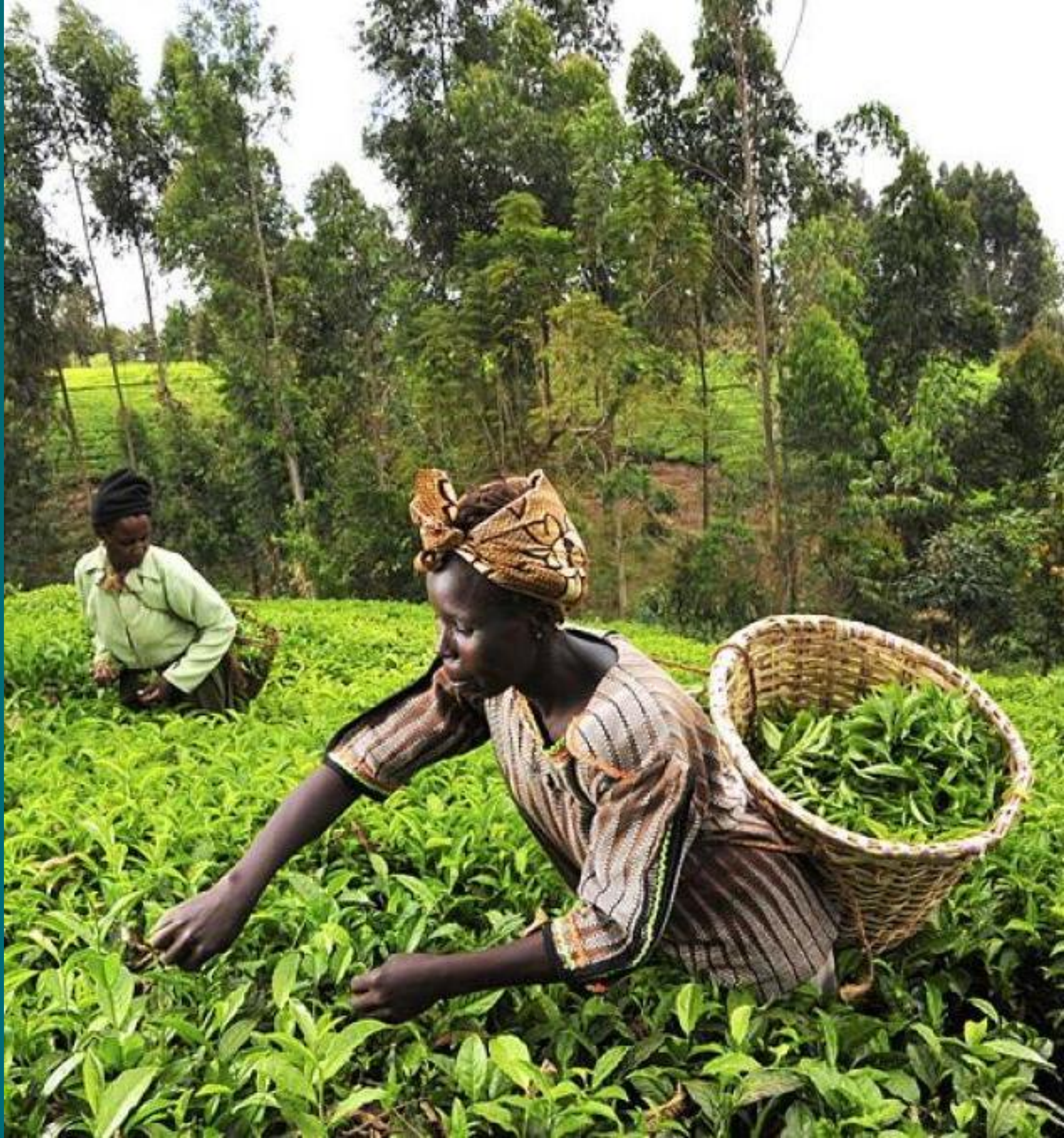
Re-WIRE Agri-food Value Chains

Analytical framework methodology

October 2025



ABOUT THIS METHODOLOGY DECK

This methodology deck provides an overview of the analytical framework and key exhibits used in the Food and Land Use Coalition (FOLU) Re-WIRE report for consultation, including an overview of the methodologies for each of the indices in the report.

The specific rationale for individual scores, and the sources used as a basis for scoring, alongside datasets included in the report, are available in an accompanying spreadsheet, the Re-WIRE fact base. If you wish to access this spreadsheet, please email info@folu.org.

Introduction

FOLU RE-WIRE ANALYTICAL FRAMEWORK - OVERVIEW

The Food and Land Use Coalition

1 Economic and social value

Global dashboard

1.1 Production

- Annual volume of production in top five producing countries.
- Productivity per hectare in top five producing countries.
- Value of gross production in top five producing countries.

1.2 Trade flows and food loss

- Top trade flows by volume and value.
- Share of production lost after production & before consumption.

1.3 Consumption

- Consumption volumes in top-consuming countries.
- Nutrient value score of commodity.
- Contribution to global calories.

2 Risks and impacts

2.1 Risks index

- **Physical climate risks:** the extent to which production volumes and suitable areas of production will be reduced by physical climate impacts.
- **Human rights risks:** the vulnerability to risks of child labor, forced labor or land rights violations.
- **Regulatory risks:** the extent to which incoming regulation could impact business operations; based on materiality, compliance readiness, and exposure.

2.2 Impacts index

- **Climate:** the extent to which emissions from production and land use change impact climate.
- **Biodiversity:** the extent to which production practices impact on-farm biodiversity and land use change impacts off-farm biodiversity.
- **Soil health:** the extent to which production practices negatively impact soil health.
- **Water:** the extent to which a value chain has negative impacts on water use and water pollution.
- **Social:** the extent to which a value chain negatively impacts decent work and pesticide exposure.
- **Societal health:** the impact of production on air quality, anti-microbial resistance, and the nutritional diversity of production.

3 State of the transition

3.1 Transforming production index

- Share of sustainable production today.
- Holistic impact assessment of more regenerative and sustainable production approaches.

3.2 Transforming consumption index

- Implication of existing reference diets on consumption shifts.
- Feasibility of consumption shift in key consumption markets.

4 Economic feasibility of the transition

4.1 Economic feasibility of production transition index

- Farm profitability.
- Productivity of core and diverse products.
- Time to recover or improve profitability.

4.2 Landscape of existing initiatives

- Compilation of certification schemes, sectoral agreements, value chain collaborations, finance mechanisms, landscape initiatives or advocacy efforts.

4.3 Value chain structure

- Market concentration, market power; trade practices; state influence.

4.4 Financial flows analysis

- Breakdown of public and private sources of external finance to the value chain.
- Breakdown of intra-value-chain flows of finance.

THE RE-WIRE FRAMEWORK APPROACH, USE CASES AND LIMITATIONS

The Re-WIRE indices generalize information at a value chain and country level to provide a bird's-eye view of risks, impacts, and the economic feasibility of transition. The Re-WIRE framework is designed to help system change leaders:

- Gain an order-of-magnitude understanding of how risks and impacts vary between value chains.
- Identify risks and opportunities for action in current and potential future product portfolios.
- Identify external advocacy and partnership strategies to transition value chains.
- Engage suppliers and other partners along the value chain to support their efforts.

Our scores for country-level scores for commodity value chains across a range of dimensions—including risks, impacts, economic feasibility, and enabling conditions—are based on the best available data and expert input at the time of writing. The scoring reflects national-level conditions; as such, it will not capture sub-national variations, localized dynamics, or the full complexity of regional contexts.

This work is intended as a starting point for business and system-change leaders to inform strategic conversations and comparative insights. While we are confident in the robustness and consistency of the approach and findings, additional depth, precision, and nuance could always be gained through further research, more granular datasets, and expanded stakeholder engagement. We see this as a living analysis and welcome future refinement as new evidence, perspectives, and analytical capacity become available.

The indices are no substitute for higher-resolution specialist data services that provide location- or supply-chain-specific data. Our indices cannot be used for:

- Identifying sub-national, location-specific variations in risk or impact.
- Providing or reporting on quantified metrics on the degree of impact.

GENERAL PRINCIPLES INFORMING OUR DATA COLLECTION AND SCORING APPROACH

Setting criteria and thresholds

- Most indicators are assessed using a 1-to-5 scale, with clearly defined thresholds for each score. A smaller subset of indicators uses a -2 to +2 scale, capturing increases/decreases.
- We aimed to create a consistent scoring approach and criteria that can be applied to both standard and regenerative, more productive agricultural systems. However, asymmetries remain; much more data is available for standard systems relative to transformed systems. For some of the latter, no quantitative data is yet available.
- We therefore largely focused our scoring criteria and thresholds around *practices*, rather than *measurements of absolute outcomes*. For example, our climate change mitigation criteria are based on the presence of top GHG-emitting elements, such as ruminant livestock, rather than g CO_2e emitted.

Data collection

We are conducting scoring using the best-available data, according to the following hierarchy of preference:

1. Compiled datasets, e.g., from the FAO
2. Academic papers (preferably comparing countries within the same study and approach)
3. Other rigorous, evidence-based reports from credible organizations
4. Expert opinion (largely used for transformed systems that lack data)

Quality assurance

The scores and methodology have undergone a quality assurance process with an external technical reviewer.

EXTERNAL CONTRIBUTORS TO BRAZIL SOY AND BEEF DEEP DIVE ANALYSES

Our desk research on soy and beef value chains in Brazil was complemented by valuable insights from the following individuals:

- **Ana Lima** – Partnerships Lead, Accountability Frameworks Initiative
- **Bo Li** – Research Associate, Forest Governance and Policy, World Resources Institute
- **Guilherme Bastos** – CEO, FGV Agro
- **Ida Breckan** – Senior Adviser, NORAD
- **Mari Martinsen** – Counselor, Norwegian Ministry of Foreign Affairs
- **Mauricio Bauer** – Senior Program Officer, Gordon and Betty Moore Foundation
- **Vedis Vik** – Senior Adviser, NICFI

1. Economic and social value

The Food and Land Use Coalition

SECTION 1 | ECONOMIC AND SOCIAL VALUE

1 Economic and social value

Global dashboard

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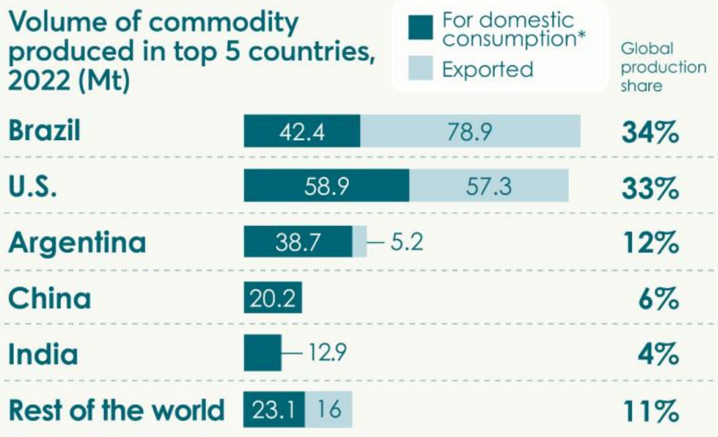
- Breakdown of intra-value-chain flows of finance.

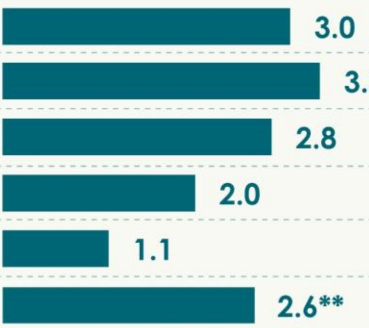
1. VALUE CREATION DASHBOARD | SOY | COMPILED

Production

Volume of commodity produced in top 5 countries, 2022 (Mt)



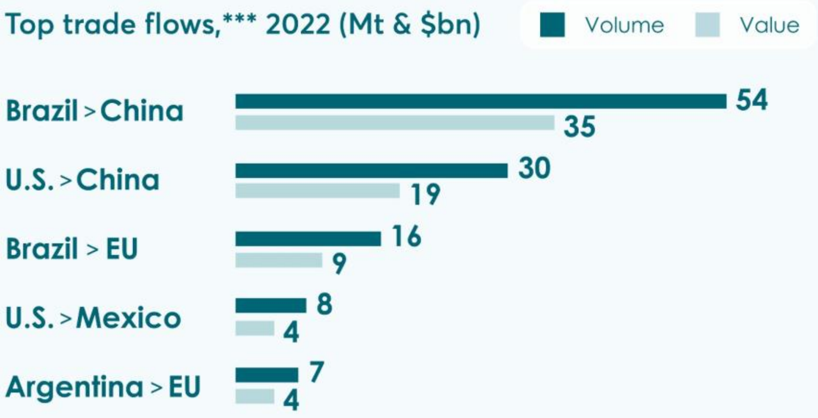
Productivity, 2022 (t/ha)



Value of gross production, 2022 ($bn)

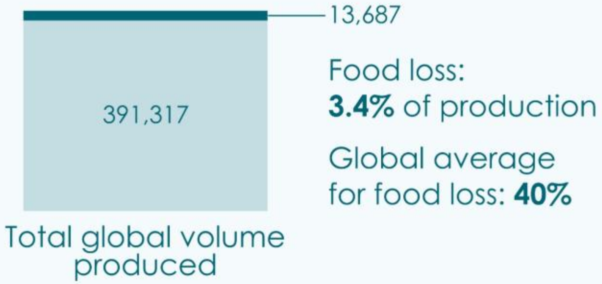
Trade flows and food loss

Top trade flows,*** 2022 (Mt & $bn)



Food loss****

Share of volume lost (after production & before consumer), 2022 (1,000 t)

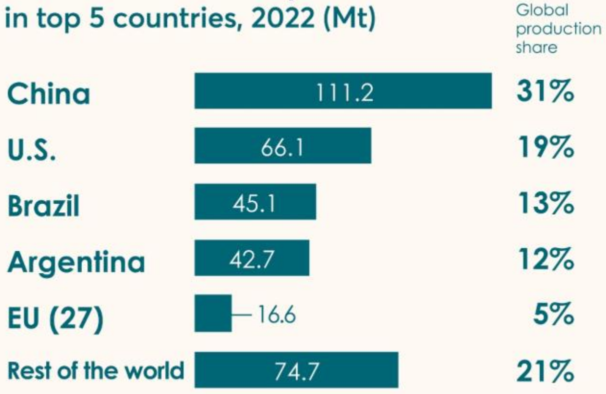


Food loss: **3.4%** of production

Global average for food loss: **40%**

Consumption

Volume of commodity consumed in top 5 countries, 2022 (Mt)



Nutrient Value Score (GAIN)

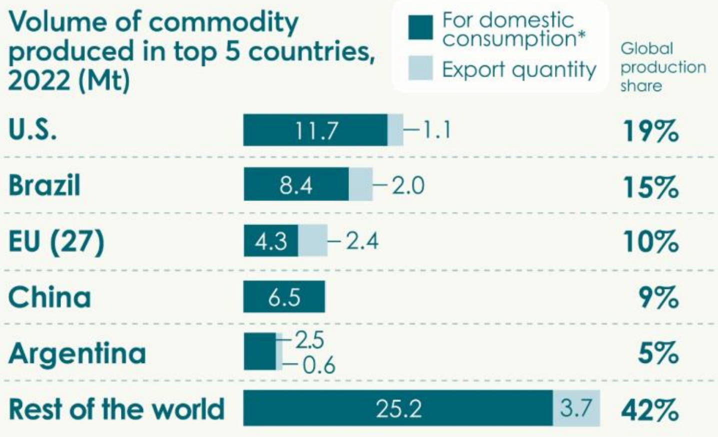
Contribution to global calories

3.3%

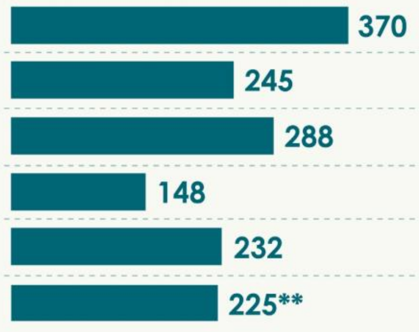
1. VALUE CREATION DASHBOARD | BEEF | COMPILED

Production

Volume of commodity produced in top 5 countries, 2022 (Mt)



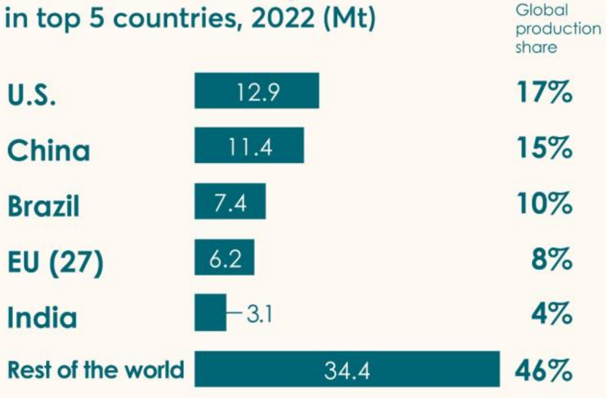
Productivity, 2022 (kg/Animal)



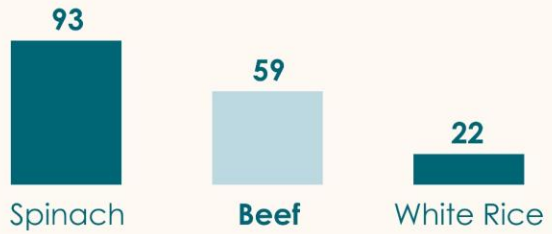
Value of gross production, 2022 ($bn)

Consumption

Volume of commodity consumed in top 5 countries, 2022 (Mt)



Nutrient Value Score (GAIN)



Contribution to global calories

1.4%

Trade flows and food loss

Top trade flows,*** 2022 (Mt & $bn)

Food loss****

Share of volume lost (after production & before consumer), 2022 (1,000 t)

Food loss: **0.8%** of production

Global average for food loss: **40%**

1. VALUE CREATION DASHBOARD | COCOA | COMPILED

The Food and Land Use Coalition

Production

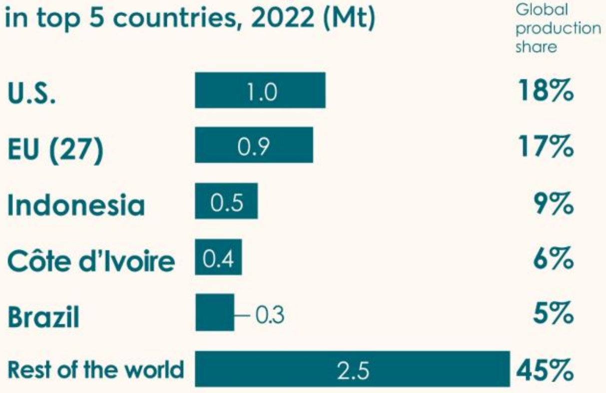
Volume of commodity produced in top 5 countries, 2022 (Mt)

Productivity, 2022 (t/ha)

Value of gross production, 2022 ($bn)

Consumption

Volume of commodity consumed in top 5 countries, 2022 (Mt)



Nutrient Value Score (GAIN)

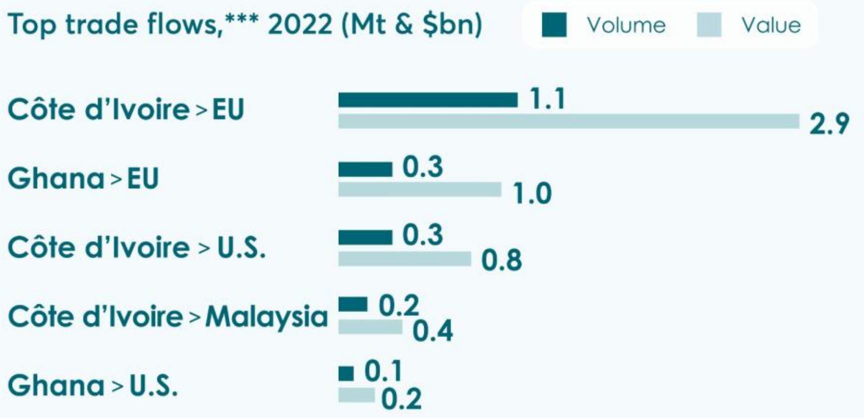
Not recorded:
not relevant for cocoa

Contribution to global calories

0.3%

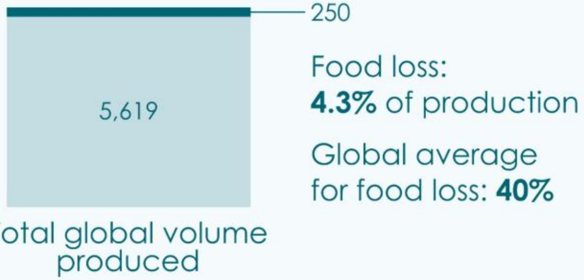
Trade flows and food loss

Top trade flows,*** 2022 (Mt & $bn)



Food loss****

Share of volume lost (after production & before consumer), 2022 (1,000 t)



Food loss: **4.3%** of production

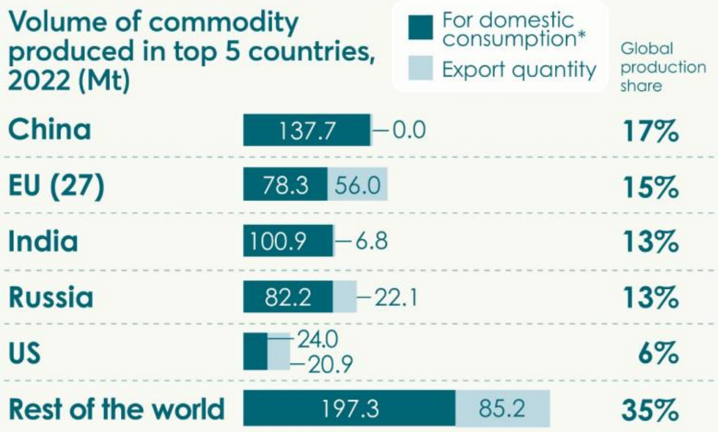
Global average for food loss: **40%**

1. VALUE CREATION DASHBOARD | WHEAT | COMPILED

The Food and Land Use Coalition

Production

Volume of commodity produced in top 5 countries, 2022 (Mt)

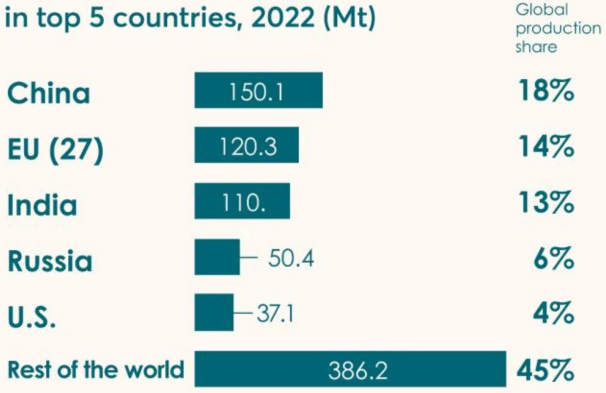


Productivity, 2022 (t/ha)

Value of gross production, 2022 ($bn)

Consumption

Volume of commodity consumed in top 5 countries, 2022 (Mt)



Nutrient Value Score (GAIN)

Contribution to global calories

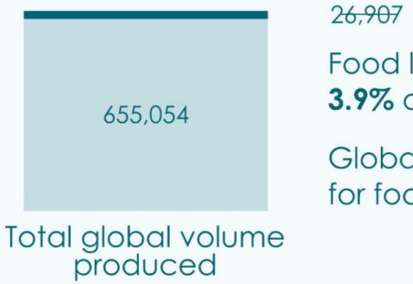
17.9%

Trade flows and food loss

Top trade flows,*** 2022 (Mt & $bn)

Food loss****

Share of volume lost (after production & before consumer), 2022 (1,000 t)



Food loss:
3.9% of production

Global average for food loss: **40%**

GLOBAL DASHBOARD ASTERISKS AND A CAVEAT ON FOOD LOSS AND WASTE

** Quantity of domestic production for domestic consumption is an indicative, simplified estimate calculated by taking the difference between total domestic production and export volumes. The total amount of the commodity consumed per country, whether produced domestically or imported, is in the "Consumption" figure.*

***"Rest of world" bar in "Productivity" figure refers to the production-weighted global average productivity of all remaining countries.*

**** Data sets underlying figures for Value of gross production (FAO) and Top trade flows (ResourceTrade) are not directly comparable but offer an indicative view of economic value created.*

***** FAO data for loss encompasses all stages in the value chain between the level at which production is recorded and the household, i.e., storage and transportation. Losses occurring before and during harvest are excluded. Waste from both edible and inedible parts of the commodity occurring in the household is also excluded.*

An important note on the limitations of our food loss and waste data: *we recognize food loss and waste as a critical lever for transforming food and land use systems. However, due to the limited availability of comparable, comprehensive, and authoritative data across geographies and commodities, we have not been able to include it robustly in our analysis.*

The figures presented in the global dashboards are sourced from FAOSTAT and reflect losses occurring between the point of recorded production and the retail or household level (i.e., including storage, handling, and transportation). They exclude both pre-harvest and harvest losses, as well as post-consumer waste, including both edible and inedible fractions discarded at the household level.

Importantly, these two excluded endpoints are where a significant share of food loss and waste is understood to occur for many commodities. While the share of losses captured by FAO data is proportionally similar across three of the four commodities in scope, this partial comparability should not be interpreted as representing total system loss. In reality, variability in pre-harvest and post-consumer stages is likely to be substantial and uneven across value chains.

2. Risk and Impact indices

The Food and Land Use Coalition

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2.1 Risk index

2.1 VULNERABILITY TO RISKS

This index assesses the vulnerability of value chains to a range of risks associated with physical climate, human rights, and existing or planned/future legislation. Identification and comparison of these risks aims to drive the imperative for businesses to change, for governments to regulate, and for both to identify entry points to mitigate those risks.

	Cocoa		Beef		Soy		Wheat	
	West Africa	Indonesia	U.S.	Brazil	U.S.	Brazil	U.S.	India
Bio-physical risks Climate risk	2	3	4	2	3	3	4	2
Social risks Human rights risk	1	3	2	2	4	3	4	2
Regulatory risks Regulatory change risk	1	4	4	4	2	3	4	2

Key Severe risk ① ② ③ ④ ⑤ Low risk

2.1 BIO-PHYSICAL RISKS | VULNERABILITY TO YIELD REDUCTION AND CHANGES TO SUITABILITY OF LAND

Scoring principles

We have looked at projections to 2050

- As far as possible, we draw on 2050 projections for this analysis due to data limitations. Where data is limited, we have made estimates that extrapolate from projections for 2030 or 2100. Although we believe near-term projections are more relevant for target stakeholders, it is more difficult to find near-term, comparable projections.

The risk score is based on two impact dimensions:[1]

1. Projected impact on crop/livestock yield by 2050.
2. Projected changes to the suitability of land for production by 2050.

The overall score is an average of these two scores

- If data is conflicting, we provide a range score.

We do not consider the feasibility of adaptation

- Projections used largely assume business-as-usual conditions, including historical adaptation investments, but do not systematically account for future adaptation efforts.
- Our scoring does not assess new adaptation feasibility; this is explored separately in our analysis of regenerative agriculture transitions.

Scoring approach per commodity production archetype

		Impact on yields by 2050	Impact on suitability of land for production by 2050
①	**Severe risk by 2050.**	Over 40% yield reduction	Majority of production regions retain limited suitability
②	**High risk by 2050.**	20-40% yield reduction	Over half existing regions of production regions retain limited suitability
③	**Moderate risk by 2050.**	10-20% yield reduction	Significant changes to suitability of production regions
④	**Low risk by 2050.**	Up to 10% yield reduction	Some changes to suitability of production regions
⑤	**Minimal risk by 2050.**	No impact or positive impact on yields	No changes or increase in production regions

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[1] Other dimensions could be added as needed by users.

2.1 SOCIAL RISKS | VULNERABILITY TO CHILD/FORCED LABOR AND LAND RIGHTS VIOLATIONS

Indicators to consider

Vulnerability to human rights risks

Evaluate the degree of human rights risks throughout the value chain with a particular focus on production. Risk factors influenced by activities in value chain and external factors.

Illustrative score is determined based on two risk dimensions:[1]

1. Child and forced labor
2. Land rights violations

What are the risks of child and forced labor?

- High: Widespread allegations of child or forced labor anywhere along the value chain
- Medium: Moderate allegations of child or forced labor
- Low: Limited allegations of child or forced labor
- None: No credible allegations or documented risk

What are the risks of land rights violations?

- High: Widespread allegations of land grabs or other serious violations of land tenure and access rights (e.g., forced evictions, disregard for customary rights)
- Medium: Moderate evidence of tenure conflicts, land disputes, or exposure to deforestation-linked land access risks
- Low: Limited or isolated reports of land-related rights violations
- None: No credible allegations or documented risk

Scoring approach per commodity production archetype

① **Severe risk:** High risk of both factors

② **High risk:** High risk of either factor

③ **Moderate risk:** Moderate risk of either factor

④ **Low risk:** Low risk of both factors

⑤ **Minimal risk:** No documented child or forced labor risk and no documented land rights risks

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[1] Other dimensions could be added as needed by users.

2.1 REGULATORY RISKS | VULNERABILITY TO FINANCIAL, OPERATIONAL, AND REPUTATIONAL IMPACT

Indicators to consider

1. **Risk of impact from regulatory changes, based on combined assessment of:**
   A. **Materiality of regulatory changes based on expected disruption if the regulation were enforced today. This includes:**
      a) **Domestic regulation affecting production**, such as:
         (i) economic instruments (e.g., subsidies, incentives, price controls)
         (ii) labor & social protections (e.g., labor standards, working conditions)
         (iii) land governance (e.g., land tenure reform, indigenous rights)
      b) **National trade regulation affecting exports**, such as:
         (i) export controls (e.g., export tariffs, trade quotas, etc.)
         (ii) domestic content or value-add rules
      c) **Importer-country regulation**, such as:
         (i) environmental standards (e.g., deforestation-free sourcing),
         (ii) human rights / social due diligence (e.g., forced labor bans)
         (iii) trade measures (e.g., import tariffs, traceability mandates)
   B. **Readiness for compliance or response based on current system capacity**, e.g., traceability systems, certification schemes, enforcement coverage

AND

2. **Share of production volume exposed to relevant regulation,** especially export-linked regulation, e.g., % of total production exported to regulated markets. Exposure can be considered High (>30%), Moderate (10-30%), or Low <10%).

Note: This scoring considers both domestic and trade-related risks. The most material source of risk (domestic or trade) determines the score.

Scoring approach per commodity production archetype

1. **Severe risk:** high risk of impact (high likelihood of regulatory change + low readiness) across 100% of the value chain
2. **High risk:** Medium risk of impact (high likelihood of regulatory change + moderate readiness / Medium likelihood + low readiness) across 100% of value chain, or high risk of impact across 50%
3. **Moderate risk:** High risk of impact across 10-30% of value chain and / or medium risk of impact for 30-50% of value chain
4. **Low risk:** Medium risk of impact for 10-30% of the value chain or high risk in up to 10% of value chain
5. **Minimal risk:** low risk of impact (low likelihood + high readiness) across 100% of the value chain or medium risk of impact in up to 10% of value chain

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1 Other dimensions could be added as needed by users.

2.2 Impact index

2.2 IMPACT SCORES | KEY INDICATORS

Our impact scores capture a holistic set of impacts based on the core and advanced criteria of the FAO TAPE framework[1] and incorporate the relevant human health impacts identified in the five health impact pathways defined by IPBES & Global Alliance for The Future of Food.[2]

Impact area	Scoring definition
Climate and biodiversity	**Climate** – Presence of significant emitting factors including land use change, enteric fermentation, manure and use of chemical fertilizers, and any common mitigating actions.
	Off-farm biodiversity – Impact of land use change on habitat loss.
	On-farm agricultural biodiversity – Diversity of on-farm agricultural production and presence of native vegetation.
Soil	**Soil health** – Presence and degree of practices that degrade or enhance soil.
Water	**Water use** – Typical water use, extent of irrigation or water-saving practices, and water scarcity of production geography.
	Water pollution – Presence of nutrient and agro-chemical effluents and any mitigating actions.
Social	**Decent work** – Labor standards, including average income, rights, working conditions and equality—in most affected segment of value chain.
	Pesticide exposure – Intensity & type of pesticide exposure and degree to which personal protective equipment is used.
Societal health	**Air quality** – Volume and type of air pollutant generated by production.
	Anti-microbial resistance – Extent of use of antibiotics.
	Nutritional diversity of production – Diversity of species produced across ten FAO food groups.

1. FAO Tool for Agroecology Performance Evaluation 2022 https://openknowledge.fao.org/server/api/core/bitstreams/8ad4bb1b-c06d-4260-835e-564698493149/content 2. IPBES & Global Alliance for the Future of Food 2017, Unravelling the Food Health Nexus: https://www.ipes-food.org/_img/upload/files/Health_FullReport(1).pdf

2.2 IMPACT SCORES | INDEX

Key Severe impact ① ② ③ ④ ⑤ Minimal impact

Impact area	Scoring definition	Cocoa		Beef		Soy		Wheat	
		West Africa	Indonesia	U.S.	Brazil	U.S.	Brazil	U.S.	India
Climate & biodiversity	**Climate** – Presence of significant emitting factors including land use change, enteric fermentation, manure and use of chemical fertilizers, and any common mitigating actions.	2	2	2	1	4	2	4	3
	Off-farm biodiversity – Impact of current land use change on habitat loss.	1	2	2	1	4	2	4	5
	On-farm agricultural biodiversity – Diversity of on-farm agricultural production and presence of native vegetation.	2	2	1	3	2	2	2	2
Soil	**Soil health** – Presence and degree of practices that degrade or enhance soil.	2	2	1	2	2	3	3	2
Water	**Water use** – Typical water use, extent of irrigation or water-saving practices, and water scarcity of production geography.	5	5	4	5	4	4	3	2
	Water pollution – Presence of nutrient and agro-chemical effluents and any mitigating actions.	3	3	1	2	3	3	3	3
Social	**Decent work** – Labor standards, including average income, rights, working conditions and equality—in most affected segment of value chain.	1	2	1	2	4	3	4	2
	Pesticide exposure – Intensity & type of pesticide exposure and degree to which personal protective equipment is used.	2	2	2	3	2	2	2	2
Societal health	**Air quality** – Volume and type of air pollutant generated by production.	3	3	1	1	3	3	3	1
	Anti-microbial resistance – Extent of use of antibiotics.	n/a	n/a	1	3	n/a	n/a	n/a	n/a
	Nutritional diversity of production – Diversity of species produced across ten FAO food groups.	1	1	2	2	2	2	2	2

2.2 CLIMATE AND BIODIVERSITY IMPACTS

Indicator		Rationale for approach to scoring	Scoring thresholds				
			1. Severe	2. High	3. Moderate	4. Low	5. Minimal
Climate and biodiversity	**Climate impacts**	**Based on number of Severe/High/Moderate Emitting Factors (S/H/MEF):[1]** **SEF: i) large-scale tropical forest land use change (current, not historic) ii) enteric emissions from large-scale and/or intensive large-ruminant livestock systems** **HEF: i) moderate tropical forest land use change or any temperate forest land use change ii) large-scale grassland land use change iii) livestock producing high volumes of manure iv) other methane source (e.g., rice paddy)** **MEF: intensive use of chemical fertilizers.** **PLUS factoring in whether relevant actions are taken related to:** **A) Nature protection: (i) traceability solutions (ii) investment in nature-positive forest frontier businesses, OR** **B) Mitigation: (i) reducing enteric fermentation (ii) reducing traditional rice paddy cultivation (iii) improving manure management (iv) improving nutrient management (v) selective breeding, OR** **C) Sequestration: (i) addition of trees (ii) other nature-based solutions that store carbon**	2 SEF, no relevant actions (nature protection, mitigating actions or sequestration)	2 SEF with relevant actions, or 1 SEF/2 HEF and no relevant actions	1 SEF/2 HEF with relevant actions, or 1 HEF with no relevant actions	1 HEF with relevant actions, or MEF with no relevant actions	MEF with relevant actions, or no SEF/HEF/MEF
	Off-farm biodiversity	**Based on the effects of current land use change (LUC) on habitat loss and fragmentation, particularly in biodiversity hotspots**	Leading driver of LUC in biodiversity hotspots	Moderate driver of LUC in biodiversity hotspots, or leading driver in non-hotspots	Indirect or minor driver of LUC in biodiversity hotspots, or moderate driver in non-hotspots	Indirect or minor driver of LUC in non-hotspots	No direct or indirect links to land use change
	On-farm agricultural biodiversity	**Based on the agricultural diversity of the farm production system and the presence of native vegetation on the farm**	Monoculture system, no trees or native vegetation	2-3 species of agricultural product in simple rotation	More than 3 species of crops or trees or livestock	Includes 2 of the following groups and 2+ species: livestock, trees, row crops,+ some native vegetation	Includes 2 of the following groups and 3+ species: tree crops, livestock and native vegetation throughout.

2.2 SOIL HEALTH IMPACTS

Indicator	Rationale for approach to scoring	Scoring thresholds				
		1. Severe	2. High	3. Moderate	4. Low	5. Minimal
Soil health	**Based on:** **A) Presence and degree of soil degrading features and practices:** intensive tillage, deforestation and land clearing, overgrazing, chemical use and monoculture or lack of agricultural diversity[1,2] **B) Presence and degree of practices that enhance soil health:** no or reduced till, crop rotation, cover crops, rotational grazing, leaving plant residue, reducing pesticides/herbicides, buffer strips, manure/nutrient management, biomass planting[3,4,5]	Presence of 4+ degrading practices with no soil enhancing practices	Presence of 3 degrading practices with no soil enhancing practices, or presence of 4+ degrading practices with enhancing practices	Presence of 2 degrading practices with no soil enhancing practices, or presence of 3 degrading practices with enhancing practices	Presence of 1 degrading practice with no soil enhancing practices, or presence of 2 degrading practices with enhancing soil practices	No soil degrading practices, or presence of 1 degrading practice with enhancing soil practices

2.2 WATER USE

Indicator	Rationale for approach to scoring	Scoring thresholds				
		1. Severe	2. High	3. Moderate	4. Low	5. Minimal
Water use	**Based on:** **A) Whether crop is irrigated or rainfed** **B) Blue water use: data from paper dataset with average global crop water use for irrigated systems**[1] **C) Presence of measures to reduce agricultural water use (e.g., drip irrigation, drought-tolerant crop varieties, enhancing soil health or mulching).**[2,3]	Very high water use (≤1100mm) and irrigated, no measures to reduce water use.	High water use (850-1100mm) and irrigated. Or crop typically scores 1, but measures used to reduce water use.	Moderate water use (600-850mm) and irrigated. Or crop typically scores 2, but measures used to reduce water use.	Low water use (350-600mm) irrigated. Or crop typically scores 3, but measures used to reduce water use.	Very low water use (≤350mm) irrigated, or rainfed. Or crop typically scores 4, but measures used to reduce water use.

After scoring a baseline with the methods above, the level of water stress in the key growing regions of each commodity-country pair is to be assessed using a reference such as the WRI Aqueduct Water Risk Atlas and a **penalty** is to be applied in certain cases, as illustrated below.

Water Stress Level	Withdrawal %	Penalty	Final Score = Base – Penalty (min 1)
Low	<10%	0	No change
Low–Medium	10–20%	0	No change
Medium–High	20–40%	–1	Moderate stress
High	40–80%	–2	Significant stress
Extremely High	>80%	–3	Critical depletion

WATER USE PER CROP | DATA TABLE USED FOR SCORING

Comparison of global crop water use (CWU) estimates by Mialyk *et al*.[1] For our analysis, we use the CWU values in the 'Our study' column. This study provides comparable data between crops by using modeled global-level averages rather than country-specific values.

	Rainfed production					**Irrigated production**				
	Average CWU (mm)					**Average CWU (mm)**				
Crop (with * if perennial)	**Our study**	**Chiarelli *et al.***	**Matching cells**	**Spatial correlation**	**Median of differences**	**Our study**	**Chiarelli *et al.***	**Matching cells**	**Spatial correlation**	**Median of differences**
Wheat	331	589	75.1%	0.38	-41.5%	406	778	86.5%	0.36	-46.2%
Maize	367	434	82.3%	0.36	-18.7%	461	627	89.1%	0.64	-27.1%
Rice	370	885	63.9%	0.11	-54.9%	562	935	90.3%	0.16	-35.5%
Barley	214	493	75.6%	0.09	-52.8%	325	455	85.0%	0.59	-28.1%
Sorghum	396	406	78.8%	0.55	-6.6%	549	638	80.4%	0.66	-12.2%
Soya bean	394	450	81.7%	0.50	-12.6%	471	634	88.8%	0.68	-23.9%
Potato	350	329	71.3%	0.63	+5.9%	453	568	85.1%	0.63	-20.9%
Sugar cane*	755	872	68.3%	0.66	-11.9%	1192	1291	89.7%	0.73	-6.7%
Oil palm*	908	1020	80.9%	0.60	-8.8%	1153	1532	44.2%	-0.32	-26.4%
Ground nut	412	397	75.2%	0.65	+6.0%	495	573	71.4%	0.60	-9.7%
Grapes*	353	498	42.6%	0.59	-31.5%	541	708	29.1%	0.73	-27.6%
Cotton	502	497	64.2%	0.47	-1.0%	696	842	89.9%	0.59	-15.5%
Coffee*	647	960	79.9%	0.43	-30.9%	824	1237	67.1%	0.37	-29.0%
Average			**72.3%**	**0.46**	**-19.9%**			**76.7%**	**0.49**	**-23.8%**

Additional values from correspondence from the paper authors: cocoa rainfed = 943.8mm, cocoa irrigated = 1098.2mm

2.2 WATER POLLUTION

Indicator	Rationale for approach to scoring	Scoring thresholds				
		1. Severe	2. High	3. Moderate	4. Low	5. Minimal
Water pollution	**Contributing factors include:** a) **High nutrient effluents from excessive nutrient use and poor manure management,** a major contributor to eutrophication. b) **Agro-chemical effluents associated with pollution** e.g., inappropriate use of pesticides and other biocides. **Mitigating factors to prevent effluents that cause water pollution include:** improved crop nutrient management, buffer strips to filter runoff, improved waste and manure management (e.g., digesters and composting), rotational grazing, cover cropping, and crop rotations	Severe effluents	High effluents	Moderate effluents	Low effluents	Minimal effluents

2.2 SOCIAL IMPACTS

Indicator	Rationale for approach to scoring	Scoring thresholds				
		1. Severe	2. High	3. Moderate	4. Low	5. Minimal
Decent work	**Labor standards (across value chain, e.g., including meatpackers):** • **Average income above minimum wage or poverty line** • **Workers' rights and working conditions (allegations of excessive hours or high rates of occupational injury)** • **Equality and discrimination (allegations of discrimination based on gender, migrant status, indigenous peoples or people with disabilities)**	Widespread allegations of very poor labor standards	Widespread allegations of poor labor standards or localized very poor labor standards	Moderate allegations of poor labor standards	Labor standards largely met with minimal reports of poor conditions	Meets labor standards
Farmer and worker exposure to pesticides	**Hazardous exposure to pesticides (farm level).** Severity of impact is based on duration of exposure, intensity, type of pesticide and the effective use of PPE.	Severe hazardous exposure	High levels of hazardous exposure	Moderate hazardous exposure	Low levels of hazardous exposure	No hazardous exposure

Decent work: The scores are derived from conditions in the parts of the value chain with the most pronounced impacts, for example slaughterhouses in the beef value chain. They do not represent an average of conditions across the value chain.

Exposure to pesticides: We have focused on exposure to pesticides only due to the wide-ranging potential impacts and the scale of pesticides used in many farming systems.

2.2 SOCIETAL HEALTH IMPACTS

Indicator	Rationale for approach to scoring	Scoring thresholds				
		1. Severe	2. High	3. Moderate	4. Low	5. Minimal
Air quality	**Hazardous exposure to airborne agricultural pollutants (societal level):** Severity of impact is based on volume and type of pollutant (e.g., particulates from practices such as slash-and-burn; or agro-chemicals like ammonia in fertilizers or naturally occurring in poorly managed manure which are a key contributor to fine particulate matter).	Severe hazardous exposure	High levels of hazardous exposure	Moderate hazardous exposure	Low levels of hazardous exposure	No hazardous exposure
Anti-microbial resistance	**Use of antibiotics in livestock and aquaculture to promote growth/prevent disease**	Very high use of antibiotics	High use of antibiotics	Moderate use of antibiotics	Occasional use of antibiotics - only when case-by-case necessary	No antibiotic use
Nutritional diversity of production	**Diversity of species produced across 10 food groups (Grains, white roots and tubers, and plantains; Pulses; Nuts and seeds; Milk/milk products; Meat, poultry, and fish; Eggs; Dark green leafy vegetables; Other vitamin A-rich fruits and vegetables; Other vegetables; Other fruits)[1].** **Does not count foods/beverages not listed in the 10 FAO groups (e.g., cocoa, coffee), non-food crops (e.g., rubber, cotton) or food crops grown for non-human consumption (e.g., animal feed, biofuels).**	No food groups produced	Produces 1 food group	Produces 2 food groups	Produces 3 food groups	Produces 4 food groups

BEEF PRODUCTION IN THE US | COMBINING THE IMPACTS OF LIVESTOCK AND FEED PRODUCTION

Context

Some forms of animal agriculture have impacts over two production systems: one for raising the animal itself and a second for producing animal feed.

In our analysis, we consider score these systems separately for US standard/sustainable intensification beef production systems. (Note: we model US cattle feed as soy because US cattle are mainly fed on maize which in the US grows in maize-soybean cropping systems.[1] For Brazil and under US regenerative agricultural practices, cattle are predominantly grazed or fed from the cattle farm itself, so only the livestock system is modelled.)

We follow two approaches to combine the livestock and feed impact scores:

A. We consider most impacts to be non-fungible and not able to be directly added because they occur at the local level.

For these indicators, we take the lower (i.e., worse impact) of the two scores.

Example: Impact on decent work is scored as 3 for livestock system and 4 for feed system. We take 3 as the overall score.

B. We consider climate impacts and nutritional diversity of production as fungible at the global level.

For these indicators, we reassess the individual evidence for the two systems and create a new, combined score for overall beef production.

i. GHG emissions can be directly added and cumulatively contribute to climate change.
Example: Livestock production has 2 HEF (produce manure & source of methane). Feed production has 1 MEF. There are no mitigating actions or sequestration. According to our scoring thresholds, this generates a score of 1.

ii. Production of multiple food groups can contribute to nutritional diversity of production at the global level, through international systems of trade.
Example: The livestock system produces meat (beef) + feed cultivation produces pulses (soy animal feed). These are considered added together, but only beef is counted as animal feed is not considered as a human food group.

Note: for scores that are N/A for one system, the sole score is taken as the overall score. E.g., anti-microbial resistance.

SCORING TRANSFORMED PRODUCTION SYSTEMS | ASSUMPTIONS ABOUT SIMILAR SYSTEMS

According to our definitions, certain production systems are very similar to one another. We therefore use the same scores and rationale for these. These systems are:

1. **Cocoa:** Scores for West Africa and Indonesia are the same for Certified, Intercropped agroforestry, and Multistrata agroforestry systems. Although the scale of these systems differ across the regions, the overarching characteristics of the systems are roughly consistent throughout.
2. **Beef:** We model US cattle feed as soy because US cattle are mainly fed on maize, which in the US grows in maize-soybean cropping systems.
3. **Beef:** Feed scores for US Standard production are same as for US Sustainable Intensification production because we assume feed sourcing doesn't change. (Note: we assume that in Brazil, neither Standard production nor Sustainable Intensification production have separate feed systems).
4. **Beef and soy:** The regenerative Crop-Livestock-Forestry Integration (CLFI) system in Brazil includes both beef and soy and thus scored similarly for each commodity.

3. State of transition

1 Economic and social value

Global dashboard

1.1 Production

- Annual volume of production in top five producing countries.
- Productivity per hectare in top five producing countries.
- Value of gross production in top five producing countries.

1.2 Trade flows and food loss

- Top trade flows by volume and value.
- Share of production lost after production & before consumption.

1.3 Consumption

- Consumption volumes in top-consuming countries.
- Nutrient value score of commodity.
- Contribution to global calories.

2 Risks and impacts

2.1 Risks index

- **Physical climate risks:** the extent to which production volumes and suitable areas of production will be reduced by physical climate impacts.
- **Human rights risks:** the vulnerability to risks of child labor, forced labor or land rights violations.
- **Regulatory risks:** the extent to which incoming regulation could impact business operations; based on materiality, compliance readiness, and exposure.

2.2 Impacts index

- **Climate:** the extent to which emissions from production and land use change impact climate.
- **Biodiversity:** the extent to which production practices impact on-farm biodiversity and land use change impacts off-farm biodiversity.
- **Soil health:** the extent to which production practices negatively impact soil health.
- **Water:** the extent to which a value chain has negative impacts on water use and water pollution.
- **Social:** the extent to which a value chain negatively impacts decent work and pesticide exposure.
- **Societal health:** the impact of production on air quality, anti-microbial resistance, and the nutritional diversity of production.

3 State of the transition

3.1 Transforming production index

- Share of sustainable production today.
- Holistic impact assessment of more regenerative and sustainable production approaches.

3.2 Transforming consumption index

- Implication of existing reference diets on consumption shifts.
- Feasibility of consumption shift in key consumption markets.

4 Economic feasibility of the transition

4.1 Economic feasibility of production transition index

- Farm profitability.
- Productivity of core and diverse products.
- Time to recover or improve profitability.

4.2 Landscape of existing initiatives

- Compilation of certification schemes, sectoral agreements, value chain collaborations, finance mechanisms, landscape initiatives or advocacy efforts.

4.3 Value chain structure

- Market concentration, market power; trade practices; state influence.

4.4 Financial flows analysis

- Breakdown of public and private sources of external finance to the value chain.
- Breakdown of intra-value-chain flows of finance.

3.1 State of production transition

The Food and Land Use Coalition

3.1 DEFINING MORE REGENERATIVE, PRODUCTIVE APPROACHES TO AGRICULTURE

Methodology for defining more regenerative and productive approaches to agriculture.

For each value chain, we have constructed a definition of ‘standard production’ and constructed definitions of commonly understood approaches to more regenerative and productive agriculture. We have also attempted to estimate the proportion of production by volume produced in these different approaches. The definitions and sources for these are outlined in the following tables for each value chain. There are limitations to this approach as for many value chains there is limited data on the adoption of different combinations of practices, outcomes or standards. The definitions and adoption ranges we have provided could be updated as better data becomes available.

Applying our impacts methodology to more regenerative and productive approaches.
Our Impacts methodology outlined in Section 2 is then applied to each of the more regenerative, productive approaches to agriculture to provide indices that compare this to standard production.

3.1 SUMMARY TABLE OF PRODUCTION SYSTEMS | SOY - US

Country / Region	Production systems and standards	Estimated share of production	Key characteristics	Level of detail and consistency	Key references
United States	Standard soy production	Data unavailable	Large-scale monocropping, often rotated with corn, GM seeds dominate, large farms, precision agriculture techniques in some farms. Widespread use of weedkillers and synthetic fertilizers, mostly rainfed, some use of fungicides and insecticides.	Implicit definition – based on dominant production methods in each country	USDA
	Organic certified	<1%	Focus on tillage, crop rotations, cover crops, and preventative or mechanical and biological weed and pest control. Most synthetic fertilizers and pesticides prohibited, use of animal manure or crop waste, no GMO seeds, efficient water use.	Standardized definition – vary by region and country	USDA Organic
	Regenerative agriculture	<1%	Cover crops, mulch, green manure, no till or reduced-till, 3+ crop rotations, extensive natural strips and buffers, some systems integrate livestock grazing. Minimization of synthetic fertilizer or pest control, using natural buffers and biological pest management instead.	Emergent – mixture of outcomes-based and practice-based definitions	IDH, NRDC

3.1 SUMMARY TABLE OF PRODUCTION SYSTEMS | SOY - Brazil

Country / Region	Production systems and standards	Estimated share of production	Key characteristics	Level of detail and consistency	Key references
Brazil	Standard soy production	Data unavailable	Large-scale, mechanized monocropping dominates, often rotated with corn (safrinha). Heavy use of pesticides, high fertilizer reliance, 98% GM crops, increasing use of irrigation in some regions.	Implicit definition – based on dominant production methods in each country	WBCSD, PNAS, industry reports
	Deforestation- and conversion-free (DCF)	33%	Soy whose production does not contribute to the conversion, legal or illegal, of natural forests or other natural ecosystems (e.g., grasslands, wetlands, and savannas) to agriculture or tree plantations after a specified cut-off date.	Standardized, widely adopted by several major organizations	Accountability Framework initiative
	Certified	4%	Encourages agricultural practices that improve productivity and soil health, labor protections, no-deforestation, or zero conversion; and practices that minimize the use of synthetic fertilizers and pesticides.	Standardized – but definitions vary across 70 different schemes	RTRS
	Regenerative CFLI	3-4%	Integrates agricultural, animal farming, and forestry systems through intercropping, crop succession, or crop rotation. Reduced reliance on inputs such as fertilizers through approaches that improve and maintain soil health.	Codified definition – in Brazil's ABC Plan and ILPF framework	EMBRAPA, ABC Plan (Brazil), industry reports

3.1 TRANSFORMING SOY PRODUCTION | IMPACT SCORES – Brazil & US

Key Severe impact ① ② ③ ④ ⑤ Minimal impact

		US			Brazil			
	Production approach	Standard	Certified organic	Regenerative agriculture	Standard	DCF	Certified	Regenerative CLFI
	Definition type	Implicit	Standardized	Emergent	Implicit	Standardized	Standardized	Codified
	Share of production	~99%	<1%	<1%	~90%	~33%	~4%	~3-4%
Impact: Climate	Climate impact	4	4	4	2	4	4	3
Nature	Off-farm biodiversity	4	4	4	2	5	5	5
	On-farm agricultural biodiversity	2	3	3	2	2	2	5
Soil	Soil health	2	3	4	3	3	3	5
Water	Water use	4	4	5	4	4	4	5
	Water pollution	3	4	5	3	3	4	5
Livelihoods	Decent work	4	4	4	3	3	4	4
	Pesticide exposure	2	4	4	2	2	4	4
Societal health	Air quality	3	4	4	3	3	4	3
	Anti-microbial resistance	n/a	n/a	4	n/a	n/a	n/a	3
	Nutritional diversity of production	2	2	3	2	2	2	3
Aggregate impact improvement against the baseline		(30/50)	+6	+10	(26/50)	+5	+10	+16

3.1 SUMMARY TABLE OF PRODUCTION SYSTEMS | BEEF - US

Country / Region	Production systems and standards	Estimated share of production	Key characteristics	Level of detail and consistency	Key references
United States	Standard beef production	Data unavailable	Intensive production with cow-calf, stocker/ backgrounding, and feedlot finishing as separate production phases. High reliance on grain-based feed, synthetic fertilizers used extensively to boost forage and feed crop production, routine antibiotic and hormone use.	Implicit definition – based on dominant production methods in each country	USDA, US FDA, industry reports
	Voluntary Sustainability Frameworks	15-25%	Voluntary frameworks such as US Roundtable for Responsible Beef, with priority indicators to encourage continuous improvement on a range of production practices designed to reduce GHGs and water use and improve land health alongside employee health, safety, and wellbeing.	Voluntary frameworks with no verification or audit requirements	US Roundtable for Responsible Beef Framework
	Certified sustainable / regenerative	<1%	GHG-focused & regenerative certifications, e.g., Low Carbon Beef, ROC, Land to Market™, AGA, AGW, USDA Organic	A variety of codified approaches	USDA Organic standards, Nature Tech Collective, Regenerative Organic certified, USDA partnerships for climate smart commodities

3.1 SUMMARY TABLE OF PRODUCTION SYSTEMS | BEEF - Brazil

Country / Region	Production systems and standards	Estimated share of production	Key characteristics	Level of detail and consistency	Key references
Brazil	Standard beef production	Data unavailable	Predominantly traditional, extensive pastures with minimal management interventions, lower productivity, and efficiency. Minimal input use, reliance on native grasses without fertilizer or soil improvement limits forage quality.	Implicit definition – based on dominant production methods in each country	EMBRAPA, industry reports
	Deforestation- and conversion-free (DCF)	Data unavailable	Beef whose production does not contribute to the conversion, legal or illegal, of natural forests or other natural ecosystems (e.g., grasslands, wetlands, and savannas) to agriculture or tree plantations after a specified cut-off date.	Standardized, widely adopted by several major organizations	Accountability Framework initiative
	Sustainable intensification	10-15%	Combination of rotational grazing, high yield forage grasses, increased stocking rates, combining pasture grazing with feed supplementation to enhance feed efficiency and reduce methane emissions, selective breeding, satellite & digital monitoring for pasture, and herd management.	Loose definition – defined in research but lacks policy standardization	RGSA, industry reports, academic papers
	Regenerative crop-livestock-forestry integration (CLFI)	6%	Integrates agricultural, animal farming, and forestry systems through intercropping, crop succession, or crop rotation. Reduced reliance on inputs through production of forage and feed and reduced need for fertilizers.	Codified definition – in Brazil's ABC Plan and ILPF framework	EMBRAPA, ABC Plan (Brazil), industry reports

3.1 TRANSFORMING BEEF PRODUCTION | IMPACT SCORES – Brazil & US

Key Severe impact 1 2 3 4 5 Minimal impact

			US			Brazil			
		Production approach	Standard	Voluntary frameworks	Certified sustainable	Standard	DCF	Sustainable intensification	Regenerative CLFI
		Definition type	Implicit	Standardized	Emergent	Implicit	Standardized	Standardized	Codified
		Share of production		15-20%	<1%		Data unavailable	10-15%	6%
Impact	Climate	Climate impact	2	2	3	1	2	3	3
	Nature	Off-farm biodiversity	2	2	3	1	5	4	4
		On-farm agricultural biodiversity	1	1	4	3	3	3	5
	Soil	Soil health	1	2	5	2	2	3	5
	Water	Water use	4	4	5	5	5	5	5
		Water pollution	1	3	4	2	2	3	5
	Livelihoods	Decent work	1	2	3	2	2	2	3
		Pesticide exposure	2	2	5	3	3	3	4
	Societal health	Air quality	1	2	4	1	1	2	3
		Anti-microbial resistance	1	3	5	3	3	3	3
		Nutritional diversity of production	2	2	3	2	2	2	3
Aggregate impact improvement against the baseline			(18/55)	+7	+26	(25/55)	+5	+8	+18

3.1 SUMMARY TABLE OF PRODUCTION SYSTEMS | COCOA

Country / Region	Production systems and standards	Estimated share of production	Key characteristics	Level of detail and consistency	Key references
West Africa	Standard cocoa production	~41% in Ghana ~70-90% in Côte d'Ivoire	Smallholder cocoa grown in full-sun monoculture on farms under 5 ha, with aging trees rarely replanted. Limited crop diversity, low input use, and no mechanization. Rainfed systems contribute to soil degradation, high deforestation, and reduced climate resilience.	Implicit definition – based on dominant production methods in each country	World Bank, IISD, Rainforest Alliance, IMANI Centre
Indonesia	Standard cocoa production	95%	Monoculture full-sun cocoa grown by smallholders on farms under 2 ha, with aging trees and low-quality planting material. Inputs are limited, labor is manual, and irrigation is absent. Soil degradation, biodiversity loss, and low farm resilience stem from deforestation and lack of shade cover.	Implicit definition – based on dominant production methods in each country	University of Indonesia, Partnership for Indonesian Sustainable Cocoa, IISD
West Africa and Indonesia	Certified cocoa	34-58% in West Africa 2.5-5% in Indonesia	Incorporates environmental and social safeguards, varying by scheme, promotes crop diversification and incorporation of shade trees. Organic certification eliminates synthetic fertilizers and pesticides, Rainforest Alliance and UTZ allow some synthetic inputs but emphasize integrated pest management.	Standardized definition – in a variety of certification schemes	World Bank, IISD
	Intercropped agroforestry	1-3% in West Africa <1% in Indonesia	Cocoa grown with one other crop or shade layer (e.g., fruit, timber, or native trees) in simple 2-strata systems. Typically rainfed with minimal input use. Offers some biodiversity, soil, and water benefits, though poor shade management can increase disease risk.	Loose definition – defined in research but lacks policy standardization	World Bank, IISD, Tropenbos International
	Multistrata agroforestry	1-3% in West Africa <1% in Indonesia	Cocoa grown in four-layer systems with forest, fruit, cocoa, and soil crops. Organically managed with no synthetic inputs, these complex systems provide shade, biodiversity, and ecological services. Though labor-intensive, they offer resilient, multifunctional production with sustained yields and strong environmental benefits.	Loose definition – defined in research but lacks policy standardization	World Bank, IISD

3.1 TRANSFORMING COCOA PRODUCTION | IMPACT INDEX

The Food and Land Use Coalition

Key Severe impact 1 2 3 4 5 Minimal impact

			West Africa				Indonesia			
		Production approach	Standard	Certified cocoa	Intercropped agroforestry	Multistrata agroforestry	Standard	Certified cocoa	Intercropped agroforestry	Multistrata agroforestry
		Definition type	Implicit	Standardized	Loose definition	Loose definition	Implicit	Standardized	Loose definition	Loose definition
		Share of production		34-58%	1-3%	1-3%	95%	2.5-5%	<1%	<1%
Impact	Climate	Climate impact	2	4	4	5	2	4	4	5
	Nature	Off-farm biodiversity	1	5	2	5	2	5	2	5
		On-farm agri. biodiversity	2	2	2	5	2	2	2	5
	Soil	Soil health	2	3	4	5	2	3	4	5
	Water	Water use	5	5	5	5	5	5	5	5
		Water pollution	3	4	4	5	3	4	4	5
	Livelihoods	Decent work	1	3	3	3	2	3	3	3
		Pesticide exposure	2	3	5	5	2	3	5	5
	Societal health	Air quality	3	5	5	5	3	5	5	5
		Anti-microbial resistance	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Nutritional diversity of production	1	2	2	4	1	2	2	4
Aggregate impact improvement against the baseline			(22/50)	+14	+14	+25	(24/50)	+12	+12	+23

3.1 SUMMARY TABLE OF PRODUCTION SYSTEMS | WHEAT

Country / Region	Production systems and standards	Estimated share of production	Key characteristics	Level of detail and consistency	Key references
United States	Standard wheat production	Data unavailable	Continuous monoculture, intensive tillage, relies heavily on synthetic fertilizers and herbicides.	Implicit definition – based on dominant production methods in each country	USDA
	Regenerative agriculture	<2%	Integrating at least two additional crops into rotation, continuous soil cover with cover crops, mulch, green manure, restoring cropland to native prairie. Reducing tillage intensity, optimizing and reducing use of synthetic fertilizers, replacing chemical pest control with natural buffers or pest-resistant varieties.	Emergent – mixture of outcomes-based and practice-based definitions	OP2B, WBCSD
India	Standard wheat production	Data unavailable	Rice-wheat monocropping, widespread residue burning, heavy fertilizer and pesticide use, heavy groundwater extraction for irrigation.	Implicit definition – based on dominant production methods in each country	ICAR
	Regenerative agriculture	<1%	Inclusion of additional row crops in rotation, perennial fruit and timber trees, direct sowing to reduce tillage, no-burn residue management, improved irrigation efficiency to reduce water use.	Emergent – mixture of outcomes-based and practice-based definitions	Regen10

3.1 TRANSFORMING WHEAT PRODUCTION | IMPACT SCORES

Key Severe impact ① ② ③ ④ ⑤ Minimal impact

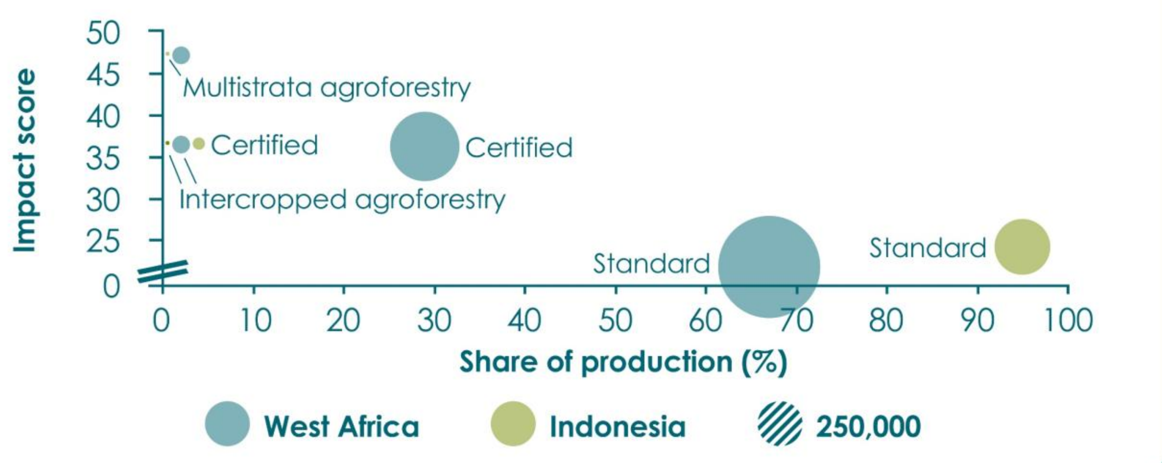
			US		India	
		Production approach	Standard	Regenerative agriculture	Standard	Regenerative agriculture
		Definition type	Implicit	Emergent	Implicit	Emergent
		Share of production	~99%	<1%	~90%	<1%
Impact	Climate	Climate impact	4	3	3	4
	Nature	Off-farm biodiversity	4	5	5	5
		On-farm agricultural biodiversity	2	4	2	4
	Soil	Soil health	3	4	2	5
	Water	Water use	3	5	2	3
		Water pollution	3	4	3	4
	Livelihoods	Decent work	4	4	2	2
		Pesticide exposure	2	4	2	4
	Societal health	Air quality	3	5	1	5
		Anti-microbial resistance	n/a	n/a	n/a	n/a
		Nutritional diversity of production	2	3	2	3
Aggregate impact improvement against the baseline			(30/50)	+11	(28/50)	+15

3.1 WHAT VOLUME OF PRODUCT IN EACH VALUE CHAIN IS PRODUCED TO BETTER STANDARDS?

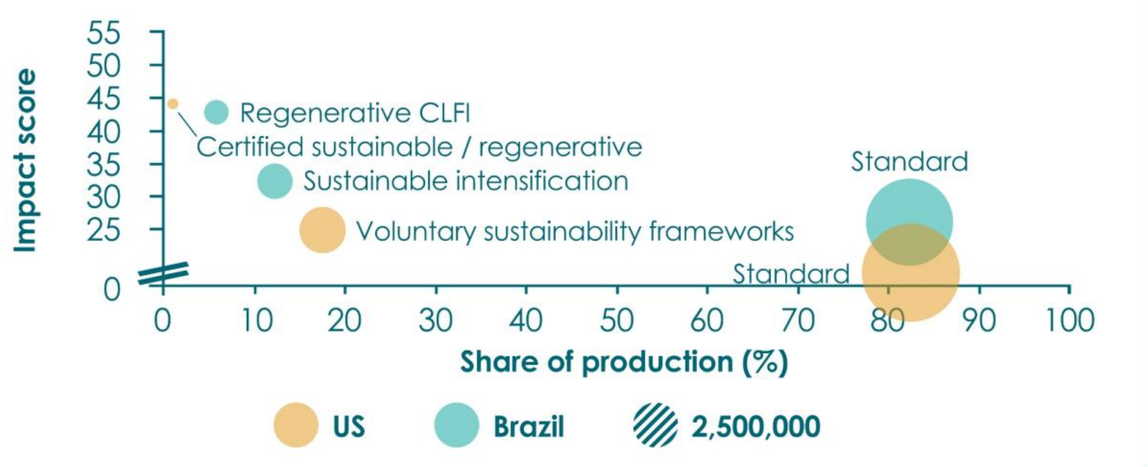
The **Food and Land Use** Coalition

Bubble size is proportional to the absolute volume produced per production system. The Y-axis represents the sum of each production system's individual impact scores. The higher the point on the Y-axis, the more sustainable the production system. The maximum value of the Y-axis in each figure represents the best possible impact score for the commodity.

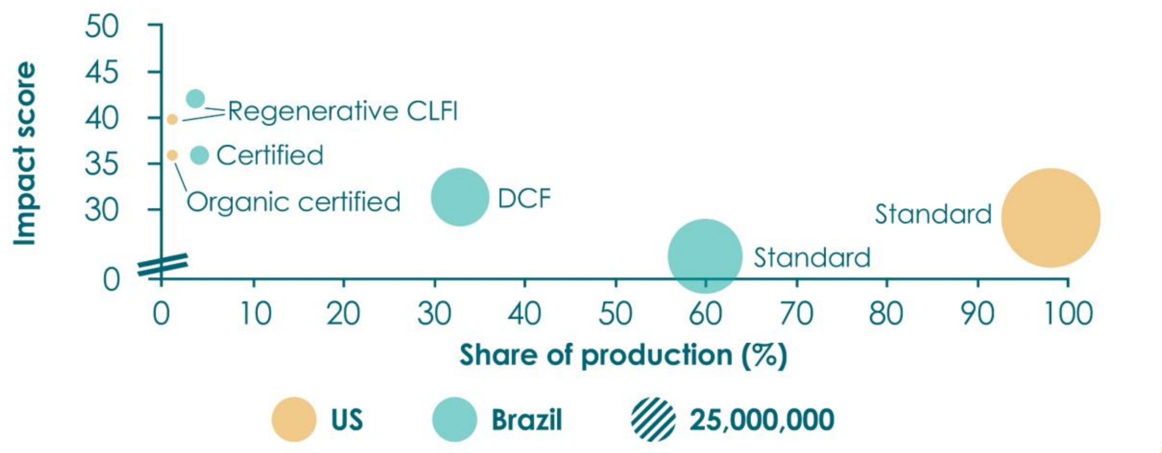
Cocoa



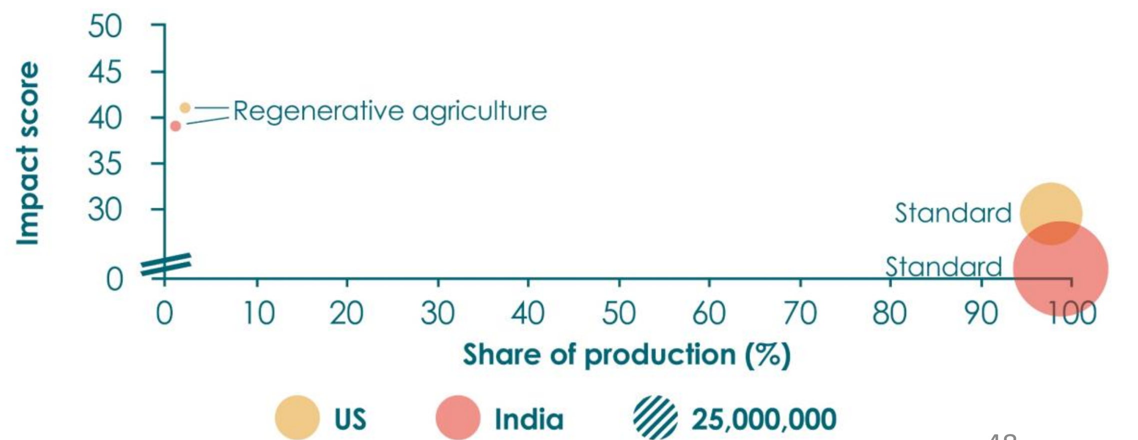
Beef



Soy



Wheat



3.2 State of consumption transition (Soy and beef)

3.2 CONSUMPTION GAP SCORING METHODOLOGY

This methodology assesses how current and projected consumption of key commodities aligns with healthier, more sustainable diets by 2050. It focuses on four diagnostic questions for each commodity-country pair (beef in the U.S. and Brazil, soy in the U.S. and China), using poultry as a proxy for soy in the U.S. and pork as a proxy for soy in China, due to soy's primary use as animal feed. We calculate the percentage change in consumption relative to FAO's 2020 baseline using four reference scenarios:

1. **FAO Business-as-usual (BAU) 2050.** Consumption change is calculated by directly comparing the FAO-projected BAU 2050 per capita consumption with FAO's 2020 historical baseline.
2. **National dietary guidelines (NDGs) 2050.** Where they exist, we used country-specific NDGs define daily or weekly intake targets for agricultural products. We estimate the proportion attributable to individual commodities (e.g., beef, poultry, pork). These adjusted targets are then compared to 2020 FAO baseline values, assuming guidelines remain unchanged by 2050.
3. **World Cancer Research Fund 2050.** World Cancer Research Fund's recommendations were used for assessments of estimated reductions in the consumption of red meat (beef and pork).
4. **EAT-Lancet 2050.** Per-capita intake targets from the EAT-Lancet Commission are compared directly with FAO 2020 baseline values to determine required consumption changes.

3.2 STATE OF THE CONSUMPTION TRANSITION | BAU (2020) VS. REDUCED-CONSUMPTION SCENARIOS BY 2050

Value chain	Soy		Beef	
Producer country	Brazil	US	Brazil	US
Consumption market	China	US	Brazil	US
Demand reduction lever	Pork	Chicken	Beef	Beef
Business As Usual (BAU) to 2050	+19%	+5%	+4%	+2%
National dietary guidelines	+17%	-68%	n/a	-68%
World Cancer Research Fund in 2050	-58%	n/a	-57%	-68%
EAT-Lancet diet in 2050	-92%	-82%	-94%	-93%

About this table

- This table compares business-as-usual consumption in 2050 to the adoption of a healthier or more sustainable diet.
- Dietary guidelines are inconsistent across countries regarding food groups and don’t always provide quantitative upper limits for intake. Therefore, the World Cancer Research Fund’s recommendations were used for assessments of estimated reductions in the consumption of red meat (beef and pork).
- Soy has several possible demand reduction levers, including replacing soy in animal feed. This index assesses the two largest global end uses of soy by volume and value: poultry (37%) and pork (20%).

* Expected change in US soy via changes in patterns of consumption of chicken are based on the US National Dietary Guidelines. No major national or international health authority has yet to provide a specific quantitative guideline for poultry or chicken consumption.

3.2 FEASIBILITY OF CONSUMPTION TRANSITION
I) AVAILABILITY OF ALTERNATIVES, II) PRICE ELASTICITY

Feasibility

Low → **High**

1. What is the availability and quality of alternatives? (fungibility)

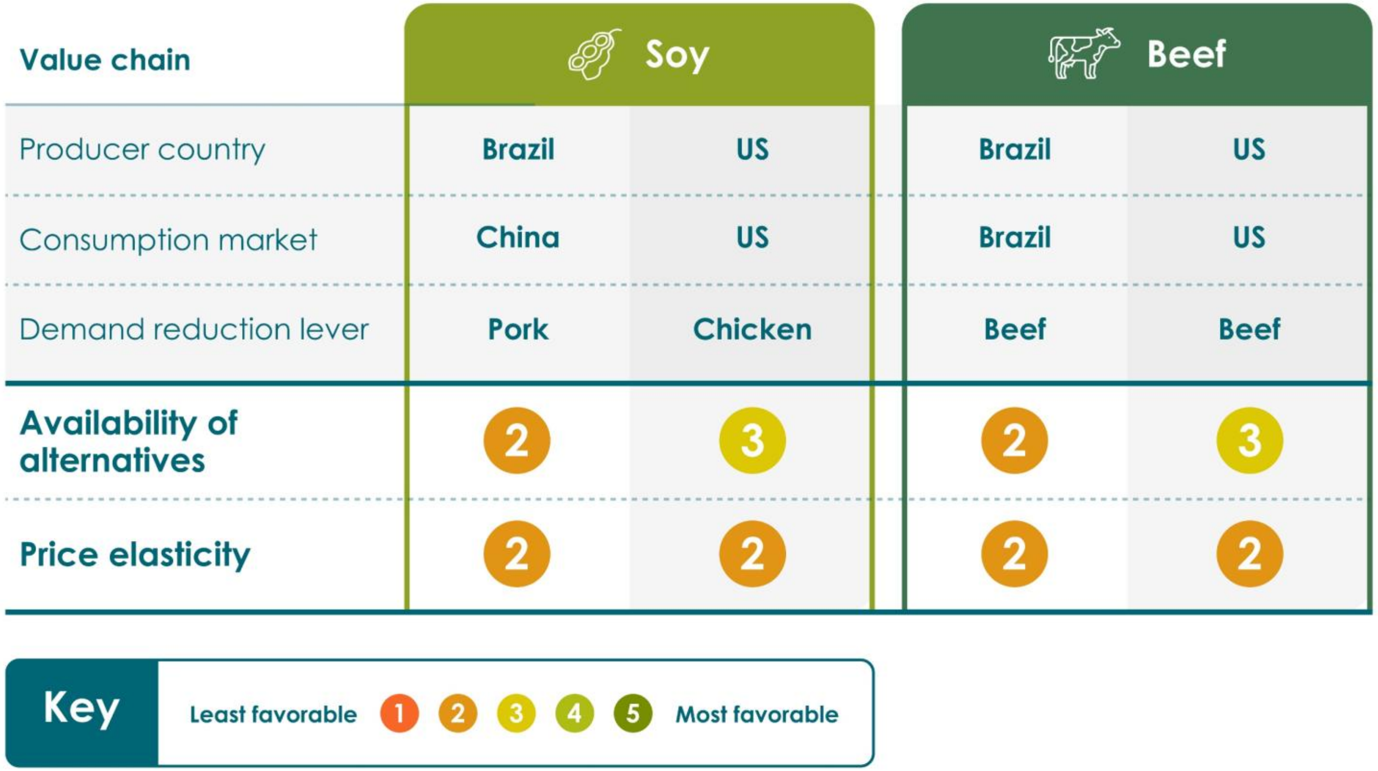
1. The end-product/ commodity has no alternatives readily available to consumers, or all alternatives are significantly lower quality (taste and nutrition) and more expensive
2. The end-product/ commodity has a limited number of alternatives readily available to consumers with similar quality (taste and nutrition) and price
3. The end-product/ commodity has a fair number of alternatives with similar quality (taste and nutrition) and price
4. The end-product/ commodity has a good number of alternatives readily available to consumers with equal quality (taste and nutrition) and similar price
5. The end-product/ commodity has plenty of alternatives readily available to consumers with equal or superior quality (taste and nutrition) and price parity

2. What is the price elasticity of the end-product?

1. The product is a necessity (e.g., staple foods) and has inelastic demand: consumers will continue buying if the prices increase (elasticity: -0.2 to 0)
2. Price elasticity is between -0.5 and -0.2. This may reflect high importance in daily diets and/or high cultural significance.
3. Price elasticity is between -0.8 and -0.5
4. Price elasticity is between -0.8 and -1.2. This may reflect low importance in daily diets and/or low cultural significance.
5. The product is a luxury or a non-essential item and consumers can cut back when prices rise (elasticity: between -1.5 and -2)

3.2 STATE OF THE CONSUMPTION TRANSITION

Index: Transforming consumption – feasibility



Value chain	Soy		Beef	
Producer country	Brazil	US	Brazil	US
Consumption market	China	US	Brazil	US
Demand reduction lever	Pork	Chicken	Beef	Beef
Availability of alternatives	2	3	2	3
Price elasticity	2	2	2	2

Key Least favorable ① ② ③ ④ ⑤ Most favorable

Key insights

- Price elasticity of meat consumption is low across all markets assessed, reflecting the significant cultural significance of meat consumption.
- The US chicken market has the highest feasibility for reducing soy consumption due to a higher availability of meat alternatives.
- This could change as the Chinese government has a stated goal of reducing meat consumption and is investing in R&D alternatives to soy in animal feed.
- The potential for substantial demand shifts in the future creates risks for soy producers.

4. Economic feasibility of the transition

1 Economic and social value

Global dashboard

1.1 Production

- Annual volume of production in top five producing countries.
- Productivity per hectare in top five producing countries.
- Value of gross production in top five producing countries.

1.2 Trade flows and food loss

- Top trade flows by volume and value.
- Share of production lost after production & before consumption.

1.3 Consumption

- Consumption volumes in top-consuming countries.
- Nutrient value score of commodity.
- Contribution to global calories.

2 Risks and impacts

2.1 Risks index

- **Physical climate risks:** the extent to which production volumes and suitable areas of production will be reduced by physical climate impacts.
- **Human rights risks:** the vulnerability to risks of child labor, forced labor or land rights violations.
- **Regulatory risks:** the extent to which incoming regulation could impact business operations; based on materiality, compliance readiness, and exposure.

2.2 Impacts index

- **Climate:** the extent to which emissions from production and land use change impact climate.
- **Biodiversity:** the extent to which production practices impact on-farm biodiversity and land use change impacts off-farm biodiversity.
- **Soil health:** the extent to which production practices negatively impact soil health.
- **Water:** the extent to which a value chain has negative impacts on water use and water pollution.
- **Social:** the extent to which a value chain negatively impacts decent work and pesticide exposure.
- **Societal health:** the impact of production on air quality, anti-microbial resistance, and the nutritional diversity of production.

3 State of the transition

3.1 Transforming production index

- Share of sustainable production today.
- Holistic impact assessment of more regenerative and sustainable production approaches.

3.2 Transforming consumption index

- Implication of existing reference diets on consumption shifts.
- Feasibility of consumption shift in key consumption markets.

4 Economic feasibility of the transition

4.1 Economic feasibility of production transition index

- Farm profitability.
- Productivity of core and diverse products.
- Time to recover or improve profitability.

4.2 Landscape of existing initiatives

- Compilation of certification schemes, sectoral agreements, value chain collaborations, finance mechanisms, landscape initiatives or advocacy efforts.

4.3 Value chain structure

- Market concentration, market power; trade practices; state influence.

4.4 Financial flows analysis

- Breakdown of public and private sources of external finance to the value chain.
- Breakdown of intra-value-chain flows of finance.

4.1 Economic feasibility of the production transition

4.1 ECONOMIC FEASIBILITY OF PRODUCTION TRANSITION INDICES

These scores are applied to the more regenerative and productive agriculture systems as defined in Section 3.1.

They are comparisons against the baseline of standard production for each value chain, as scored in the impact indices of Section 3.1.

Indices and scores for economic feasibility of the transition have been provided for soy and beef alongside their impact indices and scores to enable a holistic comparison of impact and economic feasibility.

4.1 TRANSFORMING SOY AND BEEF PRODUCTION | ECONOMIC FEASIBILITY INDEX

		Brazil							
		Soy				Beef			
	Production approach	Standard	DCF	Certified	Regenerative CLFI	Standard	DCF	Sustainable intensification	Regenerative CLFI
	Definition type	Implicit	Standardized	Standardized	Codified	Implicit	Standardized	Standardized	Codified
	Share of production	~90%	~33%	~4%	~3-4%		Data unavailable	10-15%	6%
Economic feasibility: Transition risk	Time to regain profits		n/a	3	3		n/a	2	3
Economic feasibility: Value added in the transition	Farm profitability		0	+1	+2		0	+2	+2
	Core product productivity		0	0	+1		0	+2	+1
	Diverse products productivity		0	0	+2		0	0	+2

Key: Transition risk – Time to regain profits

1	2	3	4	5
10+ years	5-10 years	3-5 years	1-3 years	0-1 years

Key: Value added in the transition – Profitability and productivity relative to standard production

-2	-1	0	+1	+2
Greatly decrease	Decrease	No change	Increase	Greatly increase

4.1 ECONOMIC FEASIBILITY OF TRANSFORMING PRODUCTION TRANSITION RISK

The Food and Land Use Coalition

Scoring

Low → **High**

1. How long will it take for farmers to recover or improve their profitability ?

1 10+ years	**2** 5-10 years	**3** 3-5 years	**4** 1-3 years	**5** <1 year

This assesses the time it will take farmers to recover or exceed baseline levels of profitability, taking into account the size of upfront investment required for the transition to the more regenerative and productive approach, and the time it takes for optimum yield productivity to be reached in the new system to 'pay back' the initial upfront investment.

4.1 ECONOMIC FEASIBILITY OF TRANSFORMING PRODUCTION VALUE ADDED IN THE TRANSITION

The Food and Land Use Coalition

Scoring

Low → High

How is economic value created for farmers in the production transition?

1. To what extent will the transition improve profitability for farmers?

-2	-1	0	1	2
Significantly lower profitability	Slightly lower profitability	No change in profitability	Improved profitability	Substantially improved profitability

Aligns with improved incomes and added value core performance indicators of FAO TAPE performance criteria

2. What is the long-term impact on the productivity of core commodities production?

-2	-1	0	1	2
Significantly lower productivity	Slightly lower productivity	No change to productivity	Improved productivity	Substantially improved productivity

This score assesses the productivity after a transition period which may entail a temporary yield drop. Aligns with improved productivity economic performance indicator of FAO TAPE performance criteria, but TAPE looks at total farm productivity, we are comparing the core and diversified crops.

3. What is the long-term impact on the yields of other products?

-2	-1	0	1	2
Significantly lower productivity	Slightly lower productivity	No change to productivity	Improved productivity	Substantially improved productivity

Aligns with improved productivity economic performance indicator of FAO TAPE performance criteria, but TAPE looks at total farm productivity, we are comparing the core and diversified crops.

4.2 Landscape assessment of existing initiatives to drive change (Soy and beef in Brazil)

The Food and Land Use Coalition

4.2 SIGNIFICANT VALUE-CHAIN-FOCUSED INITIATIVES SOY, BRAZIL

Initiative name	Initiative type	Link
Roundtable on Responsible Soy Association (RTRS)	Certification	https://responsiblesoy.org/?lang=en
Amazon Soy Moratorium (ASM)	Sectoral agreement	https://moratoriadasoja.com.br/home (Portuguese)
Soft Commodities Forum (SCF)	Trader collaboration	https://www.wbcsd.org/actions/soft-commodities-forum/
Consumer Goods Forum (CGF) Forest Positive Coalition	Retailer & manufacturer coalition	https://www.theconsumergoodsforum.com/planet/forest-positive/
Innovative Finance for the Amazon, Cerrado, and Chaco (IFACC)	Finance coalition/commitment & knowledge hub	https://www.ifacc-initiative.org/home
Responsible Commodities Facility (RCF)	Finance mechanism	https://sim.finance/responsible-commodities-facility/
Protect, Conserve, Include (PCI) initiative (Mato Grosso)	Landscape approach	https://pcimonitor.org/
WBCSD Landscape Accelerator Brazil (LAB)	Landscape approach	https://www.wbcsd.org/actions/landscape-accelerator-brazil-lab/
Soy China initiative	Bilateral Brazil-China initiative (proposed)	https://apps.fas.usda.gov/newgainapi/api/Report/DownloadReportByFileName?fileName=Assessment%20of%20Soy%20China%20Initiative%20in%20Brazil_Brasilia_Brazil_BR2025-0019.pdf
Tropical Forest Alliance (TFA)	China engagement	https://www.tropicalforestalliance.org/china

4.2 SIGNIFICANT VALUE-CHAIN-FOCUSED INITIATIVES BEEF, BRAZIL

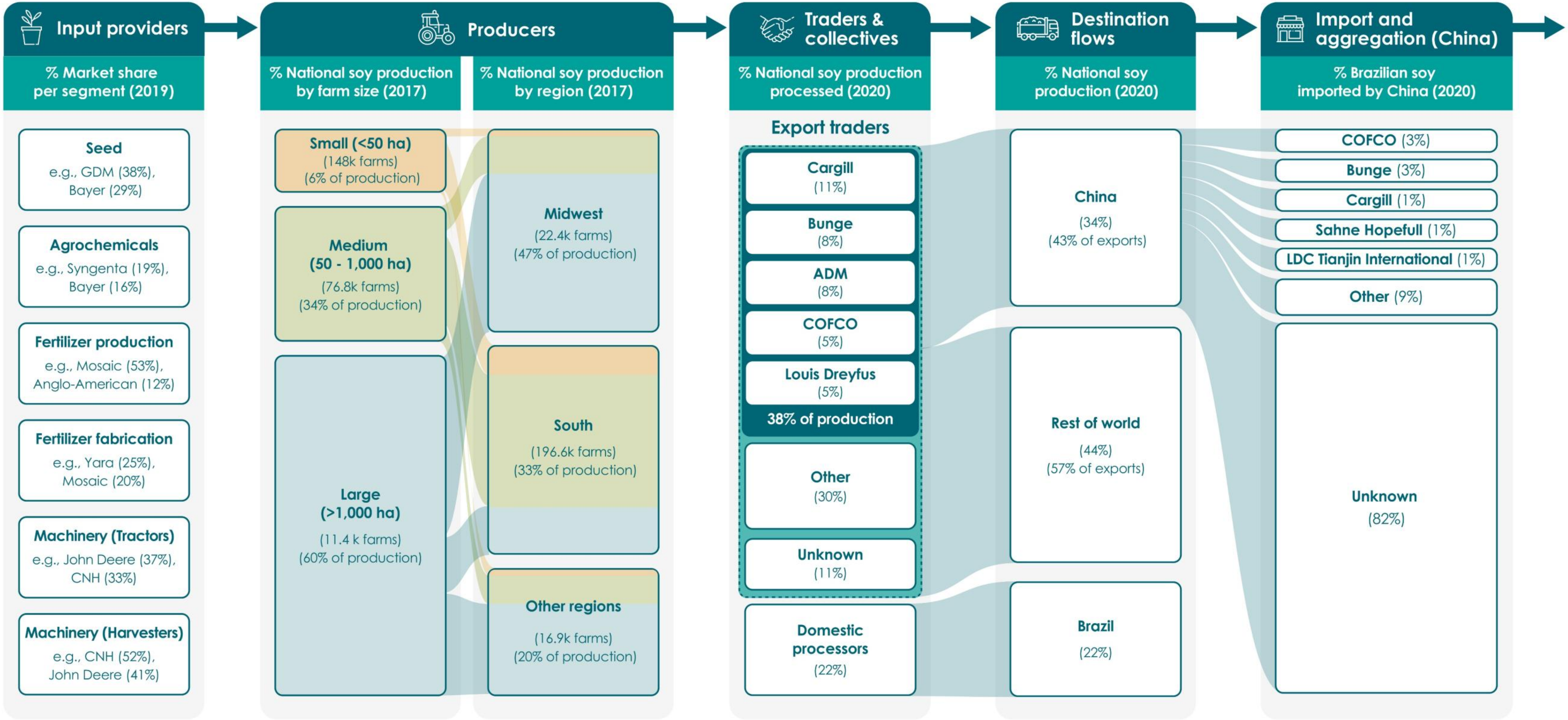
Initiative name	Initiative type	Link
Carbon Neutral Brazilian Beef (Embrapa)	Certification	https://www.embrapa.br/busca-de-publicacoes/-/publicacao/1080610/carbon-neutral-brazilian-beef-a-new-concept-for-sustainable-beef-production-in-the-tropics
TAC da Carne (Termo de Ajustamento de Conduta)	Sectoral agreement	https://moratoriadasoja.com.br/home (Portuguese)
Febraban self-regulation – cattle traceability scheme	Sectoral agreement	https://www.reuters.com/sustainability/brazilian-banks-urged-crack-down-meatpackers-tied-deforestation-2023-05-30/
Carrefour Beef Transparency Platform	Retailer policy	https://grupocarrefourbrasil.com.br/sustentabilidade/transparency-plataform-beef?utm_source=versao_pt&utm_medium=plataforma_transp&utm_id=transparency-platform-beef
Producão sustentavel de bezerros – IDH, Carrefour, Mars Pert Care, Marfrig, Faepa, Acrimat	Multi-stakeholder TA/finance/compliance program	https://idhbrasil.com/atuacao/producao-sustentavel-de-bezerros/ (Portuguese)
Boi na Linha	Monitoring and compliance	https://www.boinalinha.org/
SeloVerde (Pará & Mato Grosso)	Monitoring and compliance	https://csr.ufmg.br/seloverde21/en/
Sustainable Livestock Farming Program of Pará	Jurisdictional traceability and compliance program	https://agenciapara.com.br/noticia/49601/para-lanca-na-cop-28-plano-para-rastrear-individualmente-todo-o-rebanho-do-estado-ate-2026
Protect, Conserve, Include (PCI) initiative (Mato Grosso)	Landscape approach	https://pcimonitor.org/
WBCSD Landscape Accelerator Brazil (LAB)	Landscape approach	https://www.wbcsd.org/actions/landscape-accelerator-brazil-lab/
Bolsa Floresta	Payments for ecosystem services	https://fas-amazonia.org/wp-content/uploads/2022/12/bolsa-floresta-program-en-compressed.pdf
Bolsa Verde	Payments for ecosystem services	https://www.gov.br/mma/pt-br/composicao/snpct/dpct/bolsa-verde (Portuguese)
Boi China initiative	Bilateral Brazil-China engagement	https://agro.insper.edu.br/storage/papers/August2025/O_caso_boi_china.pdf (Portuguese)

4.3 Value chain structure

The Food and Land Use Coalition

4.3 VALUE CHAIN STRUCTURE MAP | VOLUME FLOWS | SOY BRAZIL-CHINA VALUE CHAIN (1/2)

The Food and Land Use Coalition



Input providers

% Market share per segment (2019)

- **Seed** e.g., GDM (38%), Bayer (29%)
- **Agrochemicals** e.g., Syngenta (19%), Bayer (16%)
- **Fertilizer production** e.g., Mosaic (53%), Anglo-American (12%)
- **Fertilizer fabrication** e.g., Yara (25%), Mosaic (20%)
- **Machinery (Tractors)** e.g., John Deere (37%), CNH (33%)
- **Machinery (Harvesters)** e.g., CNH (52%), John Deere (41%)

Producers

% National soy production by farm size (2017)

- **Small (<50 ha)** (148k farms) (6% of production)
- **Medium (50 - 1,000 ha)** (76.8k farms) (34% of production)
- **Large (>1,000 ha)** (11.4 k farms) (60% of production)

% National soy production by region (2017)

- **Midwest** (22.4k farms) (47% of production)
- **South** (196.6k farms) (33% of production)
- **Other regions** (16.9k farms) (20% of production)

Traders & collectives

% National soy production processed (2020)

Export traders

- **Cargill** (11%)
- **Bunge** (8%)
- **ADM** (8%)
- **COFCO** (5%)
- **Louis Dreyfus** (5%)

38% of production

- **Other** (30%)
- **Unknown** (11%)
- **Domestic processors** (22%)

Destination flows

% National soy production (2020)

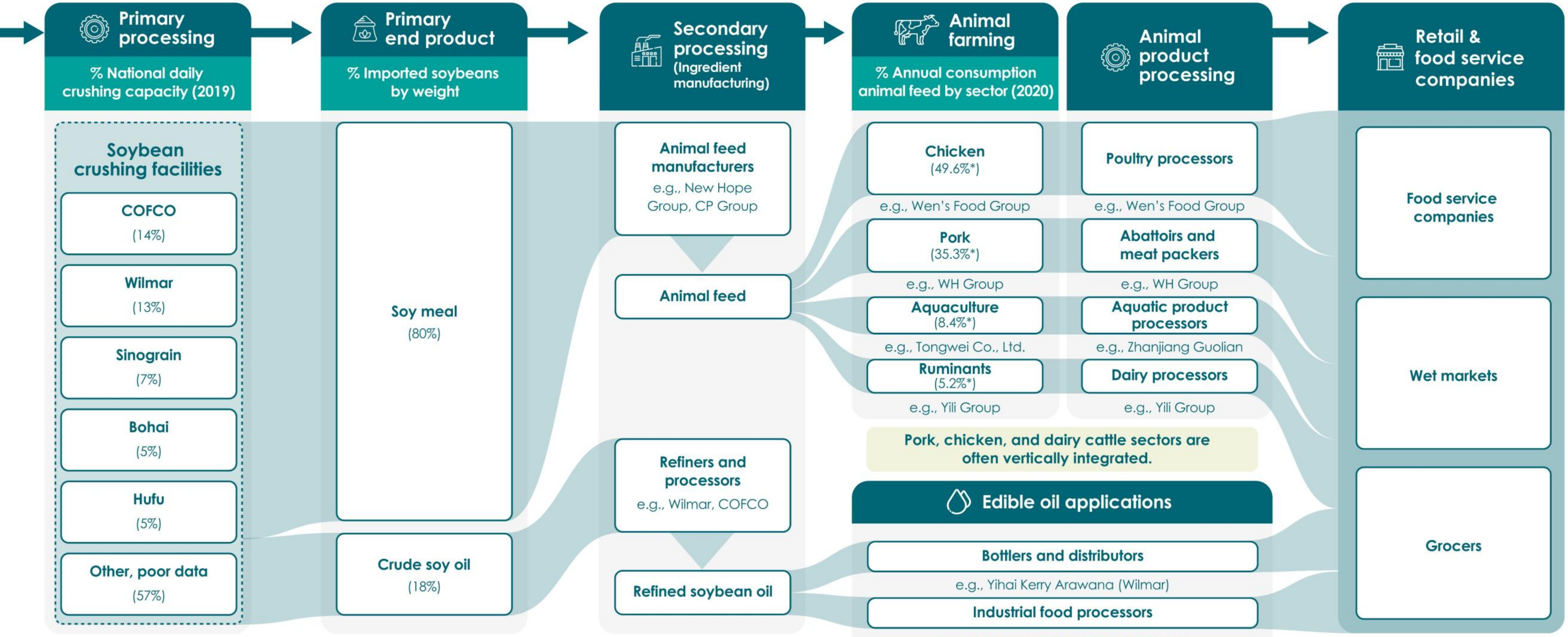
- **China** (34%) (43% of exports)
- **Rest of world** (44%) (57% of exports)
- **Brazil** (22%)

Import and aggregation (China)

% Brazilian soy imported by China (2020)

- **COFCO** (3%)
- **Bunge** (3%)
- **Cargill** (1%)
- **Sahne Hopefull** (1%)
- **LDC Tianjin International** (1%)
- **Other** (9%)
- **Unknown** (82%)

4.3 VALUE CHAIN STRUCTURE MAP | VOLUME FLOWS | SOY BRAZIL-CHINA VALUE CHAIN (2/2)



Primary processing

% National daily crushing capacity (2019)

Soybean crushing facilities

- **COFCO** (14%)
- **Wilmar** (13%)
- **Sinograin** (7%)
- **Bohai** (5%)
- **Hufu** (5%)
- **Other, poor data** (57%)

Primary end product

% Imported soybeans by weight

- **Soy meal** (80%)
- **Crude soy oil** (18%)

Secondary processing (Ingredient manufacturing)

- **Animal feed manufacturers** e.g., New Hope Group, CP Group
- **Animal feed**
- **Refiners and processors** e.g., Wilmar, COFCO
- **Refined soybean oil**

Animal farming

% Annual consumption animal feed by sector (2020)

- **Chicken** (49.6%*) e.g., Wen's Food Group
- **Pork** (35.3%*) e.g., WH Group
- **Aquaculture** (8.4%*) e.g., Tongwei Co., Ltd.
- **Ruminants** (5.2%*) e.g., Yili Group

Animal product processing

- **Poultry processors** e.g., Wen's Food Group
- **Abattoirs and meat packers** e.g., WH Group
- **Aquatic product processors** e.g., Zhanjiang Guolian
- **Dairy processors** e.g., Yili Group

Pork, chicken, and dairy cattle sectors are often vertically integrated.

Edible oil applications

- **Bottlers and distributors** e.g., Yihai Kerry Arawana (Wilmar)
- **Industrial food processors** e.g., Master Kong (Tingyi Holding Corp.)

Retail & food service companies

- **Food service companies**
- **Wet markets**
- **Grocers**

98% of Chinese soy imports are whole beans, and many importers are fully integrated agribusinesses with in-house crushing and manufacturing.

Tofu and tempeh are usually manufactured from domestically-grown soy.

4.3 VALUE CHAIN STRUCTURE MAP | VOLUME FLOWS | BEEF
BRAZIL DOMESTIC VALUE CHAIN

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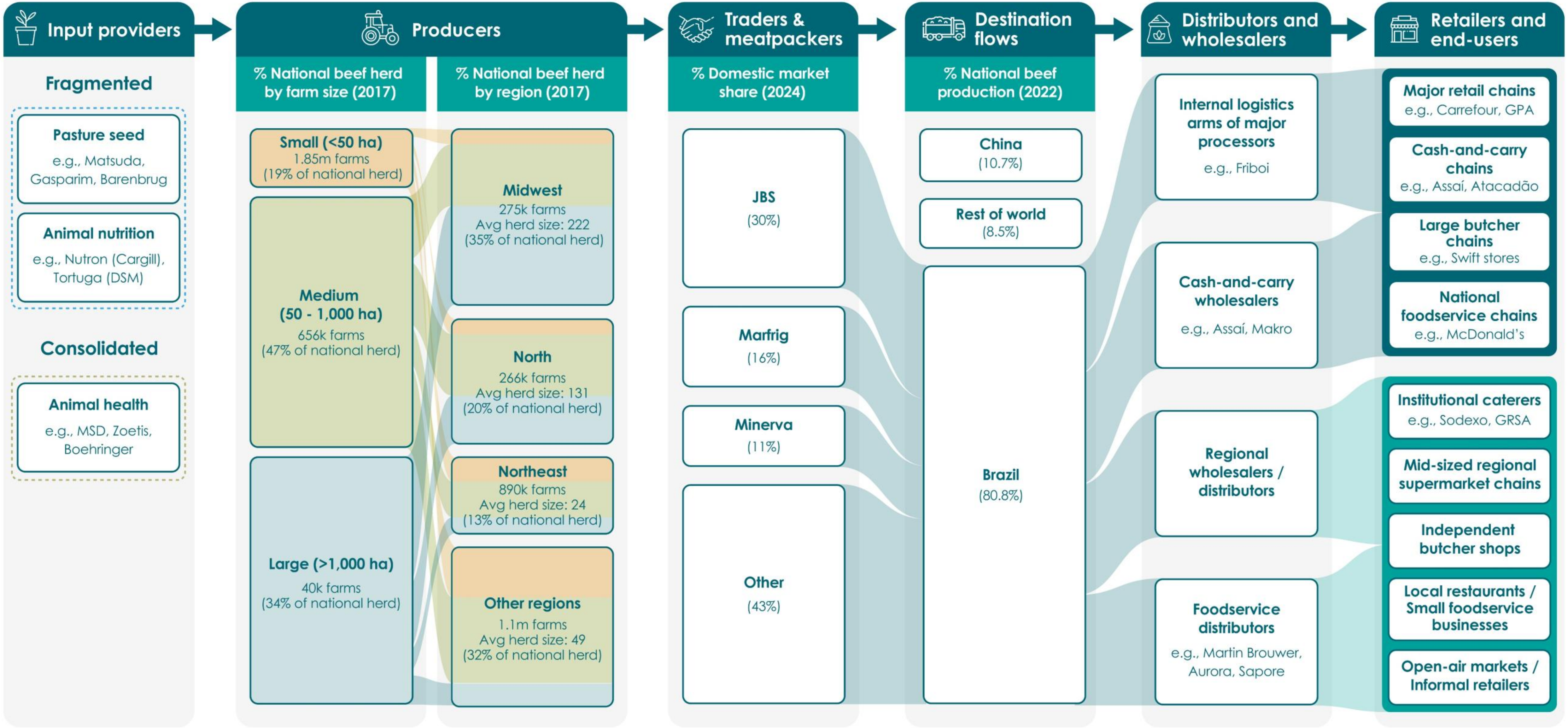
Coalition



Input providers

Fragmented

Pasture seed
e.g., Matsuda, Gasparim, Barenbrug

Animal nutrition
e.g., Nutron (Cargill), Tortuga (DSM)

Consolidated

Animal health
e.g., MSD, Zoetis, Boehringer

Producers

% National beef herd by farm size (2017)

Small (<50 ha)
1.85m farms
(19% of national herd)

Medium (50 - 1,000 ha)
656k farms
(47% of national herd)

Large (>1,000 ha)
40k farms
(34% of national herd)

% National beef herd by region (2017)

Midwest
275k farms
Avg herd size: 222
(35% of national herd)

North
266k farms
Avg herd size: 131
(20% of national herd)

Northeast
890k farms
Avg herd size: 24
(13% of national herd)

Other regions
1.1m farms
Avg herd size: 49
(32% of national herd)

Traders & meatpackers

% Domestic market share (2024)

JBS
(30%)

Marfrig
(16%)

Minerva
(11%)

Other
(43%)

Destination flows

% National beef production (2022)

China
(10.7%)

Rest of world
(8.5%)

Brazil
(80.8%)

Distributors and wholesalers

Internal logistics arms of major processors
e.g., Friboi

Cash-and-carry wholesalers
e.g., Assaí, Makro

Regional wholesalers / distributors

Foodservice distributors
e.g., Martin Brouwer, Aurora, Sapore

Retailers and end-users

Major retail chains
e.g., Carrefour, GPA

Cash-and-carry chains
e.g., Assaí, Atacadão

Large butcher chains
e.g., Swift stores

National foodservice chains
e.g., McDonald's

Institutional caterers
e.g., Sodexo, GRSA

Mid-sized regional supermarket chains

Independent butcher shops

Local restaurants / Small foodservice businesses

Open-air markets / Informal retailers

4.4 Financial flows analysis

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Coalition

4.4 VALUE CHAIN FINANCIAL FLOWS: FINANCIAL SECTOR AND PUBLIC SECTOR FLOWS MATERIAL FINANCIAL FLOWS BY TYPE OF FINANCE IN THE BRAZILIAN SOY VALUE CHAIN

The
Food and Land Use
Coalition

Financial Sector and Public Sector Flows: Breakdown by type of finance

Type of finance	Estimated value (USD) (2013-2020)[1]	Approx. % of beef formal finance	Flow origin	Flow recipient
Debt: Subsidized rural credit Working capital, crop finance Legal requirements mean that around two-thirds of funding comes from deposits at Brazilian banks, with subsidized interest rates on approximately 75% of the credit	~$47.7 bn	**74%**	**Brazilian Government** - National Rural Credit System (SNCR)	**Brazilian cattle farmers—mostly large farmers**
Debt: Commercial lending Short- and medium-term loans, including working capital and investment credit; supply chain loans; production credit	~$1.8 bn	**3%**	**All other public and private sources of financing:** Brazilian public and private banks (as commercial lenders) and foreign banks	**Brazilian cattle farmers, cooperatives, traders**
Underwriting	~$11.2 bn	**17%**		
Shareholding	~$4.1 bn	**6%**		
Bondholding	~$0.6 bn	**1%**		

4.4 VALUE CHAIN FINANCIAL FLOWS: FINANCIAL SECTOR AND PUBLIC SECTOR FLOWS MATERIAL FINANCIAL FLOWS BY FLOW ORIGIN IN THE BRAZILIAN SOY VALUE CHAIN

The Food and Land Use Coalition

Financial Sector and Public Sector Flows: Breakdown by flow origin

Flow Origin	Flow recipient	Type of debt	Estimated value (USD) (2013-2020)[1]	Approx. % of soy formal lending	Approx. distribution of flows
Banco do Brasil	**Brazilian soy farmers**	Short- and medium-term loans, including working capital and investment credit	~$14.8 bn	**45%**	Banco do Brasil and other Brazilian public banks play a significant role as conduits of public finance in addition to commercial lending.
Other Brazilian public banks	**Brazilian soy farmers**	Short- and medium-term loans, including working capital and investment credit	~$3.2 bn	**10%**	
Brazilian private banks (e.g., Bradesco, BTG Pactual)	**Soy producers, cooperatives**	Commercial loans, working capital, supply chain finance, production credit	~$7.6 bn	**16%**	Private credit overwhelmingly flows to large, low-risk soy producers with collateral and supply chain integration. Smallholders remain sidelined due to informality, perceived risk, and lack of assets.
Western banks* (e.g., Rabobank, Santander, HSBC)	**Traders, large-scale producers**	Corporate loans, supply chain finance	~$7.7 bn	**16%**	

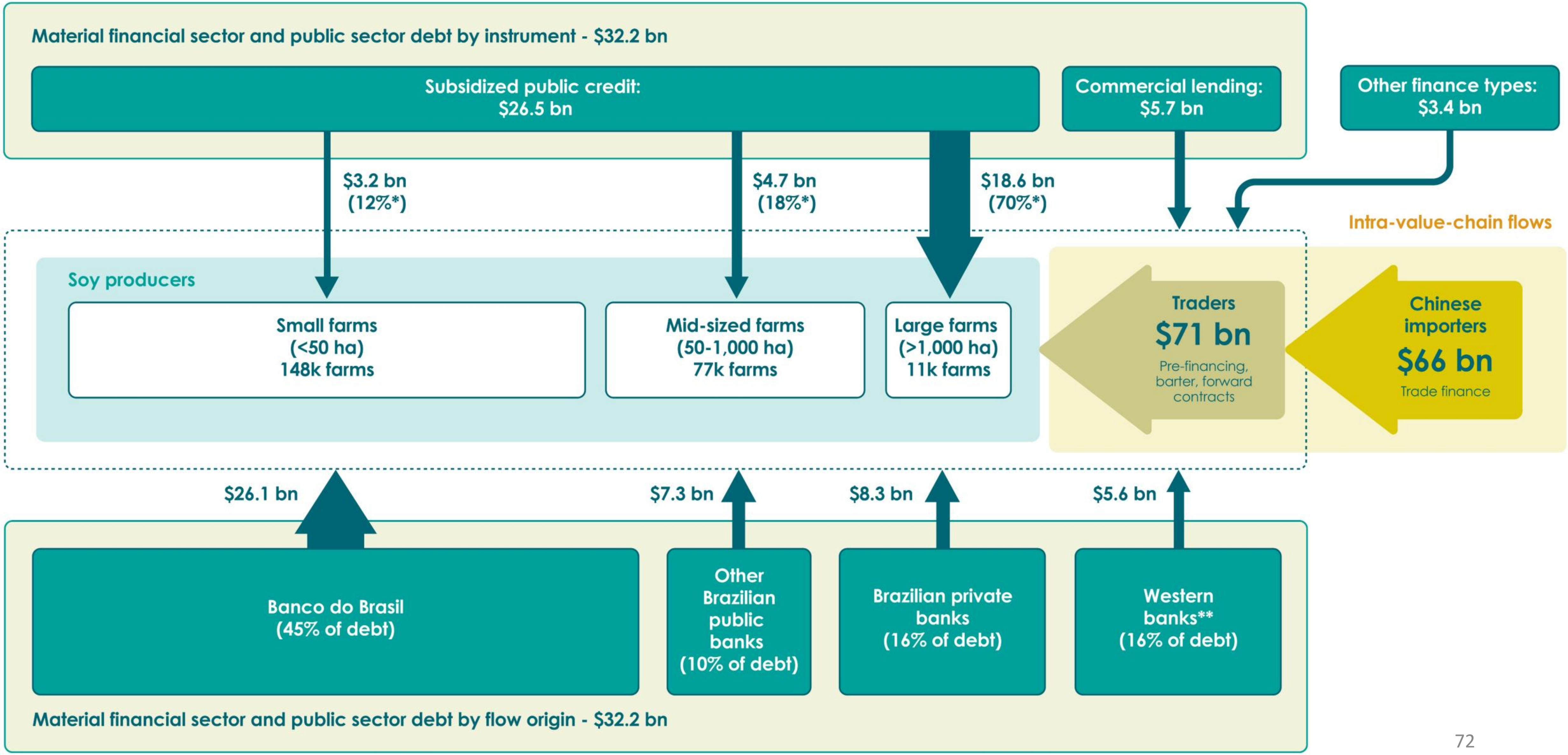
4.4 VALUE CHAIN FINANCIAL FLOWS: INTRA-VALUE-CHAIN FLOWS
MATERIAL FINANCIAL FLOWS BY FLOW ORIGIN IN THE BRAZILIAN SOY VALUE CHAIN

The
Food and Land Use
Coalition

Intra-value-chain flows

Flow Origin	Flow recipient	Type of finance	Estimated value (USD) (2013-2020)[1]	Approx. distribution of flows
Multinational traders (e.g., Cargill, Bunge, ADM)	**Brazilian soy farmers**	Pre-financing, barter (future crop inputs), forward contracts	~$71 bn[1]	Predominantly flow to large, low-risk producers. Barter and trade finance are dominated by input suppliers and traders but remain out of reach for smallholders lacking land titles, delivery guarantees, and formal market access.
Chinese importers (State/private)	**Brazilian traders, exporters**	Trade finance (letters of credit, advance payments)	~$66 bn[2]	Assuming proportional distribution of soy volume exported, most finance flows to the top five traders by volume. In descending order, these are: Cargill, Bunge, ADM, COFCO, and Louis Dreyfus, which collectively handle 38% of Brazilian soy production.

4.4 VALUE CHAIN FINANCIAL FLOWS: BRAZILIAN SOY VALUE CHAIN MATERIAL FINANCIAL FLOWS (2013-2020)



Material financial sector and public sector debt by instrument - $32.2 bn

Subsidized public credit: $26.5 bn

Commercial lending: $5.7 bn

Other finance types: $3.4 bn

$3.2 bn (12%*)

$4.7 bn (18%*)

$18.6 bn (70%*)

Intra-value-chain flows

Soy producers

Small farms (<50 ha) 148k farms

Mid-sized farms (50-1,000 ha) 77k farms

Large farms (>1,000 ha) 11k farms

Traders $71 bn Pre-financing, barter, forward contracts

Chinese importers $66 bn Trade finance

$26.1 bn

$7.3 bn

$8.3 bn

$5.6 bn

Banco do Brasil (45% of debt)

Other Brazilian public banks (10% of debt)

Brazilian private banks (16% of debt)

Western banks** (16% of debt)

Material financial sector and public sector debt by flow origin - $32.2 bn

4.4 VALUE CHAIN FINANCIAL FLOWS: FINANCIAL SECTOR AND PUBLIC SECTOR FLOWS
MATERIAL FINANCIAL FLOWS BY TYPE OF FINANCE IN THE BRAZILIAN BEEF VALUE CHAIN

Financial Sector and Public Sector Flows: Breakdown by type of finance

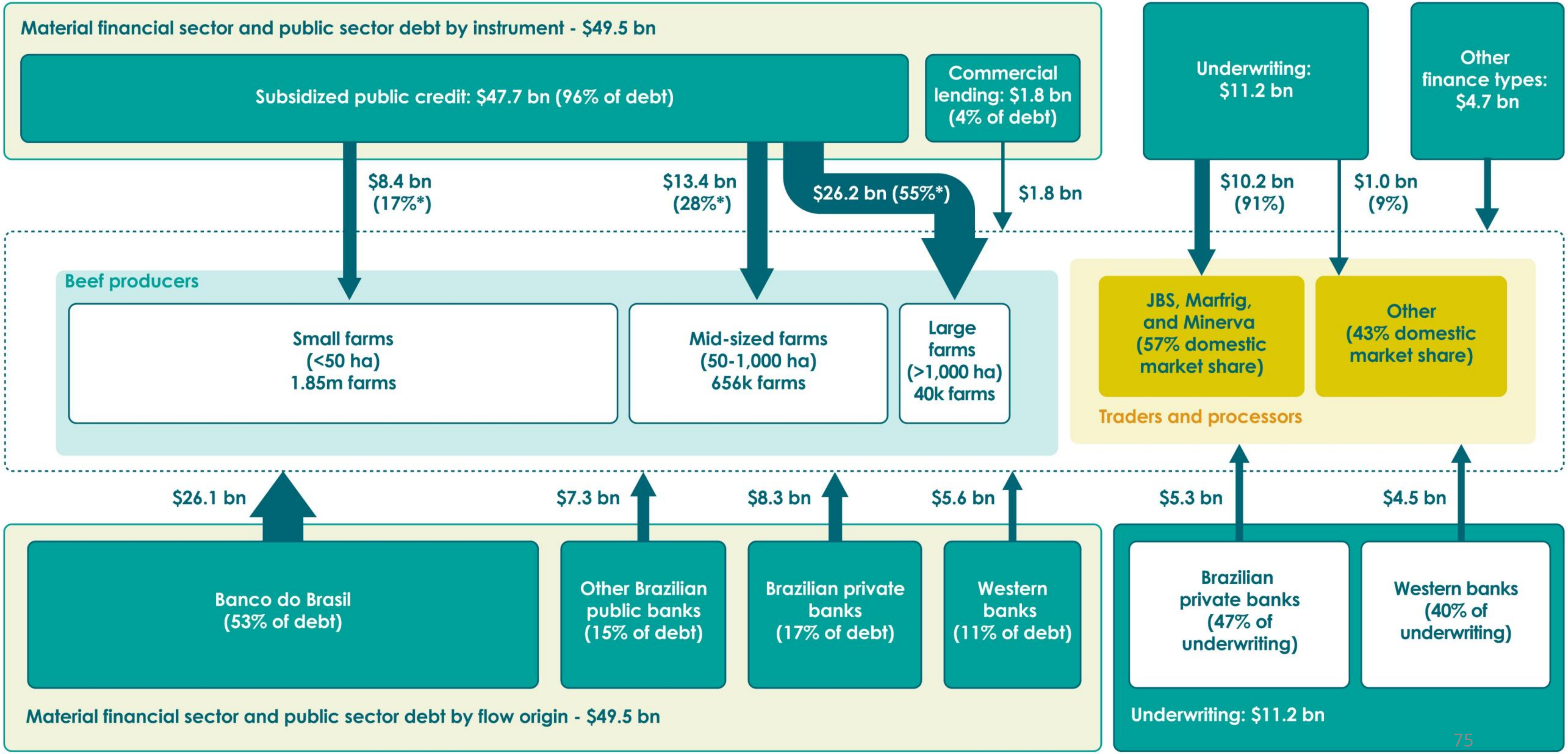
Type of finance	Estimated value (USD) (2013-2020)[1]	Approx. % of beef formal finance	Flow origin	Flow recipient
Debt: Subsidized rural credit Working capital, crop finance Legal requirements mean that around two-thirds of funding comes from deposits at Brazilian banks, with subsidized interest rates on approximately 75% of the credit	~$47.7 bn	**73%**	**Brazilian Government** - National Rural Credit System (SNCR)	**Brazilian cattle farmers—mostly large farmers**
Debt: Commercial lending Short- and medium-term loans, including working capital and investment credit; supply chain loans; production credit	~$1.8 bn	**3%**	**All other public and private sources of financing:** Brazilian public and private banks (as commercial lenders) and foreign banks	**Brazilian cattle farmers, cooperatives, traders**
Underwriting	~$11.2 bn	**17%**		
Shareholding	~$4.1 bn	**6%**		
Bondholding	~$0.6 bn	**1%**		

4.4 VALUE CHAIN FINANCIAL FLOWS: FINANCIAL SECTOR AND PUBLIC SECTOR FLOWS
MATERIAL FINANCIAL FLOWS BY FLOW ORIGIN IN THE BRAZILIAN BEEF VALUE CHAIN

Financial Sector and Public Sector Flows: Breakdown by flow origin

Flow Origin	Flow recipient	Type of finance	Estimated value (USD) (2013-2020)[1]	Approx. % of beef formal finance	Approx. distribution of flows
Banco do Brasil (Acting as commercial lender & public finance conduit)	**Brazilian cattle farmers**	**Debt:** Short- and medium-term loans, including working capital and investment credit	~$26.1 bn	**40%**	Banco do Brasil and other Brazilian public banks play a significant role as conduits of public finance in addition to commercial lending.
Other Brazilian public banks	**Brazilian cattle farmers**	**Debt:** Short- and medium-term loans, including working capital and investment credit	~$7.3 bn	**11%**	
Brazilian private banks (e.g., Bradesco, BTG Pactual)	**Cattle farmers & cooperatives**	**Debt:** Commercial loans, working capital, supply chain finance, production credit	~$8.3 bn	**13%**	Private lenders tend to avoid financing extensive beef production due to low productivity, slow turnover, and limited formal market access for small/medium producers, who rely heavily on public finance or self-financing with limited engagement from private banks or investors.
	Traders	**Underwriting**	~$5.3 bn	**8%**	
Western banks* (e.g., Rabobank, Santander, HSBC)	**Traders, large-scale producers**	**Debt:** Corporate loans, supply chain finance	~$5.6 bn	**9%**	
		Underwriting	~$4.5 bn	**7%**	

4.4 VALUE CHAIN FINANCIAL FLOWS: BRAZILIAN BEEF VALUE CHAIN MATERIAL FINANCIAL FLOWS (2013-2020)



Material financial sector and public sector debt by instrument - $49.5 bn

Subsidized public credit: $47.7 bn (96% of debt)

Commercial lending: $1.8 bn (4% of debt)

Underwriting: $11.2 bn

Other finance types: $4.7 bn

$8.4 bn (17%*)

$13.4 bn (28%*)

$26.2 bn (55%*)

$1.8 bn

$10.2 bn (91%)

$1.0 bn (9%)

Beef producers

Small farms (<50 ha) 1.85m farms

Mid-sized farms (50-1,000 ha) 656k farms

Large farms (>1,000 ha) 40k farms

JBS, Marfrig, and Minerva (57% domestic market share)

Other (43% domestic market share)

Traders and processors

$26.1 bn

$7.3 bn

$8.3 bn

$5.6 bn

$5.3 bn

$4.5 bn

Banco do Brasil (53% of debt)

Other Brazilian public banks (15% of debt)

Brazilian private banks (17% of debt)

Western banks (11% of debt)

Material financial sector and public sector debt by flow origin - $49.5 bn

Brazilian private banks (47% of underwriting)

Western banks (40% of underwriting)

Underwriting: $11.2 bn

Framework for private sector action (Soy and beef)

The Food and Land Use Coalition

INTRODUCING THE FRAMEWORK: HOW WE CAN RE-WIRE VALUE CHAINS

The Food and Land Use Coalition

	Unilateral private sector action	Cross-value-chain collaboration	Business policy advocacy
Demand DCF and regenerative supply Demand signals and incentive schemes for productive, regenerative and DCF supply.	Individual companies set DCF and regenerative procurement standards.	Multiple companies use certifications, align DCF and regenerative procurement standards or consumer premiums.	Importer countries mandate standards for DCF and regenerative production.
Make finance conditional Public or private capital rewards productive, regenerative farming.	Sustainability linked loans or bonds, green loans or credit lines, exclusion policies, ESG-linked bonds, technical assistance grants.	Blended finance funds, risk pooling and portfolio guarantees, offtake-backed loans, and securitization vehicles.	Agricultural subsidies, state credit and agricultural insurance are conditional on regenerative production.
Lower or eliminate the cost penalty Reduced operational and transaction costs, or legislation that levels the playing field.	Implement traceability technology.	Implement mass-balance, traceability technologies, and common approaches to mapping.	National or state enforcement of nature protection, land use laws, or agricultural production standards.
Make regenerative inputs and TA available Bundled input-finance packages that incentivize & enable regenerative production.	Individual input providers or regional buyers offer innovative input-finance bundles.	Input finance bundles, voluntary industry standards or cross value-chain incentives for inputs.	National or state government incentivizes more sustainable use of inputs and provides TA to support this transition.
Improve diets & prepare for reduced demand Scale healthier alternatives to over-consumed products and support producers to adapt.	Increase Research and Development (R&D) investment into new products and ingredients that can replace high-impact products.	Align on new product standards and marketing; Advocate for supportive regulation.	Public R&D investment. Supportive regulation for testing, advertising and marketing more sustainable products.

PRIVATE SECTOR ACTIONS TO RE-WIRE SOY

	Unilateral private sector action	Cross-value-chain collaboration	Business policy advocacy
Demand DCF and regenerative supply Make DCF soy the baseline and align on a shared ambition for regenerative, resilient soy.	Embed traceability in contracts, procurement, onboarding checks, payment timing, and working capital with public reporting.	Align procurement / onboarding checks across the value chain focusing on high-risk regions.	Mandate standards for DCF and regenerative production in importer countries.
Make finance conditional Public or private capital rewards productive, regenerative farming.	Make sustainability-linked loans, bonds, credit lines, and technical assistance grants conditional on DCF supply.	Collaborate to provide flexible, targeted packages of inputs, credit, technical assistance, and finance for high-risk producers.	Advocate for scaling up ABC+ / RenovAgro and for conditionality of PRONAF and PRONAMP credit on minimum sustainability criteria.
Lower or eliminate the cost penalty Reduced operational and transaction costs; legislation that levels the playing field.	Leverage existing national registries and common traceability systems.	Limited action here due to recent improvements in traceability technologies and data infrastructure.	Advocate for strengthening the Forest Code to encompass clearing native vegetation to lower the opportunity cost for at-risk producers.
Make regenerative inputs and TA available Bundled input-finance packages that incentivize & enable regenerative production.	Individual input providers or regional buyers offer innovative input-finance bundles.	Collaborate to provide flexible, targeted packages of inputs, credit, technical assistance, and finance for high-risk producers.	Collaborate with state-led efforts to reach mid-sized producers with targeted technical assistance programs.
Improve diets & prepare for reduced demand Scale healthier alternatives to over-consumed products and support producers to adapt.	Increase R&D investment into nutritious, plant-based alternatives to beef.	Align on new product standards and marketing; Advocate for regulation supporting plant-based alternatives to beef.	Advocate for increased public R&D investment & regulation supporting testing, advertising, and marketing of plant-based alternatives to beef.

PRIVATE SECTOR ACTIONS TO RE-WIRE BEEF

	Unilateral private sector action	Cross-value-chain collaboration	Business policy advocacy
Demand DCF and regenerative supply Raise the floor with commitments to DCF beef covering indirect suppliers.	Commit to deforestation- and conversion-free beef for indirect suppliers. Embed traceability in contracts and working capital.	Launch deforestation- and conversion- free product lines and redirect advertising and marketing spend to educate consumers.	Redesign public procurement frameworks to recognize legal reserves and Permanent Preservation Areas as productive assets.
Make finance conditional Public or private capital rewards productive, regenerative farming.	Make sustainability-linked loans, bonds, credit lines, trade finance and technical assistance grants conditional on DCF supply.	De-risk procurement by bundling inputs, technical assistance and offtake contracts for DCF mid-sized ranchers.	Scale up ABC+ / RenovAgro and make PRONAF and PRONAMP credit conditional on DCF, productivity and sustainability.
Lower or eliminate the cost penalty Reduced operational and transaction costs; legislation that levels the playing field.	Support jurisdictional approaches to scaling up traceability across indirect suppliers.	Collaborate to co-invest in traceability technologies to tackle the challenge of indirect suppliers.	Strengthen Forest Code enforcement and integrate CAR and GTA databases to reduce the burden of compliance.
Make regenerative inputs and TA available Bundled input-finance packages that incentivize & enable regenerative production.	Individual input providers or regional buyers offer innovative input-finance bundles.	Collaborate to provide flexible, targeted packages of inputs, credit, technical assistance, and finance for high-risk producers.	Advocate for state investments in TA for pasture recovery, productivity enhancements, and methane reduction.
Improve diets & prepare for reduced demand Scale healthier alternatives to over-consumed products and support producers to adapt.	Increase R&D investment into animal feed that replaces soy with lower-impact alternatives.	Align on new product standards and marketing; Advocate for regulation supporting more sustainable animal feed.	Health ministries strengthen national dietary guidelines for red meat consumption and reduce overconsumption of ultra-processed red meat.