech

Sugar Cane in select markets, Production (Mt DM yr.)

Brazil



India



Scenario-specific values and rationale

Scenarios	Rationale
>3ºC Historic Trends	**Brazil:** Sugar cane production follows demand and grows with population and income. **India:** Although sugar cane demand grows with population and income, production declines as the country becomes a net-importer.
Climate Transition Scenarios	**Brazil:** Production decreases due to a shift towards alternative proteins and a decline in feed demand. **India:** Under all action scenarios, tropical regions face additional land constraints due to area protection and climate policies and regulation. This leads to an increase in land and production costs for most agricultural commodities, increasing the comparative advantage of Indian sugar cane relative to Historic Trends. Consequently, India becomes a net exporter and production increases.

Sugar Cane: price trends by region

Sugar cane can be used to produce sugar as well as fuel

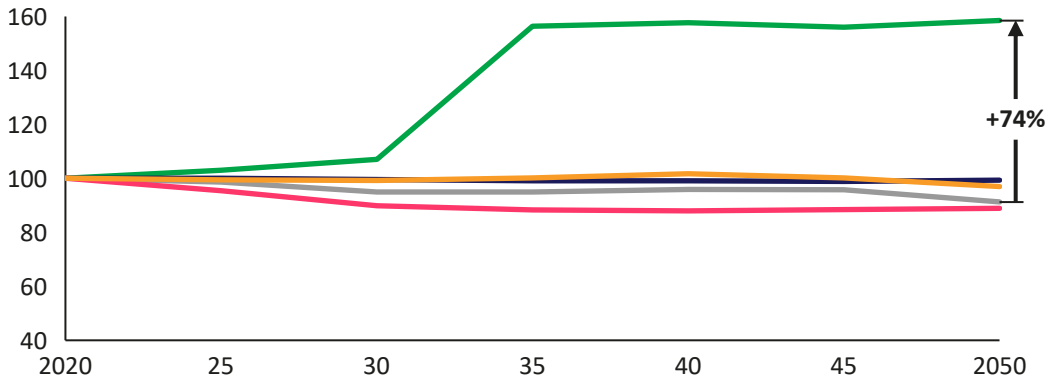
Sugar crops

>3ºC Historic Trends | <2ºC IPR Forecast Policy | 1.5ºC Societal Transformation | <2ºC Coordinated | 1.5ºC Innovation

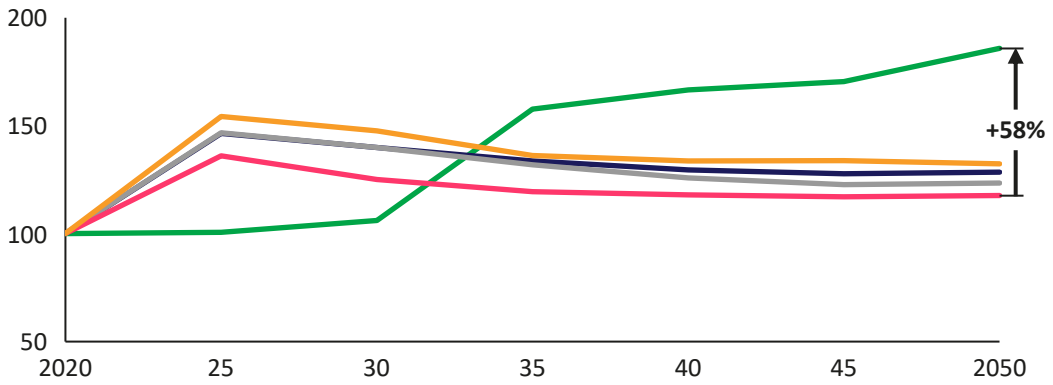
Protected areas | Food waste reductions | GHG Prices | Input efficiency | Bioenergy pathway | Diet shifts | Yield-enhancing tech

Sugar Cane in selected markets, Indexed Prices (2020=100)

Brazil



India



Scenario-specific values and rationale

Scenarios	Rationale
>3ºC Historic Trends	**Brazil and India:** Initially cheap, cropland expansion becomes more costly around 2030 as land scarcity increases competition, although land is not as constrained in tropical regions. The cost increase is passed through to farmgate prices.
Climate Transition Scenarios	**Brazil:** Prices under transition scenarios remain below Historic Trends, as demand stays flat throughout and technological innovation offsets the increase of transition costs. **India:** Prices under transition scenarios initially increase above historical trends in the first decade, as climate policies and regulation increase pressure on the land use system. Prices peak in 2025 as technological innovation helps reduce costs for producers and decline thereafter.

Sugar Beet: Reductions in food waste and first-generation bioenergy demand slow production growth under climate transitions

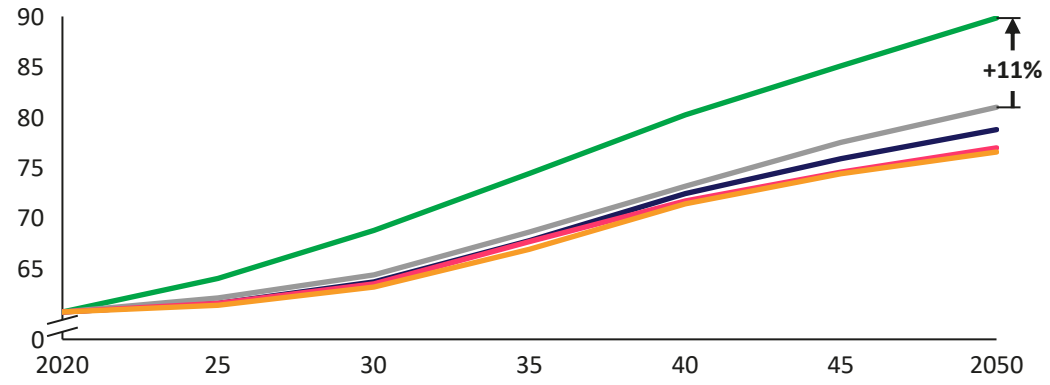
Sugar crops

>3ºC Historic Trends | <2ºC IPR Forecast Policy | 1.5ºC Societal Transformation | <2ºC Coordinated | 1.5ºC Innovation

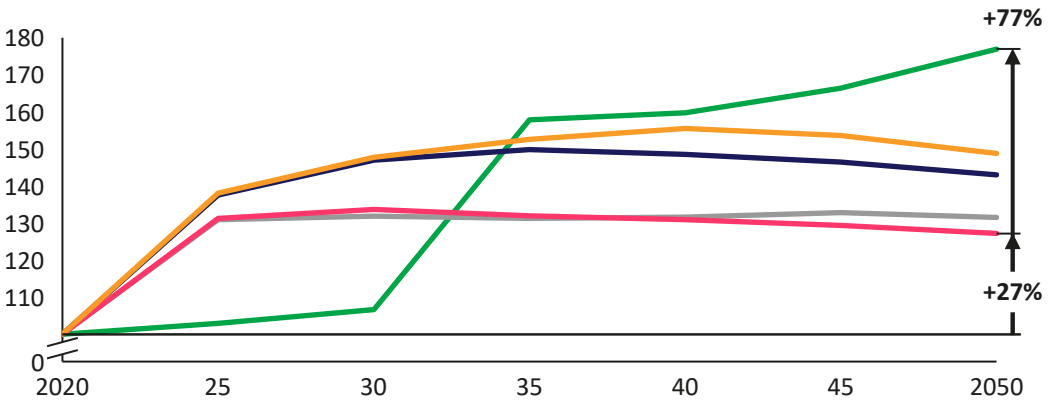
Protected areas | Food waste reductions | GHG Prices | Input efficiency | Bioenergy pathway | Diet shifts | Yield-enhancing tech

Sugar Beet, Global, Production (Mt DM yr.) and Indexed Prices (2020=100)

Global Production



Global Prices



Scenario-specific values and rationale

Scenarios	Rationale
>3ºC Historic Trends	Global production increases linearly from 2020-2050 as population and income grow, leading to higher demand for food. Initially cheap, cropland expansion becomes more costly around 2030 as land scarcity increases competition, although land is not as constrained in tropical regions. The cost increase is passed through to farmgate prices.
Climate Transition Scenarios	Production increases across most transition scenarios after 2020 as tropical regions are not as land constrained. Prices under transition scenarios increase above historical trends in the first decade, as climate policies and regulation increase pressure on the land use system.
<2ºC Forecast Policy (IPR)	2ºC IPR is lower than 2ºC Coordinated because climate action is less ambitious in large producing regions such as: Middle East & Northern Africa, Russia, and the Former Soviet Union, reducing land competition
<2ºC Coordinated	2ºC Coordinated has the second highest prices, as climate action is orderly and moderately ambitious, but there is no land use mechanism strong enough to fully offset its effect on land competition (e.g. productivity increase / demand reductions)
1.5ºC Societal Transformation	1.5ºC Social Transformation has the highest prices because of the additional land constraints coming from ambitious area protection
1.5ºC Innovation	1.5ºC Innovation has the lowest price as the yield growth offsets the increase in land competition brought on by ambitious climate action and area protections not as strong as under 1.5ºC Societal Transformation

Content

Scenarios and scope

Commodities Overview

- Cereals
- Oil Crops
- Sugar Crops
- **Other Crops**
- Animal Products
- Forest Products

Other Crops

Four Other Crop commodities include Fruits, Vegetables, and Nuts, Potatoes, Pulses, and Tropical Fruits

Potential risk Future opportunity

Key Drivers

Food waste reductions

- By 2050, food waste will reduce 40-50% under transition scenarios, leading to a substantial decrease in demand, particularly in high-income regions

Reduces land competition

Reduces food demand

GHG prices

- GHG pricing will increase the cost of production, particularly in scenarios/regions with high GHG prices

Increase agricultural production costs

Diet shifts

- Shifts in diets away from animal proteins will reduce the use of for feed production.
- The need for protein alternatives will increase use of pulses for food demand

Increases demand for vegetable oils

Reduces feed demand

Yield growth

- By 2050, average crop yields could increase up to 69% globally under transition scenarios. Yield growth will reduce land competition and prices, particularly in high-income regions

Reduces land competition

Key Trends

Prices

- Other Crops prices under transition scenarios increase above Historic Trends in the first decade as climate policies increase pressure on the land use system.

Production

Trends in production of Other Crops vary substantially by commodity:

- Diet shift is a key driver for pulses' productions, as it increases demand and production
- Production of fruits, nuts and vegetables, potatoes and tropical roots is lower under transition scenarios as food waste reductions lead to a decline in demand relative to Historic Trends

Fruits, Vegetables, and Nuts: Reductions in food waste slow production growth slightly under climate transitions

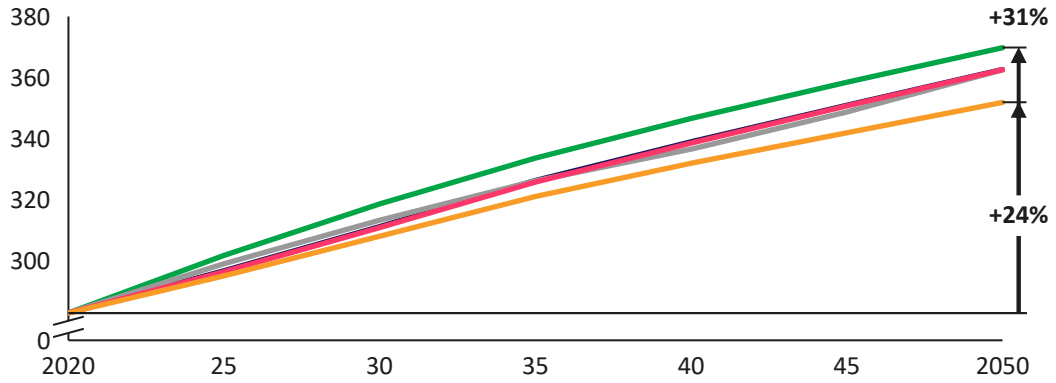
Other Crops

>3ºC Historic Trends | <2ºC IPR Forecast Policy | 1.5ºC Societal Transformation | <2ºC Coordinated | 1.5ºC Innovation

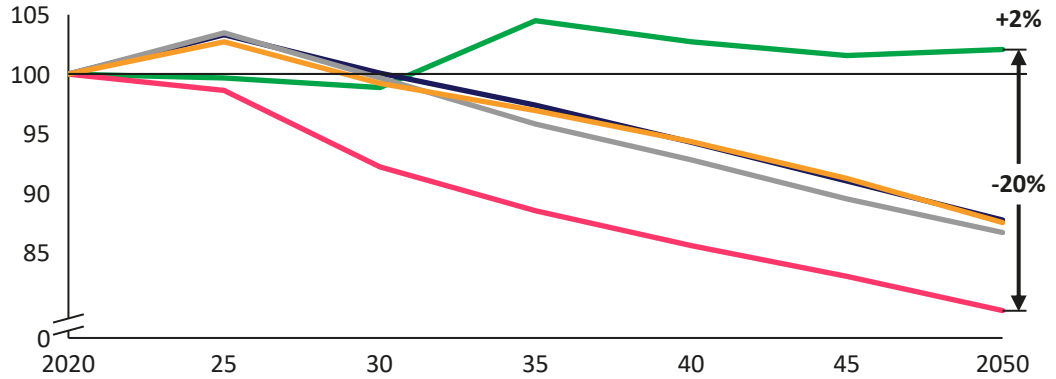
Protected areas | Food waste reductions | GHG Prices | Input efficiency | Bioenergy pathway | Diet shifts | Yield-enhancing tech

Fruits, Vegetables, and Nuts, Global, Production (Mt DM yr.) and Indexed Prices (2020=100)

Global Production



Global Prices



Scenario-specific values and rationale

Scenarios	Rationale
>3ºC Historic Trends	Global production increases linearly from 2020-2050 as population and income grow, leading to higher demand for food. Land competition dynamics create price fluctuations: land expansion becomes expensive around 2030, requiring additional investments in expensive yield-enhancing technologies and practices. After 2035, prices stabilize above 2020 levels as productivity growth benefits from the investments in innovation reducing land conversion costs.
Climate Transition Scenarios	Production increases from 2020-2050 under the transition scenarios as population and income grow. In the first decade, Prices remain above Historic Trends, as climate policies harshen land constraints and demand grows. Food waste reductions, however, bring demand growth below Historic Trends, with a positive effect on long term land competition and prices, which decline below 2020 levels after 2030.
1.5ºC Innovation	Prices decrease from 2020-2050 high productivity growth reduces land competition and land conversion costs.

Potatoes: Reductions in food waste slow production growth under climate transitions

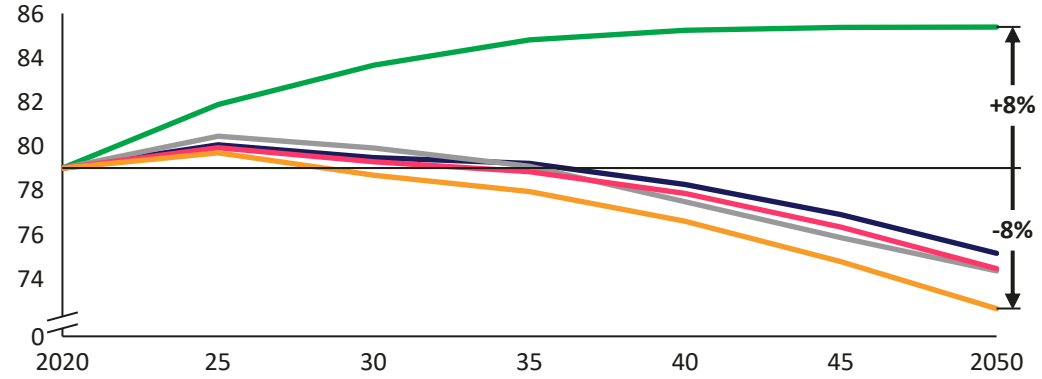
Other Crops

>3ºC Historic Trends | <2ºC IPR Forecast Policy | 1.5ºC Societal Transformation | <2ºC Coordinated | 1.5ºC Innovation

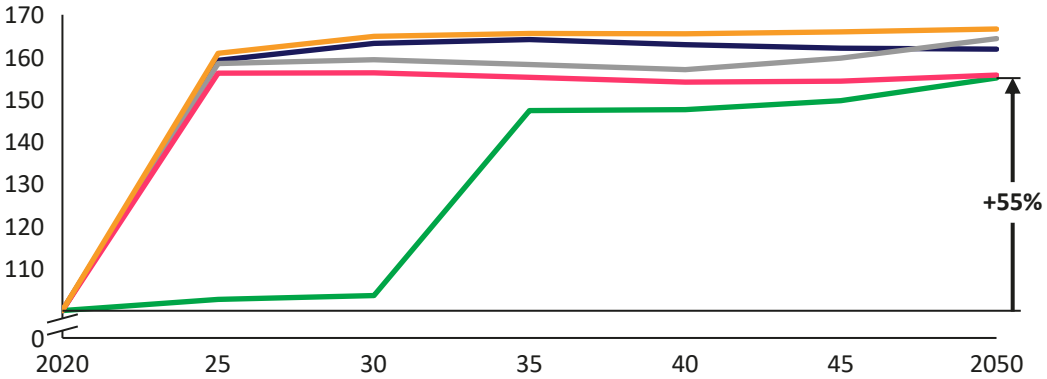
Protected areas | Food waste reductions | GHG Prices | Input efficiency | Bioenergy pathway | Diet shifts | Yield-enhancing tech

Potatoes, Global, Production (Mt DM yr.) and Indexed Prices (2020=100)

Global Production



Global Prices



Scenario-specific values and rationale

Scenarios	Rationale
>3ºC Historic Trends	Global production grows with population and income up to 2035, when the decline in population in key markets, such as Greater China and Europe, reduces demand.
Climate Transition Scenarios	Food waste reductions hamper demand growth, leading to production levels below Historic Trends. Nevertheless, the initial demand growth leads to a substantial increase in prices, as climate action increases land conversion costs in key regions such as Europe and China. Around 2025, the combination of waste reductions and diet shifts away from animal products offset the effect of population and income growth, leading to a decline in demand. As a consequence, production declines below 2020 levels across all transition scenarios and prices stabilize at their 2025 levels.

Pulses: Despite food waste reductions, production grows faster under climate transitions as diets shifts towards plant-based proteins such as pulses

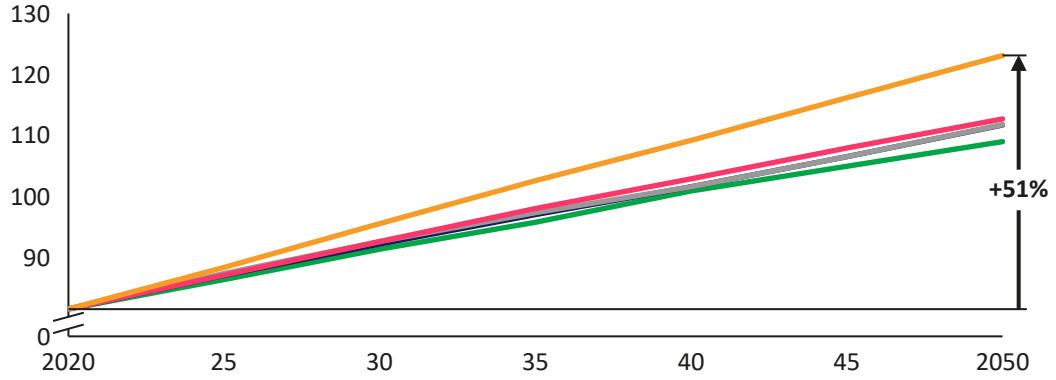
Other Crops

>3ºC Historic Trends | <2ºC IPR Forecast Policy | 1.5ºC Societal Transformation | <2ºC Coordinated | 1.5ºC Innovation

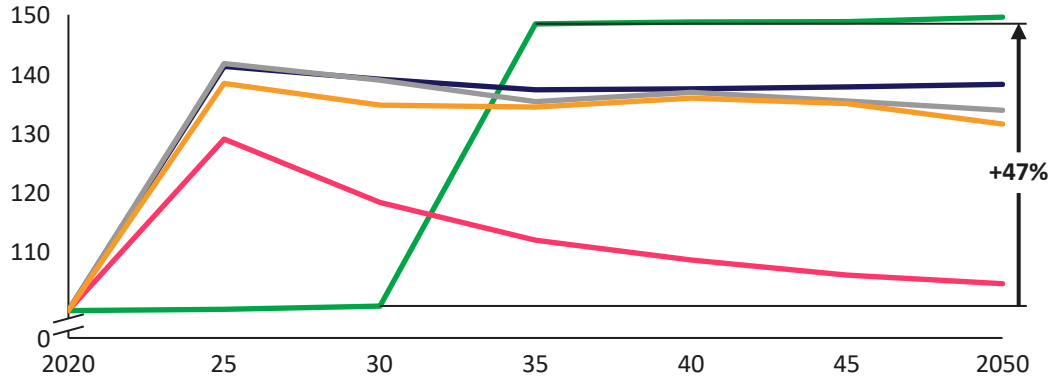
Protected areas | Food waste reductions | GHG Prices | Input efficiency | Bioenergy pathway | Diet shifts | Yield-enhancing tech

Pulses, Global, Production (Mt DM yr.) and Indexed Prices (2020=100)

Global Production



Global Prices



Scenario-specific values and rationale

Scenarios	Rationale
>3ºC Historic Trends	Global production increases linearly from 2020-2050 as population and income grow, leading to higher demand for food. Initially cheap, cropland expansion becomes more costly around 2030 as land scarcity increases competition. The cost increase is passed through to farmgate prices.
Climate Transition Scenarios	Production increases form 2020-2050 under all transition scenarios due to diet shifts and the fact the largest producers are tropical regions, which are not as land constrained, leading to reduced land competition. Prices under transition scenarios increase above historical trends in the first decade, as climate policies and regulation increase pressure on the land use system.
1.5ºC Societal Transformation	Production increases due to high diet shifts, as pulses are a key protein substitute. Prices remain relatively flat after 2025 as demand continues to grow increasing land competition.
1.5ºC Innovation	Prices decrease because high yield growth reduces land competition. A reduced diet shift also reduces demand.

Tropical Roots: Reductions in food waste slow production growth under climate transitions

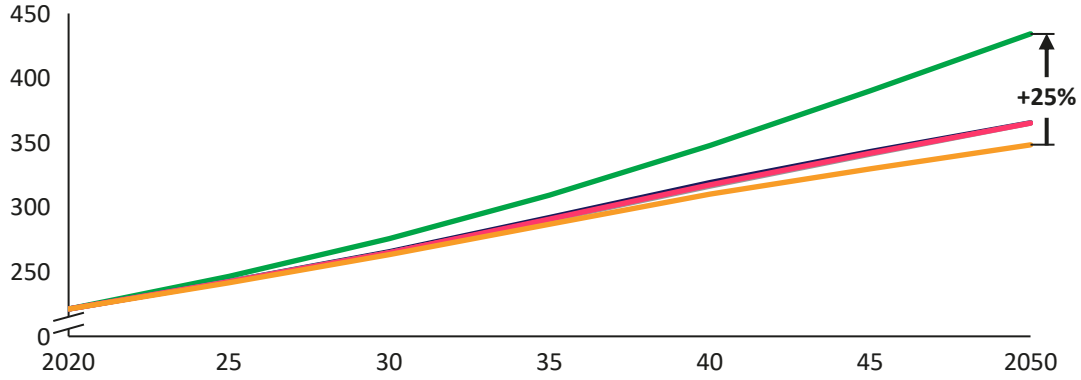
Other Crops

>3ºC Historic Trends | <2ºC IPR Forecast Policy | 1.5ºC Societal Transformation | <2ºC Coordinated | 1.5ºC Innovation

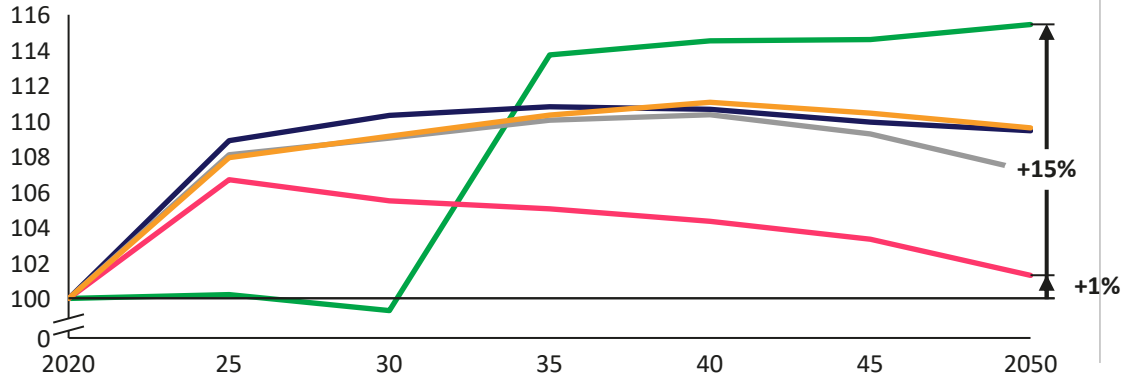
Protected areas | Food waste reductions | GHG Prices | Input efficiency | Bioenergy pathway | Diet shifts | Yield-enhancing tech

Tropical Roots, Global, Production (Mt DM yr.) and Indexed Prices (2020=100)

Global Production



Global Prices



Scenario-specific values and rationale

Scenarios	Rationale
>3ºC Historic Trends	Global production increases linearly from 2020-2050 as population and income grow, leading to higher demand for food. Initially cheap, cropland expansion becomes more costly around 2030 as land scarcity increases competition, although land is not as constrained in tropical regions. The cost increase is passed through to farmgate prices.
Climate Transition Scenarios	Production increases across most transition scenarios after 2020 as tropical regions are not as land constrained. Prices under transition scenarios increase above historical trends in the first decade, as climate policies and regulation increase pressure on the land use system.
<2ºC Forecast Policy (IPR)	2ºC IPR is lower than 2ºC Coordinated because climate action is less ambitious in Tropical Africa and Southeast Asia, where tropical roots are largely produced, reducing land competition
<2ºC Coordinated	2ºC Coordinated has the second highest prices, as climate action is orderly and moderately ambitious, but there is no land use mechanism strong enough to fully offset its effect on land competition (e.g. productivity increase / demand reductions)
1.5ºC Societal Transformation	1.5ºC Social Transformation has the highest prices because of the additional land constraints coming from ambitious area protection
1.5ºC Innovation	1.5ºC Innovation has the lowest price as the yield growth offsets the increase in land competition brought on by ambitious climate action and area protections not as strong as under 1.5ºC Societal Transformation.

Content

Scenarios and scope

Commodities Overview

- Cereals
- Oil Crops
- Sugar Crops
- Other Crops
- **Animal Products**
- Forest Products

Animal Products

Potential risk Future opportunity

Key Drivers

Area protection

- By 2050, up to 50% of global land area could be protected, limiting the availability of land for raising animals and producing their feed

Increases costs of producing animal products (land)

GHG pricing

- GHG prices could range from USD$100–153 / ton CO2e by 2050, increasing the prices of emission intensive proteins

Increases costs of producing animal products (GHG pricing)

Diet shifts

- Shifts in diets away from animal proteins will cause a decrease in production of conventional proteins. Poultry emerges as a substitute

Increases demand for alternative proteins

Reduces feed demand

Key Trends

Prices

- Population and income growth drive demand for animal products but price trends vary substantially by commodity and scenario, and over time. Variations are driven by a combination of diet shifts, GHG prices, and area protection.

Production

- Production of emissions intensive beef declines across all transition scenarios. Production of less emissions intensive poultry increases, acting as a substitute.

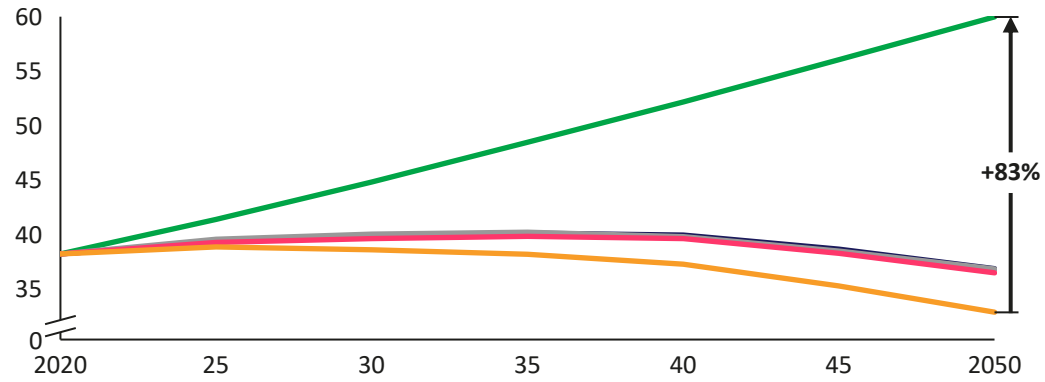
Beef, Sheep, and Goat: Rising GHG emissions costs and diet shifts under climate transitions lead to long-term production declines

Animal Products

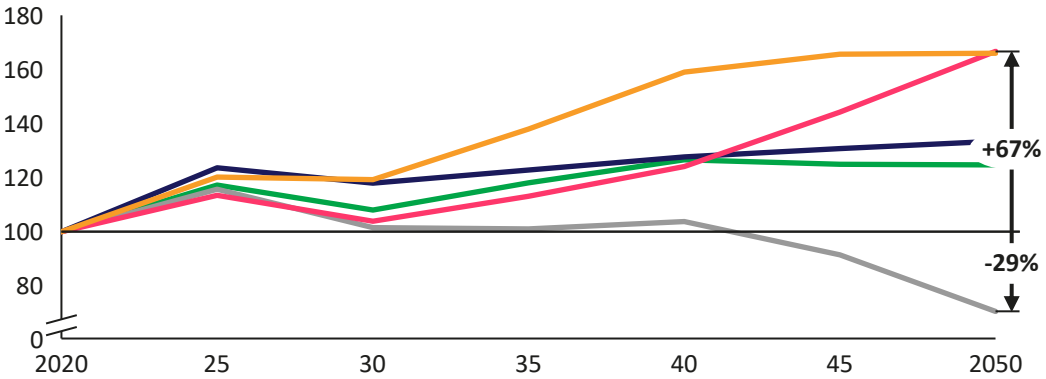
>3°C Historic Trends | 2°C Coordinated | 2°C IPR Forecast Policy | 1.5°C Innovation | 1.5°C Societal Transformation

Beef, Sheep, and Goat, Global, Production (Mt DM yr.) and Indexed Prices (2020=100)

Global Production



Global Prices



Scenario-specific values and rationale

Scenarios	Rationale
>3°C Historic Trends	Beef, Sheep and Goat production increases with population and income. Prices remain stable, though the fluctuation in prices of crop commodities used for feed production is visible between 2025 and 2040.
Climate Transition Scenarios	Beef, sheep, and goat production decreases across all transition scenarios. Diet shifts cause decrease demand, the highest occurring under the 1.5°C Societal Transformation scenario. Prices shifts vary across specific transition scenarios.
<2°C Forecast Policy (IPR)	Under the 2°C IPR scenario, key beef producers, such as Brazil, do not face stringent climate policies and regulations reducing costs for producers and farmgate prices.
<2°C Coordinated	Under the 2°C Coordinated scenario, there is more unified policy and regulation, causing an increase in cost for producers and farmgate prices in all regions.
1.5°C Societal Transformation	Under both 1.5°C scenarios, emission costs directly affect the price of beef, an emission intensive commodity (both for its links to deforestation and for the methane emissions produced from enteric fermentation).
1.5°C Innovation	Under, the 1.5°C Innovation scenario the price is lower until 2050 because yield growth reduces feed prices and area protection is lower.

Beef, Sheep and Goat: production trends by region

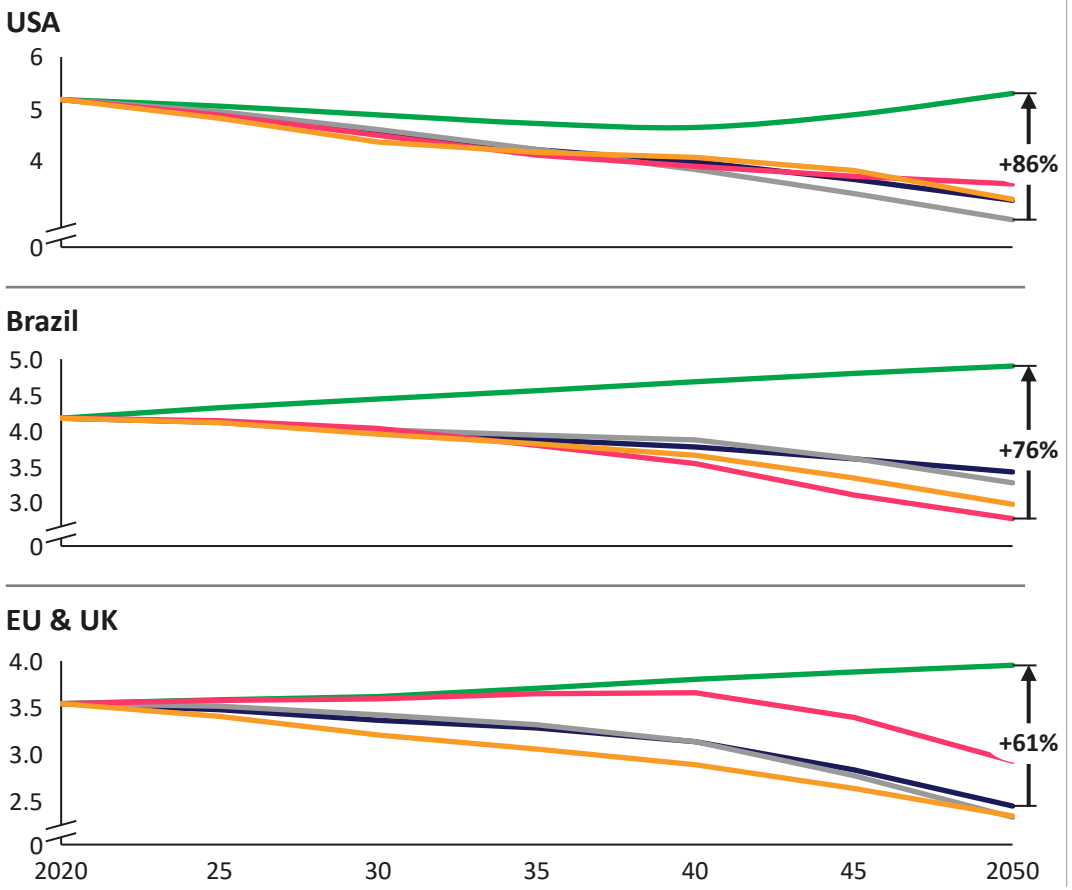
Animal Products

Beef, sheep and goat is a significant source of protein in many regions

>3°C Historic Trends | <2°C Forecast Policy (IPR) | 1.5°C Societal Transformation
<2°C Coordinated | 1.5°C Innovation

Protected areas | Food waste reductions | GHG Prices | Input efficiency
Bioenergy pathway | Diet shifts | Yield-enhancing tech

Beef, sheep and goat in selected markets, Production (Mt DM yr.)



Scenario-specific values and rationale

Scenarios	Rationale
>3°C Historic Trends	Growth in ruminant meat production follows historic trends and exports increase from these regions to emerging and low-income economies as their meat demand increases.
<2°C Forecast Policy (IPR) **<2°C Coordinated**	**USA, Brazil, Europe, & UK:** A medium diet shift reduces production. In the US, a net exporter, the difference in production between IPR and the Coordinated scenario is more evident. This is because under IPR the US is subject to more climate policy and regulation relative to its neighbors, leading to increased land competition and agricultural production costs. These conditions reduce the region's competitive advantage, resulting in a decline in exports and production larger than under Coordinated action.
1.5°C Innovation	**USA and Brazil:** A medium diet shift decreases production. Brazil loses some of its exports as yield growth in high-income regions increases their competitive advantage. **EU & UK:** Production continues at historic rates through 2040, as yield-enhancing technologies reduce land competition in Europe, increasing the region's competitive advantage and exports. After 2040, the medium diet shift offsets the increase in exports leading to a reduction in production.
1.5°C Societal Transformation	**USA, EU, & UK:** A high diet shift decreases ruminant meat production **Brazil:** Brazil hosts some of the highest carbon dense and biodiverse forests globally. Regulation to halt deforestation and incentives for land restoration increases the production costs of most meat commodities, reducing their production. A high diet shift decreases production even more.

Beef, Sheep and Goat: price trends by region

Animal Products

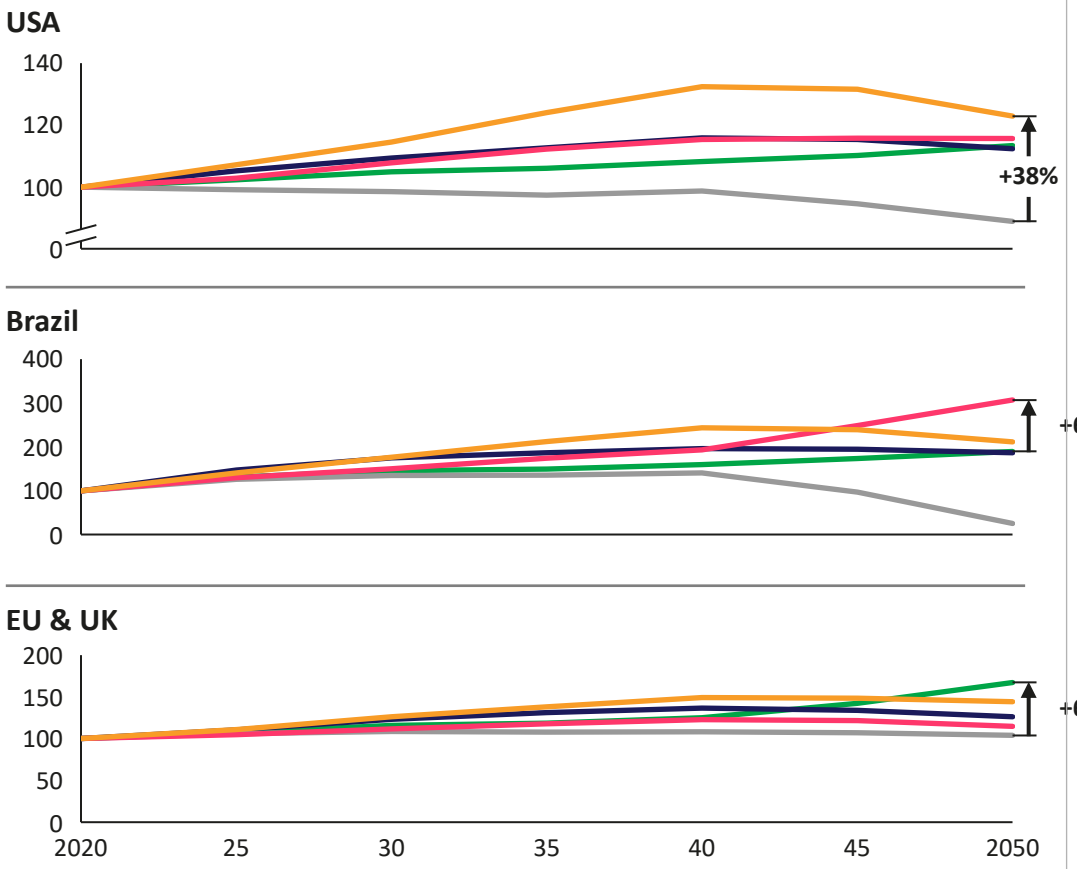
Beef, sheep and goat meat is a significant source of protein in many regions

- >3°C Historic Trends
- <<2°C Forecast Policy (IPR)
- 1.5°C Societal Transformation
- <<2°C Coordinated
- 1.5°C Innovation

Protected areas | Food waste reductions | GHG Prices | Input efficiency

Bioenergy pathway | Diet shifts | Yield-enhancing tech

Beef, Sheep and Goat in selected markets, Indexed Prices (2020=100)



Scenario-specific values and rationale

Scenarios	Rationale
>3°C Historic Trends	**USA & Brazil and EU & UK:** Growth in livestock demand increases prices
<2°C Forecast Policy (IPR)	**USA:** A moderate decrease in demand for meat decreases prices overall through 2050, despite higher production costs due to high GHG prices and land protection policies **Brazil:** Moderate GHG prices, combined with increased land protection policies, slightly increase prices through 2040. However, a significant drop in demand for beef, sheep and goat occurs from 2040-2050, dropping prices. **EU & UK:** Price increases caused by GHG prices and land protection policies are counterbalanced by a slight decrease in prices due to a decrease in demand for ruminant meat. Overall, prices slightly increase through 2050
<2°C Coordinated	**USA, Brazil and EU & UK:** Moderate GHG prices, combined with increased land protection policies, increase the price of ruminant meat
1.5°C Innovation	**USA and EU & UK:** High GHG prices, combined with increased land protection policies, slightly increase the price of meat **Brazil:** High GHG prices significantly increase the price of meat
1.5°C Societal Transformation	**USA, Brazil, and EU & UK:** High GHG prices, combined with increased land protection policies, significantly increase the price of meat.

Pork: Under transition scenarios, diet shifts away from animal products reduce pork demand and production below 2020 levels

Animal Products

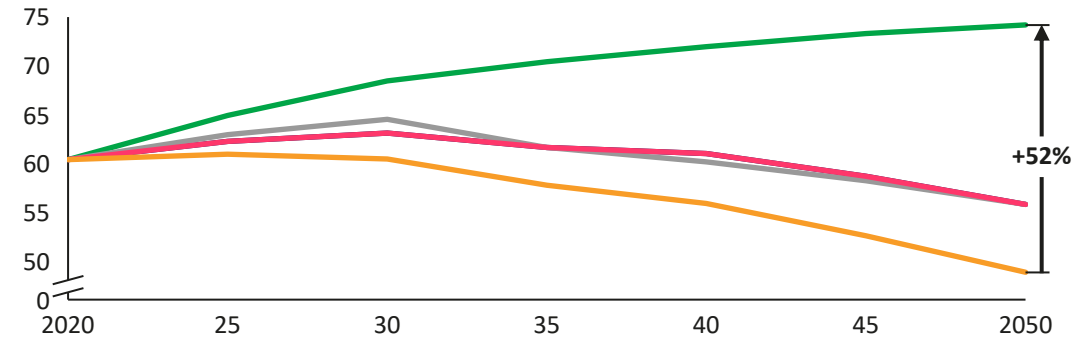
Pork is an important source of protein in many regions, particularly in China and the EU

>3°C Historic Trends | 2°C Coordinated | 2°C IPR Forecast Policy | 1.5°C Innovation | 1.5°C Societal Transformation

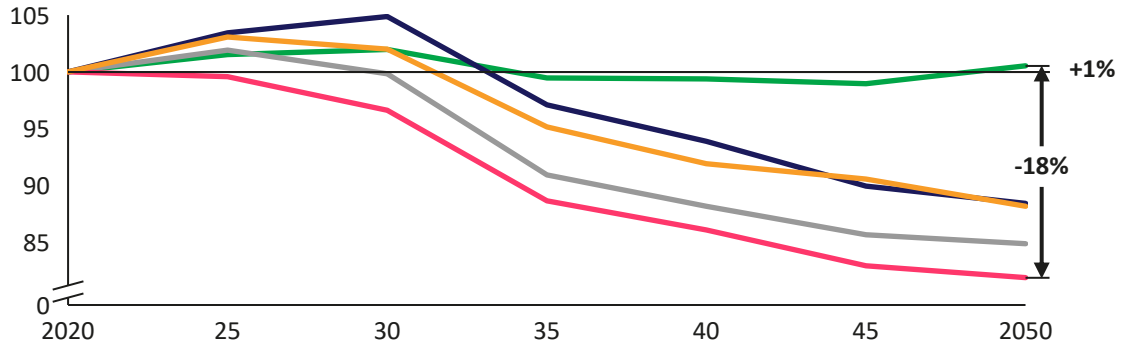
Pork, Global, Production (Mt DM yr.) and Indexed Prices (2020=100)

Trajectories increase under Historic Trends, but decrease under the other four scenarios

Global Production



Global Prices



Scenario-specific values and rationale

Scenarios	Rationale
>3°C Historic Trends	Growth in livestock production increases with incomes and population. Prices remain stable, as lack of climate action keeps prices low for key producers (e.g., China).
Climate Transition Scenarios	In the first decade, the diet shifts away form livestock products hampers demand growth, leading to a decline in production. As the effect of diet shifts put downward pressure on demand for pork, both prices and production stabilize.
<2°C Coordinated	Under 2°C Coordinated and 1.5°C Societal Transformation, key producers, such as the EU, Greater China and Southeast Asia, face increasing land competition as climate action intensifies and yield growth remains at historic levels. This increases prices above Historic Trends, as high land conversion and emission costs are passed through to the consumer. Between 2030 and 2035, the demand reductions from the diet shift away from animal proteins are enough to offset the effect of land competition on prices, which start declining.
1.5°C Societal Transformation	

Pork: production trends by region

Animal Products

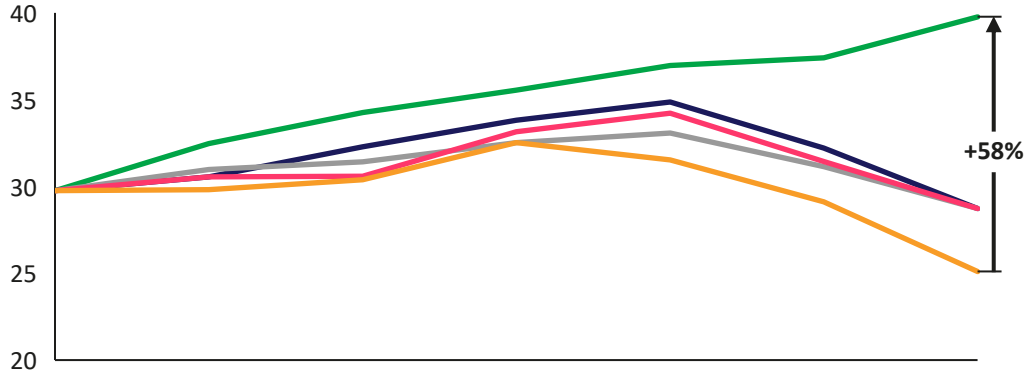
Pork is an important source of protein in many regions, particularly in China and the EU

>3°C Historic Trends | <2°C Forecast Policy (IPR) | 1.5°C Societal Transformation | <2°C Coordinated | 1.5°C Innovation

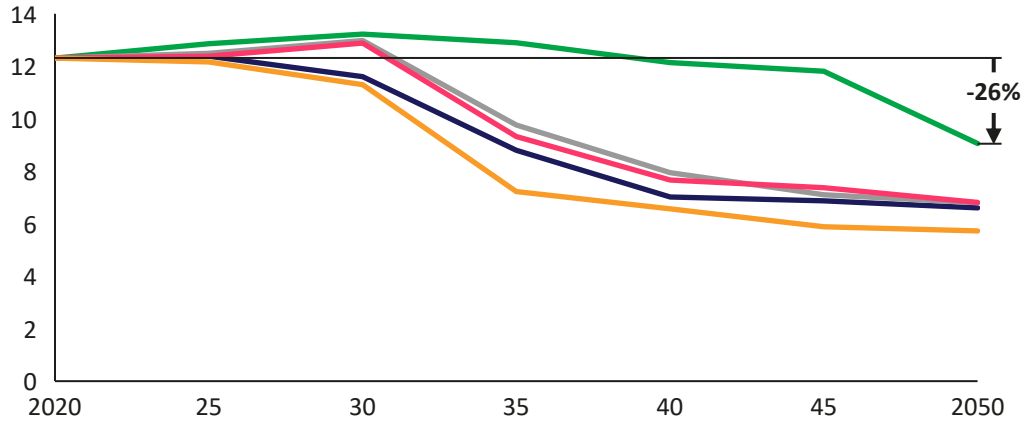
Protected areas | Food waste reductions | GHG Prices | Input efficiency | Bioenergy pathway | Diet shifts | Yield-enhancing tech

Pork in selected markets, Production (Mt DM yr.)

Global Production



EU & UK



Scenario-specific values and rationale

Scenarios	Rationale
>3°C Historic Trends	**Greater China:** Growth in production follows historic trends. **EU & UK:** Growth in pork production remains stable around 2020 levels until 2045, when land constraints in Europe increase the price of pork and reduce its exports. follows historic trends
<2°C Forecast Policy (IPR)	**Greater China:** Growth in production continues at a slower rate through 2040 and then falls due to *moderate* diet shifts. **EU & UK:** Production follows historic trends through 2030 and then falls due to a *moderate* diet shift
<2°C Coordinated	**Greater China:** Growth in production continues at a slower rate through 2040 and then falls due to *moderate* diet shifts **EU & UK:** Production falls due to a *moderate* diet shift
1.5°C Innovation	**Greater China:** Growth in production continues at a slower rate through 2040 and then falls due to *moderate* diet shifts **EU & UK:** Production follows historic trends through 2030 and then falls due to a *moderate* diet shift
1.5°C Societal Transformation	**Greater China:** Growth in production continues at a slower rate through 2035 and then falls due to *high* diet shifts **EU & UK:** Production falls due to a *high* diet shifts

Pork: price trends by region

Animal Products

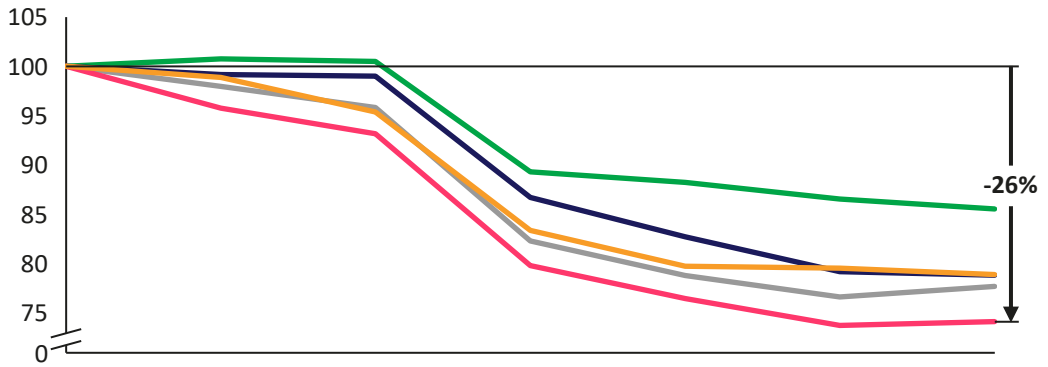
Pork is an important source of protein in many regions, particularly China and the EU

>3°C Historic Trends | <2°C Forecast Policy (IPR) | 1.5°C Societal Transformation | <2°C Coordinated | 1.5°C Innovation

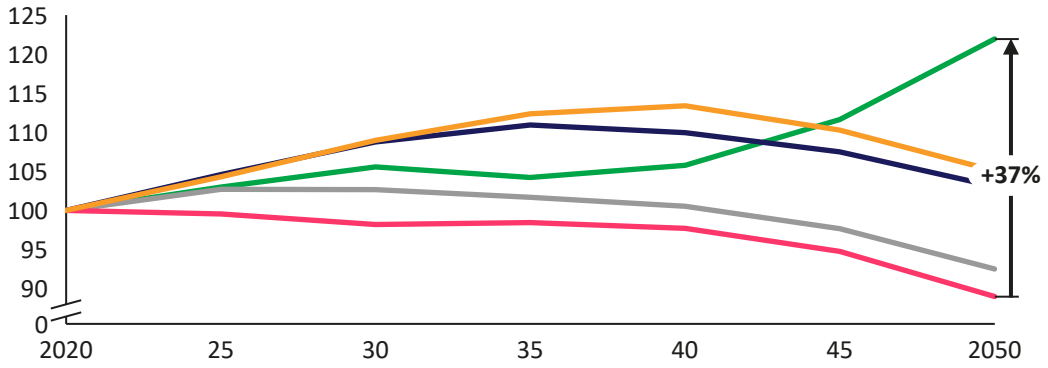
Protected areas | Food waste reductions | GHG Prices | Input efficiency | Bioenergy pathway | Diet shifts | Yield-enhancing tech

Pork in selected markets, Indexed Prices (2020=100)

Global Production



EU & UK



Scenario-specific values and rationale

Scenarios	Rationale
>3°C Historic Trends	**EU & UK:** Growth in livestock demand increases price **Greater China:** Livestock demand decreases with a decrease in population, decreasing prices
<2°C Forecast Policy (IPR)	**EU & UK and Greater China:** A moderate increase in GHG prices raises pork prices, but a moderate decrease in demand for pork meat decreases prices overall
<2°C Coordinated	**Greater China:** A moderate increase in GHG prices raises prices, but a moderate decrease in demand for pork meat decreases prices overall **EU & UK:** Moderate increases in agricultural innovation combined with a decrease in demand for pork meat decreases prices, but a moderate GHG price increases prices slightly overall
1.5°C Innovation	**USA and EU & UK:** High GHG prices, combined with increased land protection policies, slightly increase the price of meat **Brazil:** High GHG prices slightly increase the price of meat
1.5°C Societal Transformation	**EU & UK and Greater China:** High GHG prices increase prices despite a high decrease in demand for pork.

Poultry: Production grows faster under most climate transitions as poultry is a lower emissions substitute for beef

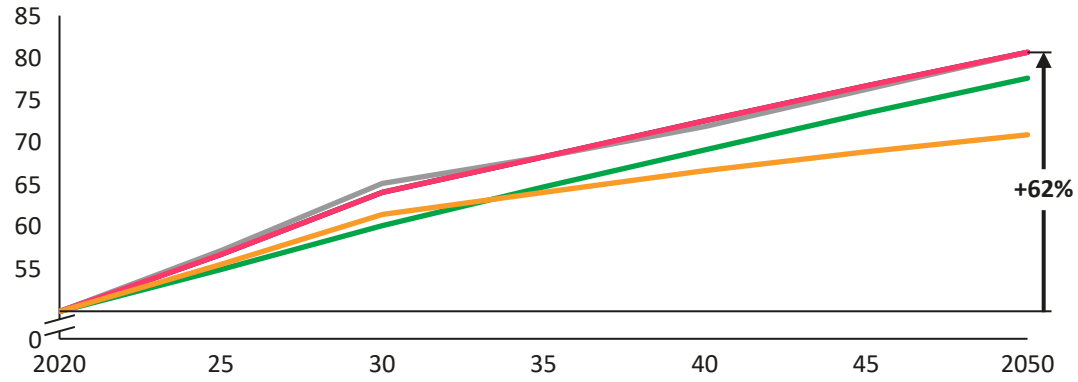
Animal Products

These increases are somewhat dampened in later years as plant-based proteins gain relative production share.

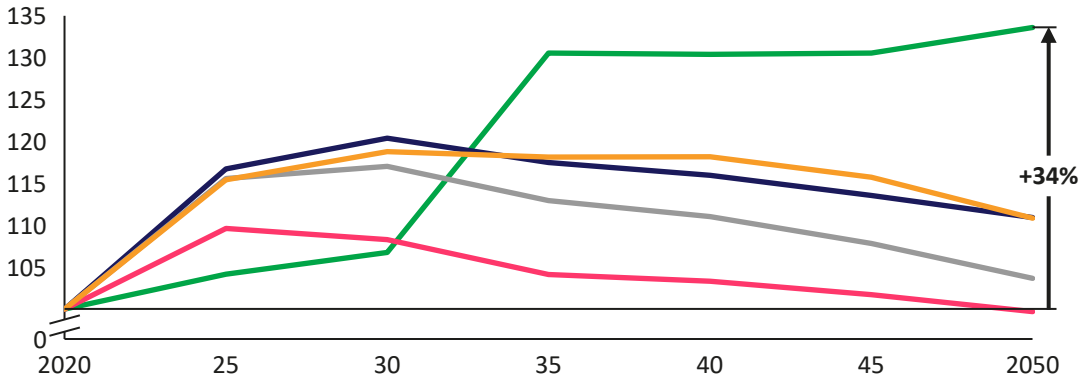
>3°C Historic Trends | 2°C Coordinated | 2°C IPR Forecast Policy | 1.5°C Innovation | 1.5°C Societal Transformation

Poultry, Global, Production (Mt DM yr.) and Indexed Prices (2020=100)

Global Production



Global Prices



Scenario-specific values and rationale

Scenarios	Rationale
>3°C Historic Trends	Global production increases linearly from 2020-2050 as population and income grow, leading to higher demand for food. Initially cheap, cropland expansion becomes more costly around 2030 as land scarcity increases competition. The cost increase is passed through to farmgate prices.
Climate Transition Scenarios	Production increases across all transition scenarios after 2020 as poultry serves as an interim substitute for proteins contributing high emissions (e.g., beef). The line begins to flatten for the 1.5°C Social Transformation as there is a higher diet shift. Prices under transition scenarios increase above historical trends in the first decade, as climate policies and regulation increase pressure on the land use system
<2°C Forecast Policy (IPR)	2°C IPR is lower than 2°C Coordinated because climate action is less ambitious in Brazil, India, Tropical Africa, and Southeast Asia, where sugar cane is largely produced, reducing land competition
<2°C Coordinated	2°C Coordinated has second highest prices, as climate action is orderly and moderately ambitious, but there's no land use mechanism to fully offset its effect on land competition (e.g. productivity increase / demand reductions)
1.5°C Societal Transformation	1.5°C Societal Transformation has the highest prices because of the additional land constraints coming from ambitious area protection
1.5°C Innovation	1.5°C Innovation has the lowest price as the yield growth offsets the increase in land competition brought on by ambitious climate action and area protections not as strong as under 1.5°C Societal Transformation.

Poultry meat: production trends by region

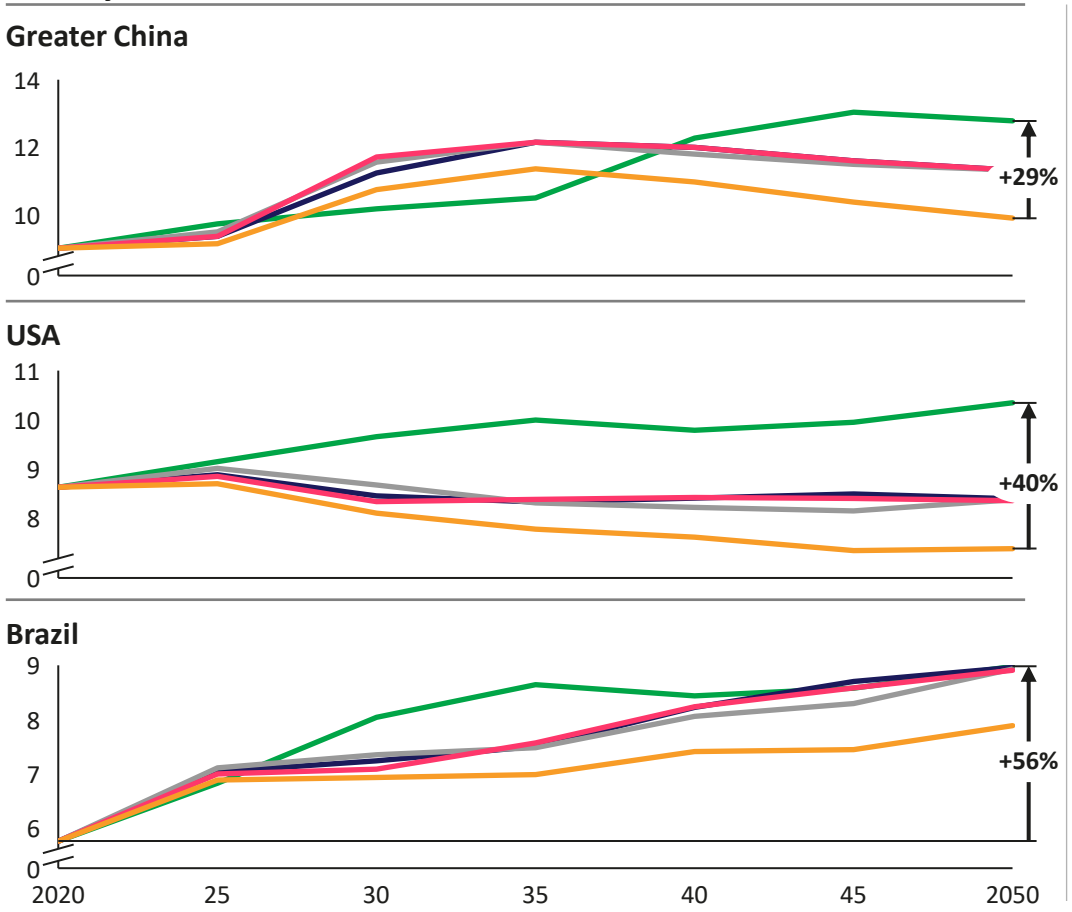
Animal Products

Poultry meat is a significant source of protein in many regions

>3°C Historic Trends | <2°C Forecast Policy (IPR) | 1.5°C Societal Transformation
<2°C Coordinated | 1.5°C Innovation

Protected areas | Food waste reductions | GHG Prices | Input efficiency
Bioenergy pathway | Diet shifts | Yield-enhancing tech

Poultry Meat in selected markets, Production (Mt DM yr.)



Scenario-specific values and rationale

Scenarios	Rationale
>3°C Historic Trends	**Greater China:** The region switches from being a net-importer to a net exporter around 2035, leading to a substantial growth in production. Although domestic demand for poultry peaks in 2045 with population, exports remain stable, mitigating the effect on production which remains stable through 2050. **USA:** Poultry production follows historic trends. After 2040, the growth in demand from neighboring emerging economies, increases US exports and production. **Brazil:** Production growth slows after 2035 as demand and exports stabilize.
<2°C Forecast Policy (IPR) **<2°C Coordinated** **1.5°C Innovation**	**Greater China:** Production of poultry meat grows between 2020 and 2030 as poultry is an interim substitute to emission-intensive meat products. After 2030, the growth in uptake of meat alternatives stabilizes annual demand and production levels **USA:** Production declines due to moderate diet shifts **Brazil:** Production of poultry meat grows as poultry is an interim substitute to emission-intensive meat products
1.5°C Societal Transformation	**Greater China:** Production of poultry meat grows between 2020 and 2030 as poultry is an interim substitute to emission-intensive meat products. After 2030, the growth in uptake of meat alternatives stabilizes annual demand and production levels **USA:** Production declines due to moderate diet shifts **Brazil:** Production of poultry meat grows as poultry is an interim substitute to emission-intensive meat products

Poultry meat: price trends by region

Animal Products

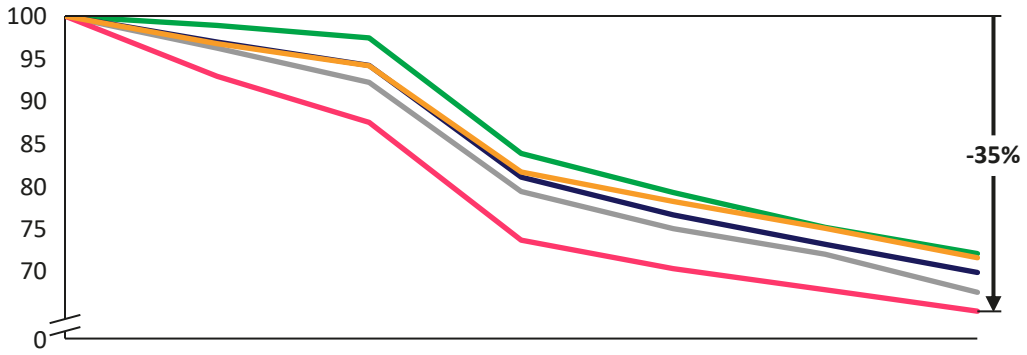
Poultry meat is a significant source of protein in many regions

>3°C Historic Trends | <2°C IPR Forecast Policy | 1.5°C Societal Transformation | <2°C Coordinated | 1.5°C Innovation

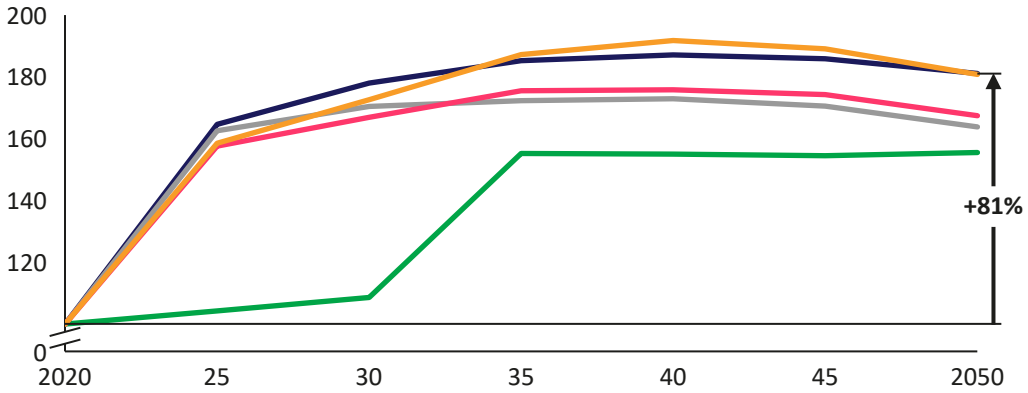
Protected areas | Food waste reductions | GHG Prices | Input efficiency | Bioenergy pathway | Diet shifts | Yield-enhancing tech

Poultry Meat in selected markets, Indexed Prices (2020=100)

Greater China



USA



Scenario-specific values and rationale

Scenarios	Rationale
>3°C Historic Trends	**Greater China:** Livestock demand decreases with a decrease in population, which lowers prices **USA:** To increase production, agricultural land expands without much investment in productivity and efficiency. After 2030, the pressure on the land use system pushes prices up.
<2°C Forecast Policy (IPR)	**Greater China:** Livestock demand decreases with a decrease in population combined with diet shifts and an increase in agricultural innovation, decreasing prices **USA:** Growth in poultry demand as consumers switch from beef due to a medium diet shift combined with GHG prices implemented after 2030 increases prices
<2°C Coordinated	**Greater China:** Livestock demand decreases with a decrease in population combined with diet shifts and an increase in agricultural innovation, decreasing prices **USA:** Growth in poultry demand as consumers switch from beef due to a medium diet shift combined with moderate GHG prices increases prices
1.5°C Innovation	**Greater China:** Livestock demand decreases with a decrease in population combined with diet shifts and an increase in agricultural innovation, decreasing prices despite high GHG prices **USA:** Growth in poultry demand as consumers switch from beef due to a medium diet shift combined with high GHG prices increases prices, but is offset by large gains in agricultural innovation
1.5°C Societal Transformation	**Greater China:** Livestock demand decreases with a decrease in population combined with diet shifts and an increase in agricultural innovation, decreasing prices **USA:** Growth in poultry demand as consumers switch from beef due to a high diet shift combined with high GHG prices increases prices

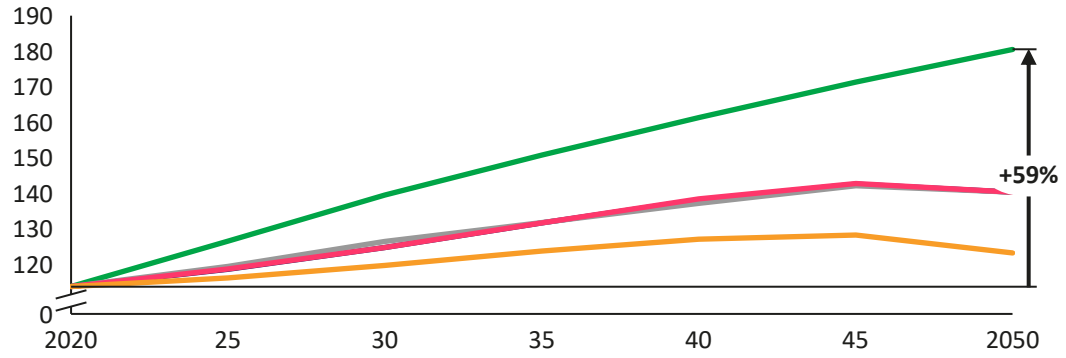
Dairy: Production is relatively lower under climate transitions as consumers shift diets away from animal products

Animal Products

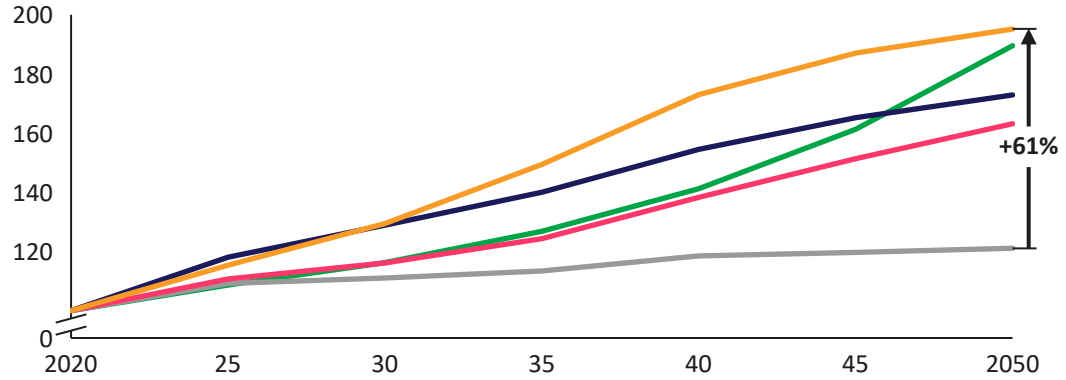
>3°C Historic Trends | 2°C IPR Forecast Policy | 1.5°C Societal Transformation | 2°C Coordinated | 1.5°C Innovation

Dairy, Global, Production (Mt DM yr.) and Indexed Prices (2020=100)

Global Production



Global Prices



Scenario-specific values and rationale

Scenarios	Rationale
>3°C Historic Trends	Growth in livestock production increases with incomes and population. Prices increase even in absence of climate action, as land competition forces South Asian regions to meet demand through expensive imports.
Climate Transition Scenarios	The diet shifts away form livestock products hampers demand growth, leading to a decline in production after 2045. As demand grows across all scenarios, prices grow above 2020 levels.
<2°C Forecast Policy (IPR)	Prices remain low in the 2°C Forecast Policy Scenario, as lack of policy action in key producing regions like India and South Asia coupled with lower demand for dairy reduce pressure on dairy producers and land competition.
1.5°C Innovation	Price growth is lower than Historic Trends, as higher productivity and lower demand for dairy products reduce land competition and pressure on dairy producers.

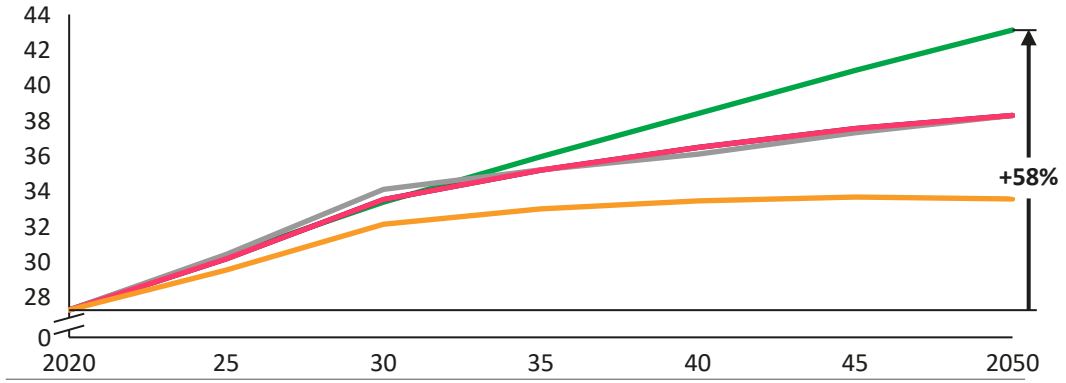
Eggs: Production is relatively lower under transition scenarios as diets shift away from animal proteins

Animal Products

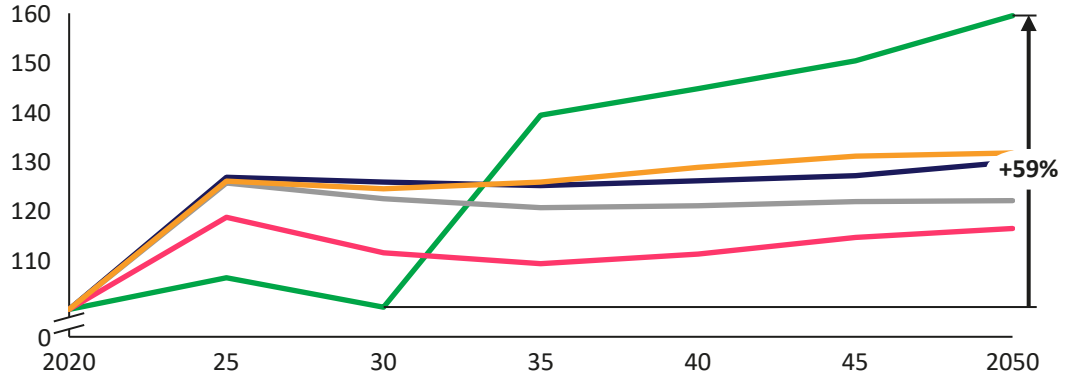
>3°C Historic Trends | 2°C IPR Forecast Policy | 1.5°C Societal Transformation | 2°C Coordinated | 1.5°C Innovation

Eggs, Global, Production (Mt DM yr.) and Indexed Prices (2020=100)

Global Production



Global Prices



Scenario-specific values and rationale

Scenarios	Rationale
>3°C Historic Trends	Growth in livestock production increases with incomes and population. Initially cheap, cropland expansion becomes more costly around 2030 as land scarcity increases competition. The cost increase is passed through to farmgate prices.
Climate Transition Scenarios	Because of the interim use of poultry as a substitute for emission-intensive meats, eggs production declines below Historic Trends only under 1.5°C Societal Transformations before 2030. In the first decade, prices under the transition scenarios increase above Historic trends as climate policies and regulation increase pressure on the land use system. As the effect of diet shifts puts downward pressure on demand for eggs, both prices stabilize.
1.5°C Innovation	Prices are lowest under 1.5°C Innovation due to increased yields reducing land competition.

Content

Forest Products

Potential risk Future opportunity

Key Drivers

Area protection

- By 2050, up to 50% of global land area could be protected, limiting the availability of land for agricultural and forestry production.

Increases land competition

GHG pricing

- GHG prices could range from USD$100–153 / ton CO2e by 2050, creating both costs and new revenue streams.

Increases production costs of forest products

Creates new revenue streams (e.g, carbon credits)

Bioenergy

- Bioenergy production could reach over 100 EJ by 2050 to accommodate the growth in BECCS and biofuels, limiting land availability and creating additional competition among uses for forest products

Increases land competition

Yield growth

- By 2050, average crop yields could increase up to 69% globally unde transition scenarios, dampening the impact of increased land competition between food, fuel, and forest products.

Reduces land competition increasing capacity for forest expansion

Key Trends

Production

- Increased GHG prices under transition scenarios can incentivize additional demand for timber products in construction.
- Productivity growth under the 1.5°C Innovation scenario increases land availability and timber production capacity.

Timber: Production is relatively higher under transition scenarios as demand from the sustainable construction activity rises

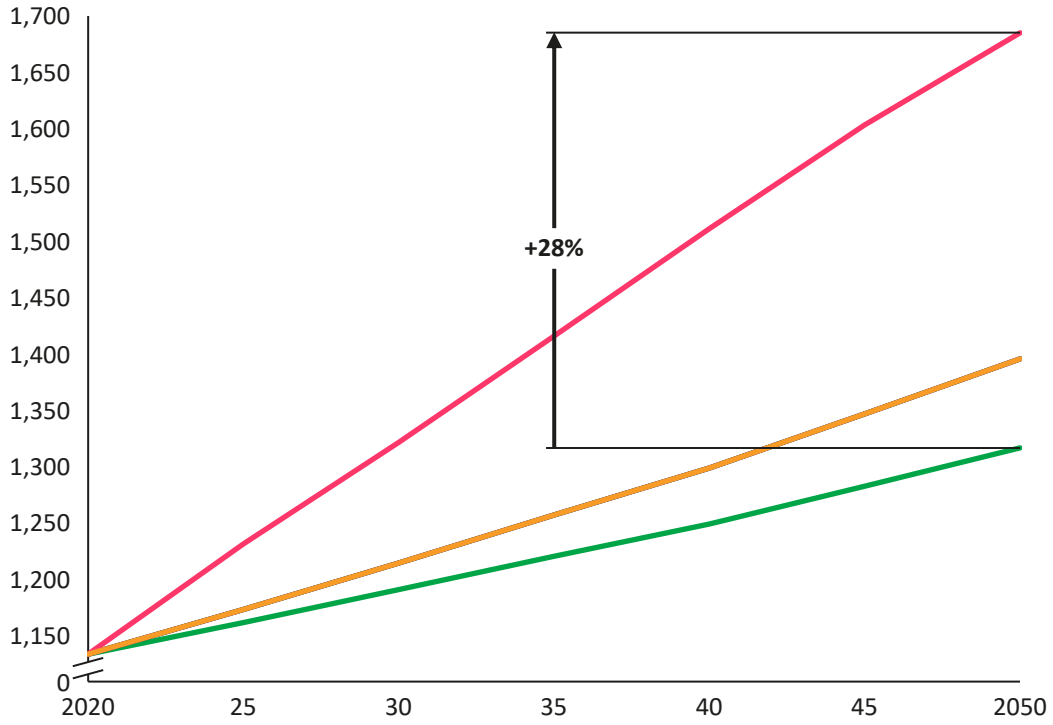
Forest Products

>3°C Historic Trends | 2°C IPR Forecast Policy | 1.5°C Societal Transformation | 2°C Coordinated | 1.5°C Innovation

Timber, Global, Production (Mt DM yr.)

Global Production

The Innovation scenario has the highest trajectory in 2050



Scenario-specific values and rationale

Scenarios	Rationale
>3°C Historic Trends Scenario	Timber demand keeps growing at historical rates (+16% between 2020 and 2050), as climate action is not enough to incentivize a substantial shift to timber in the construction sector.
<2°C Forecast Policy (IPR) **<2°C Coordinated**	Climate action pushes demand for lumber in new builds above Historic Trends, with 10% of new builds being constructed using timber. Area protection and climate targets increase land competition in the land use sector and reduce capacity for timber production. GHG prices increase the value of intact forest and create additional competition across uses for forestry products.
1.5°C Societal Transformation	Although the high GHG prices could incentivize additional demand for timber products in construction, the ambitious targets for area protection (50% globally by 2050) limit land availability for plantation and timber supply. Timber demand increases by 23% between 2020 and 2050.
1.5°C Innovation	The high GHG prices incentivize additional demand for timber products in construction as half of all new builds use timber as a construction material. High productivity growth increases land availability and timber production capacity. Demand grows by 50% between 2020 and 2050.

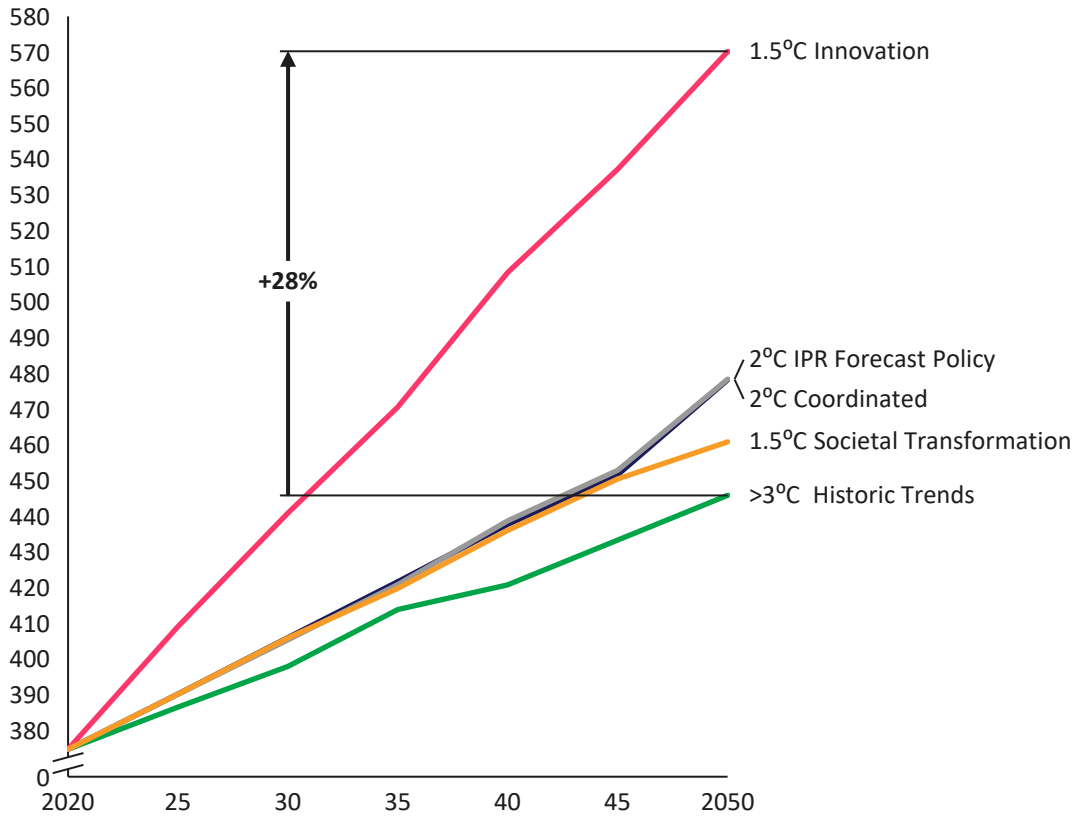
Pulpwood: Production is relatively higher under transition scenarios as demand for bio-based products rises

Pulpwood is mostly used to produce food and fuel

Pulpwood, Global, Production (Mt DM yr.)

Trajectories increase by nearly 200 Mt DM under the Innovation scenario

Global production



Scenario-specific values and rationale

Scenarios	Rationale
>3°C Historic Trends	Pulpwood production follows historic growth trends.
Climate Transition Scenarios	Pulpwood production follows timber production closely leading to higher production levels under transition scenarios.
<2°C Forecast Policy (IPR) **<2°C Coordinated**	After 2045, production under <2°C scenarios diverges as regional distribution of timber production favors regions where pulpwood is a larger share of timber.