Alfalfa to get back into planetary boundaries

2025 world alfalfa congress
FRANCE REIMS-CHÂLONS

Session 1 : Animal feed, still a market for alfalfa tomorrow. And beyound?

Tabel C. & Brun M.

Plenary session 1

FROM 03 › TO 06 nov. 2025

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Global market and perspectives for alfalfa

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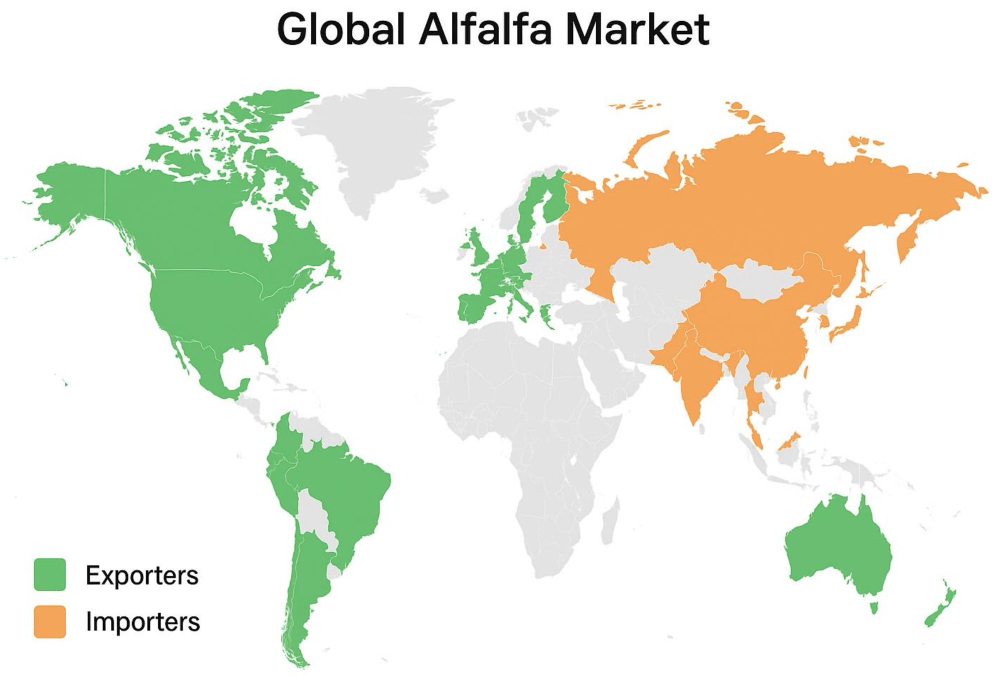
The global alfalfa market

Major export hubs

- US – Largest exporter; supplier of 90% of China imports (900k MT)
- Australia & Canada – secondary exporters, serving Asia & MENA
- Spain – player in dehydrated alfalfa (pellets/cubes/bales)
- Italy, France, Netherlands, Romania, South Africa, Egypt – additional exporters (mix of hay and dehydrated products)



Major import hubs

- China – #1 destination for U.S. alfalfa; strong dairy-driven demand
- Japan – top buyers; but strict phytosanitary - inspection requirements
- Saudi Arabia & UAE – Large MENA buyers;
  - water scarcity pushed a ban on domestic green-fodder cultivation (2018)
  - 2024 banned alfalfa seed imports; prohibition on domestic alfalfa production from 2027
- South Korea & Qatar – Smaller but steady buyers

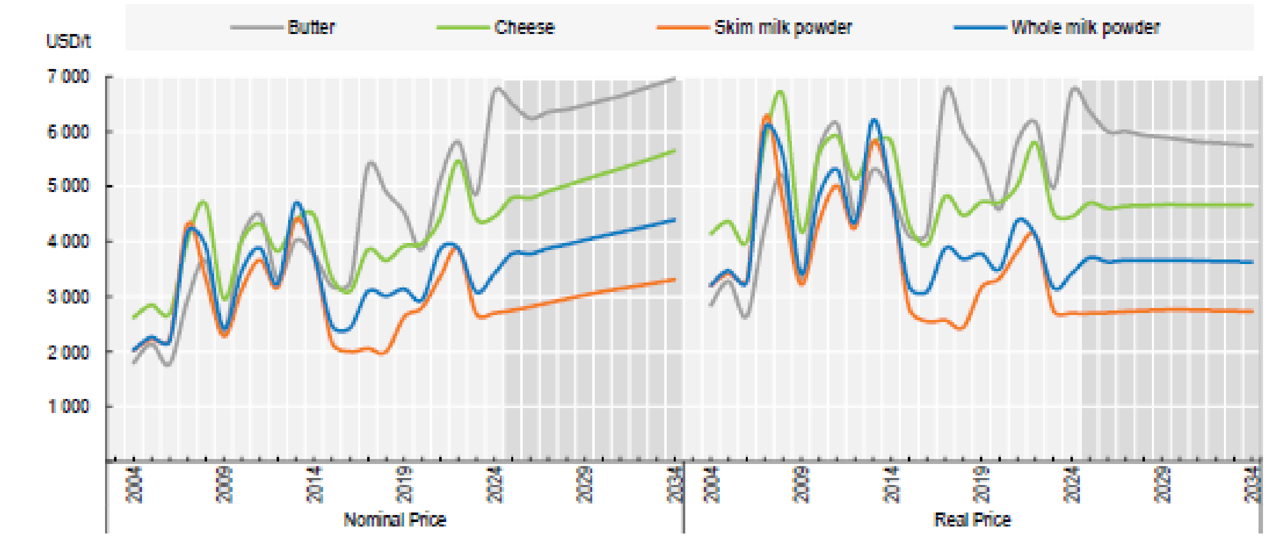
Global trade of forages (2023):
- USD 3 Billions (code HS 121490; OEC)

Market model to explains alfalfa hay prices ($/ton)

- **Feed substitutes and complements:**
  - Corn (energy feed)
  - Soybean meal (protein feed)
  - Milk price (dairy sector demand proxy)
- **Autoregressive lags:**
  - captures price persistence from the past two months
- **Monthly dummies:**
  - capture seasonal patterns (harvest, storage, winter feeding)
  - 10 yrs time series
- **log–log regression**
  - coefficients = **elasticities:** percentage response of alfalfa price to a 1% change in each driver

Driver's prices	Elasticity	Notes
Corn	+0.2 to +0.3	A 10% rise in corn → 2–3% increase in alfalfa price (feed substitution effect).
Soybean meal	+0.1 to +0.2	A 10% rise in soybean meal → 1–2% higher alfalfa price (protein value link).
Milk	+0.3 to +0.4	A 10% rise in milk → 3–4% increase in alfalfa price (strong dairy demand effect).

- The alfalfa market is **most sensitive to dairy sector profitability** (milk prices) and **feed competition** from corn.
- higher feed or milk prices tend to **raise hay prices**
- Markets consider **alfalfa more complex than a protein crop**

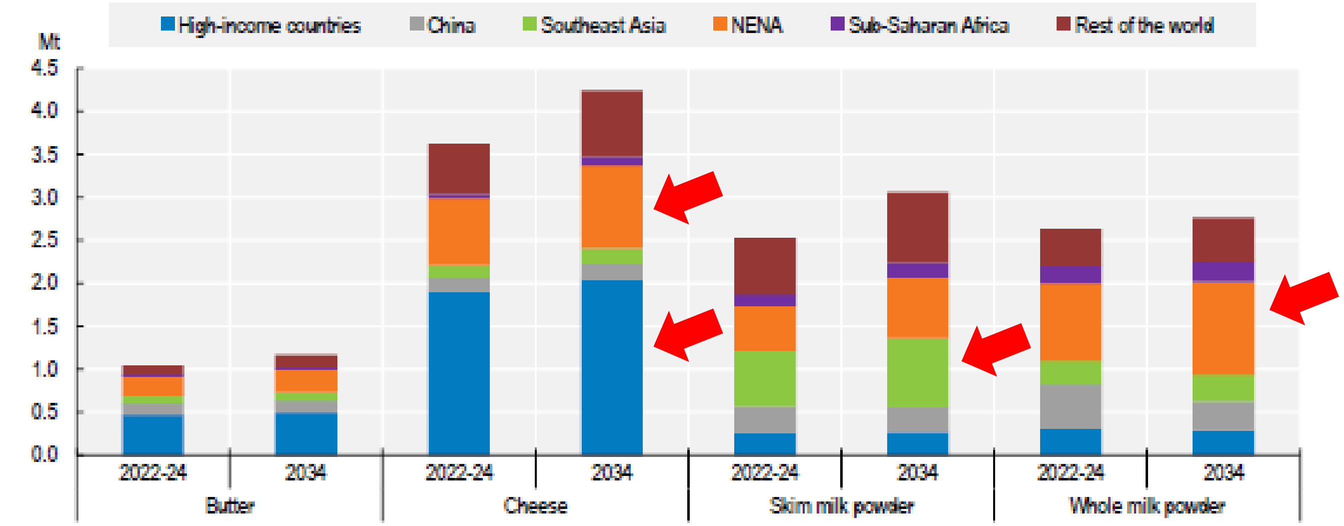


Note: Butter, FOB export price, 82% butterfat, Oceania; Skim Milk Powder, FOB export price, non-fat dry milk, 1.25% butterfat, Oceania; Whole Milk Powder, FOB export price, 26% butterfat, Oceania; Cheese, FOB export price, cheddar cheese, 39% moisture, Oceania. Real prices are nominal world prices deflated by the US GDP deflator (2024=1).
Source: OECD/FAO (2025), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://data-explorer.oecd.org/s/1hc.

Perspective: Dairy product prices (2004-34)

Imports of dairy products by region

- **Positive perspective of dairy prices**
- **Driver of cheese value-chain in high-income countries and MENA**
- **Driver of milk powder in Southeast Asia and MENA**



Note: NENA stands for Near East and North Africa. Saudi Arabia is included in NENA and therefore subtracted from high-income countries.
Southeast Asia contains Indonesia, Malaysia, Philippines, Thailand and Viet Nam.
Source: OECD/FAO (2025), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://data-explorer.oecd.org/s/1hc.

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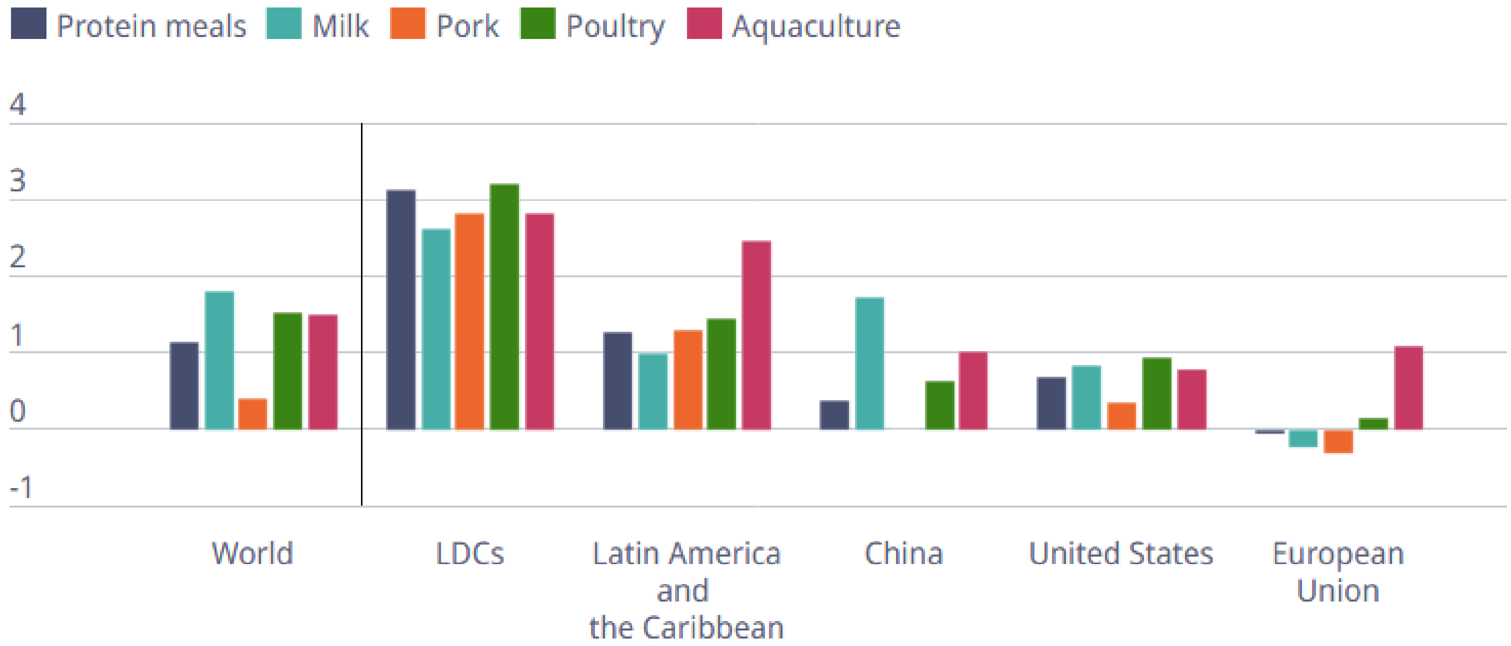
Average annual growth in protein meal consumption and animal production (2025-34)



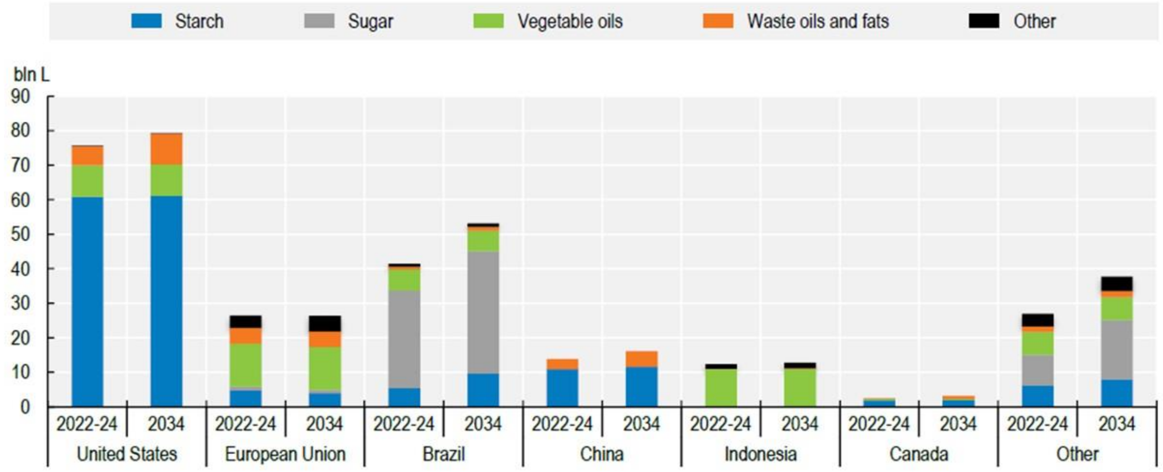
- **Feed demand**: +15% globally (protein basis), mainly from Asia and Africa
- **Efficiency:** Productivity growth (+16.6%) outpaces herd expansion (+7%), improved feed conversion ratios
- **Composition:** Protein meals (soybean, canola, sunflower) grow slower at +1.1%/yr : efficiency gains and slower Chinese demand
- **Innovation drivers:** Precision feeding, genetic selection, by-product feeds, and better nutrient management.
- **Sustainability impact:** With a 15% productivity rise and emission-reduction technologies, agricultural GHGs could drop 7% below current levels while eradicating hunger by 2034

Source: OECD/FAO (2025),

Price competition from oil crops

- oilseeds and oil crops are crushed into protein meal and vegetable oil
  - 1/4 of their production is used for direct human food consumption as vegetable oil
  - 3/4 are used as protein meal in animal feed
    (OECD-FAO Agricultural Outlook 2025-2034)
- Global use of biofuels
  - expected to grow by 0.9% / yr over the next decade
- Prices of vegetable oil and protein meals
  - diverging future developments:
    - Vegetable oil prices are expected to remain relatively strong due to sustained demand growth and slower production growth for palm oil and other oilseeds,
    - protein meal prices are expected to be relatively flatter, due to coupled supply and considerable slower demand growth.
- increased demand for fiber
  - to supplement protein cake

World biofuel production from different feedstocks



Source: OECD/FAO (2025), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://data-explorer.oecd.org/s/1hc.

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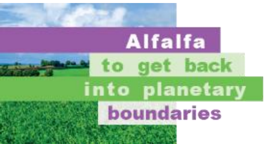
Sustainability of feed use of protein meals and animal production

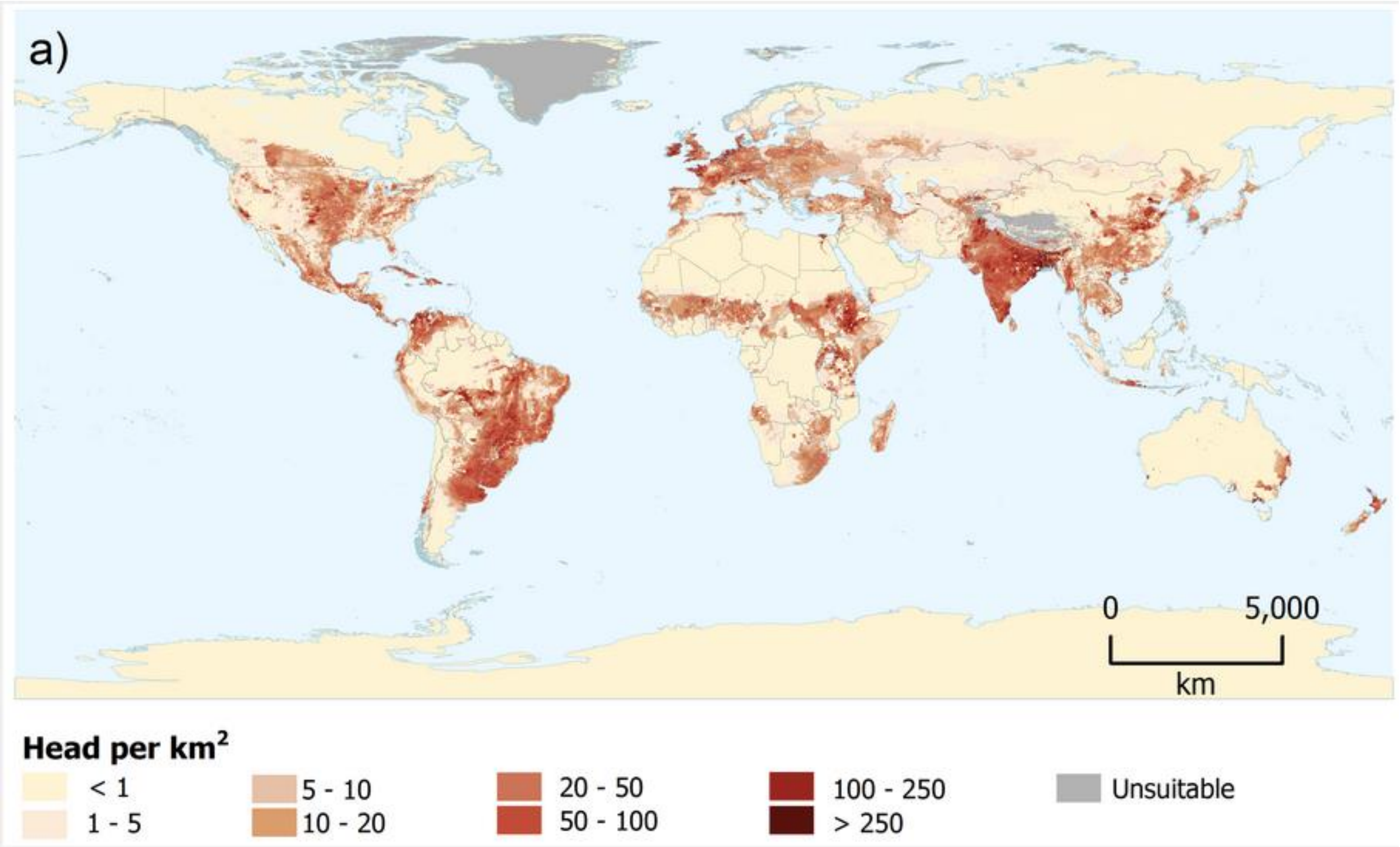
Aspect	Description	Sustainability Outcome
Nitrogen Efficiency	Overfeeding protein leads to excess nitrogen excretion (ammonia, nitrates, nitrous oxide).	Balanced protein diets cut nitrogen losses by 20–30%, improving environmental performance
Carbon Footprint	Protein meal sourcing (soy) linked to land-use change emissions in South America.	Shifting to local or certified sustainable protein sources reduces lifecycle emissions.
Circular Economy & By-products	Inclusion of oilseed cakes or food-industry by-products replaces protein inputs	Reduces waste and feed carbon intensity.
Water & Land Use	Alfalfa and legumes fix nitrogen naturally, improving soil fertility and reducing fertilizer demand.	Enhances ecosystem services and long-term farm resilience.
Feed Innovation & ESG Goals	Adoption of insect, microbial, or single-cell proteins offers low-footprint alternatives.	Aligns with corporate sustainability and carbon-neutral targets.



Strategic Roadmap for Dairy Feed Producers

Short Term (2025–2026)	**Secure and Diversify Supply Chains**
	Enhance Feed Efficiency & Formulation
Medium Term (2026–2028)	**Invest in Climate-Resilient Sourcing**
	Adopt Circular & Localized Feed Models
Long Term (2028–2030)	**Digital Integration & Traceability**
	Sustainability & Branding Alignment
	Strategic Market Alliances

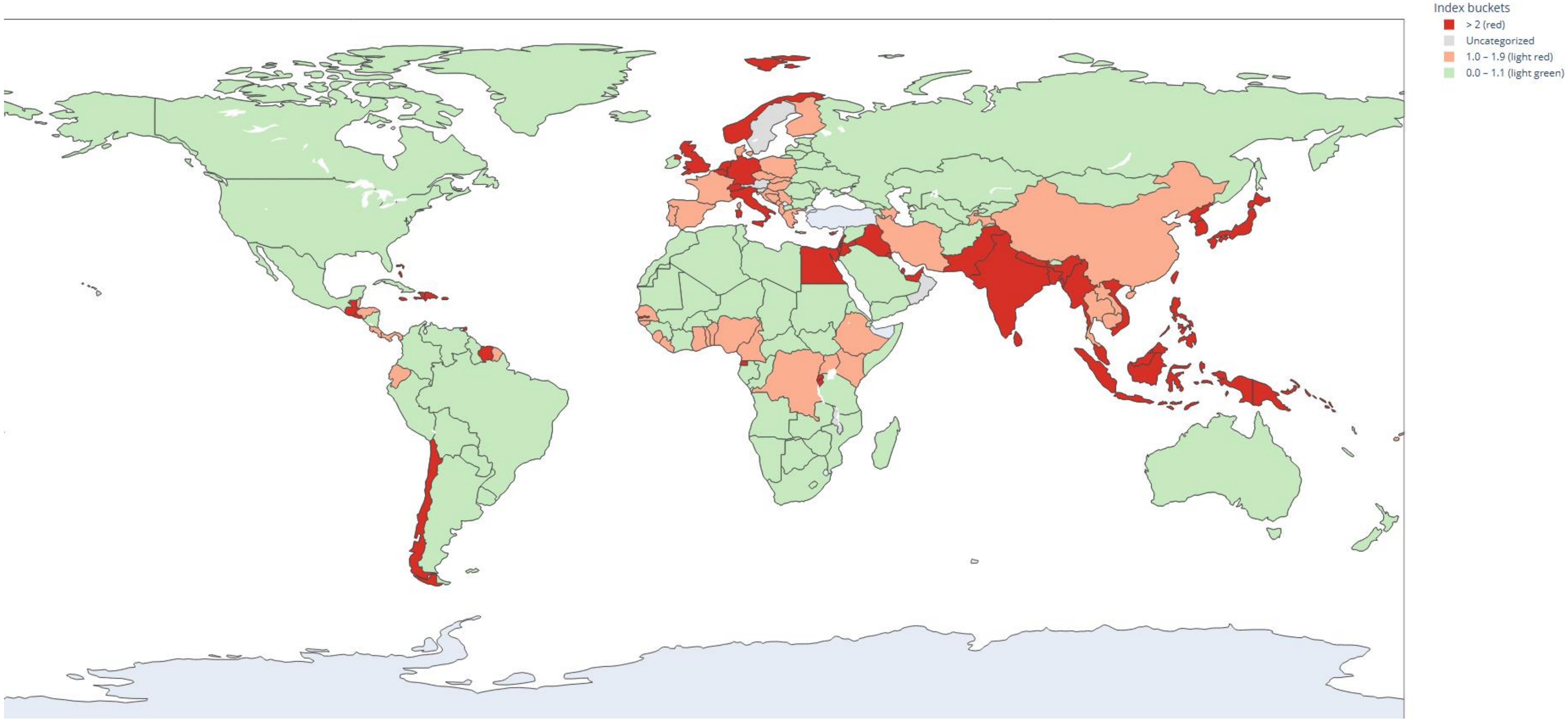
Target markets: Cattle Density Index
(n. heads of cattle / unit of agricultural land)



Target markets: Human population density relative to global average density on agricultural land / world agricultural land

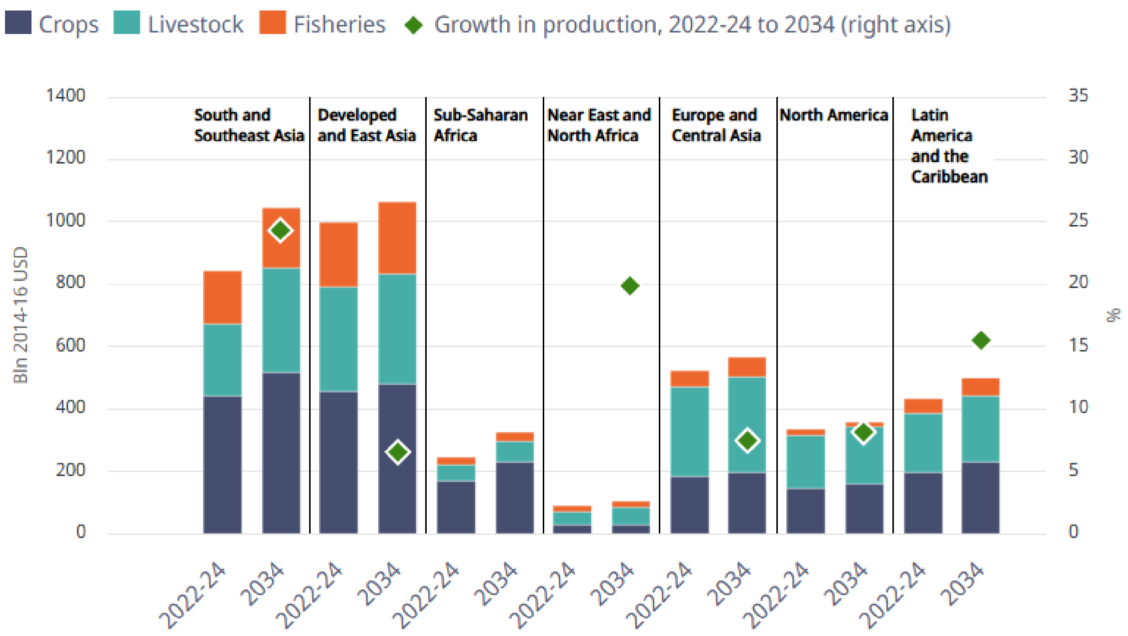
Country i (2023):

$$\text{Index}_i = \frac{\left(\dfrac{Pop_i}{World\ Pop}\right)}{\left(\dfrac{AgriLand_i}{World\ AgriLand}\right)} = \frac{Pop_i / AgriLand_i}{World\ Pop/\ World\ AgriLand}$$



Rising global production:
increase agricultural greenhouse gas emissions

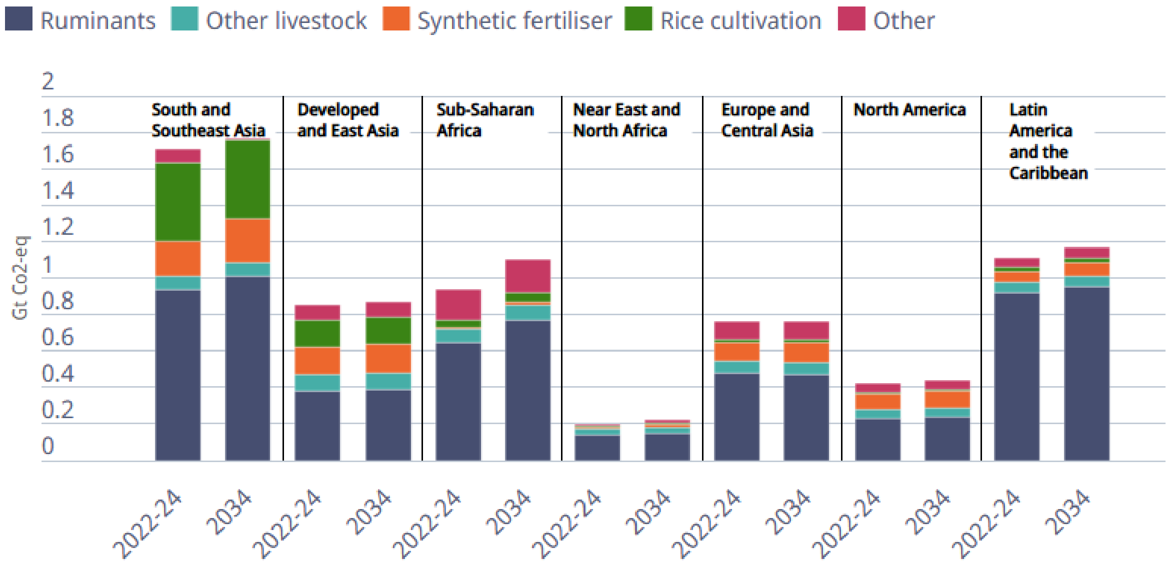
Trends in global agricultural production



Note: Values are measured at constant USD of the period 2014-16.

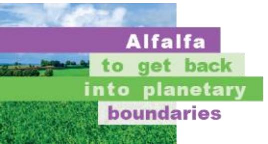
Source: OECD/FAO (2025), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://data-explorer.oecd.org/s/1hc.

Direct GHG emissions from crop and livestock production by activity



Note: Estimates are based on historical time series from the FAOSTAT Climate Change: Agrifood systems emissions databases which are extended with the Outlook database.CO2 equivalents are calculated using the global warming potential of each gas as reported in the IPCC Sixth Assessment Report (AR6). Emission types that are not related to any Outlook variable (organic soil cultivation and burning savannahs) are kept constant at their latest available value. The category 'Other' includes direct GHG emissions from burning crop residues, burning savanna, crop residues, and cultivation of organic soils.

Source: FAOSTAT Emissions-Agriculture Database, http://www.fao.org/faostat/en/#data/GT, accessed December 2024; OECD/FAO (2025), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://data-explorer.oecd.org/s/1hc.



quantify and credit methane (CH_4) emission reductions from ruminant livestock achieved through feed ingredients

Certification scheme:

⚙️ Core Components
- Additives inhibit CH_4-producing microbes or alter rumen conditions
- Eligibility: Approved & safe ingredients, no herd/antibiotic changes, 2–3 years baseline data
- Baseline = standard feeding | Project = additive use (measured or modeled CH_4 reductions)

🔍 Additionality & Boundaries
- Automatic in low-adoption regions (<5%) or via VCS Tool VT0008
- Includes feed production, transport, enteric CH_4, and manure (if affected)

🧪 Monitoring & Verification
- Track animal groups, feed data, CH_4 emissions, additive sourcing
- Expert oversight & QA/QC → Verified reductions = tradable carbon credits

✅ Impact
- Drives climate-smart livestock systems
- Aligns with IPCC & FAO frameworks
- Incentivizes low-emission feeding strategies

Source: VERRA VM0041

Role of Alfalfa in Reducing Methanogenesis

- ✓ Rich in bioactive compounds – saponins, tannins, flavonoids.
- ✓ Saponins reduce rumen protozoa → fewer methanogens.
- ✓ Tannins bind proteins/carbohydrates → lower H_2 availability for CH_4.
- ✓ Shifts fermentation toward propionate (H_2-consuming pathway).
- ✓ Improves feed efficiency and reduces rumen retention time.
- ✓ Result: ↓ Methane emissions (≈5–20%) without harming productivity.

Factor	Influence
Alfalfa variety and maturity	Secondary metabolite concentration varies; younger plants often have more bioactive compounds.
Processing method	Drying, ensiling, or pelleting may alter saponin and tannin activity.
Diet composition	Alfalfa's effect is more pronounced when fed with high-fiber diets (grass or straw).
Inclusion level	Moderate inclusion (30–60% of forage DM) tends to optimize both animal performance and CH_4 mitigation.

Financial markets

- **Devaluation of USD**
  - Changing in global reserves: USD's share of global reserves has slightly declined but remains dominant
- **European Central Bank: attention to the structural transformation of the financial system**
  - More than 60% of financial flow out of banks (non-banks) = 350% of the GDP
  - Technology also amplifies both the speed and scale with which risks can materialize
- **Digital currencies and tokenization. Diverging trans-Atlantic approaches:**
  - US: halted CBDC plans; promoting dollar-backed stablecoins.
  - EU: developing digital euro; strict MiCA regulation for crypto-assets.
- **Outlook**
  - USD remains pre-eminent but faces structural headwinds: US fiscal strain, political polarization, and digital disruption.
  - The Euro's future role depends on EU integration and digital leadership.
  - The most plausible outcome: a multipolar currency system rather than a single global hegemon.

Alfalfa and Nature Credits

🏦 Agri-Fintech and Carbon Markets

- New financial products link farming to **carbon credits** and **sustainability finance**:
- Alfalfa fields can contribute to **soil carbon sequestration**, which may become monetizable under carbon offset programs.
- **Regenerative finance (ReFi)** projects might tokenize these environmental benefits for trading on digital asset markets.

Nature Credit Opportunities

Type of Credit	Alfalfa Contribution	Potential
Carbon	Soil C sequestration, N reduction	★★★★☆
Biodiversity	Habitat creation	★★★☆☆
Water	Improved infiltration, recharge	★★☆☆☆
Soil Health / Regenerative	Organic matter buildup	★★★★☆

Role in Carbon Sequestration

- Increases **soil organic carbon (SOC)** by root biomass
- Reduces **nitrous oxide emissions** by minimizing fertilizer
- Estimated carbon storage: **0.5–2.5 t CO_2e/ha/year**
- **carbon credit projects** in soil carbon farming

🐝 Biodiversity Benefits

- Provides **habitat and floral resources** for pollinators
- Supports **soil microfauna** and ecological diversity
- Serves as **buffer strips or corridors** in farm landscapes
- Potential for **biodiversity crediting** under emerging schemes

💧 Water and Soil Health

- Improves **infiltration** and reduces **runoff and erosion.**
- Enhances **water-holding capacity** of soils.
- Can aid **groundwater recharge** under managed systems.
- Supports **soil health credit** and **water stewardship credit** potential.

Some remarks on global alfalfa market outlook

- **Rising incomes, in middle-income economies**
  - increase the daily per capita caloric intake of meat, dairy, and other animal products by 6% over the next decade (OECD-FAO, 2025)
- **Alfalfa value: sensitive to dairy sector profitability (milk prices) and feed competition (corn)**
  - higher feed or milk prices tend to raise hay prices
  - Drivers of cheese value-chains
  - Opportunity: alfalfa is not a substitute of soy proteins but mainly of corn (more completed meal: proteins + fiber)
- **World milk production is projected to grow at 1.8% p.a. over the next decade**
  - increasing yields per animal
  - Moderate growth in the number of cows in some countries
- **Environmental and health issues:**
  - dairy production accounts for a substantial share of greenhouse gas emissions (GHG).
  - alfalfa may benefit from carbon credits, green finance, and sustainability certifications or green incentives due to its soil carbon and nitrogen benefits.
- **Financial markets:**
  - Alfalfa production and financial markets are linked through agricultural economics, input cost dynamics, and water-use and land-use decisions
  - turmoil of geopolitical scenario
  - greater regionalization of trade and depreciation of Dollar
  - Demand for sustainable finance and nature credits may provide added value to alfalfa (FAO-NETSOB; EU Roadmap towards Nature Credits, COM(2025) 374 final)

Global challenges for the future of food and agricultural systems

DIRECTORATE-GENERAL FOR INTERNAL POLICIES
POLICY DEPARTMENT B
STRUCTURAL AND COHESION POLICIES
European Parliament

Agriculture productivity

- Population increase, High urbanisation and economic growth of developing countries putting pressure on the demand.
- The production of high-calorie but low-nutrition food, reduced access of small-scale farmers to distribution channels, high levels of food loss and important ecological footprint.

Conservation of resources and environment

- Increased water and land usage for agriculture
- CO_2 emissions
- Fertilizers consumption
- Deforestation and topsoil erosion

Improvement of nutrition and public health

- Hunger and obesity disparities
- Diet-related chronic diseases
- Difficult adoption of healthy diets across developed countries

Food security

Food safety and health

Sustainability

"GREAT FOOD TRANSFORMATION"

Alfalfa to get back into planetary boundaries

Innovation strategy: reconnecting agriculture and animal husbandry to ensure quality on the table

Thank you

Gian Luca Bagnara

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